Chapter 1 | overview

In this chapter, the origin of project management is explained as well as the development of project management over the years. Following the definition of a project and project management, the development of project management starting with the archaic 'over the fence' management is dealt with in the next paragraph. Subsequently, a few of the project management standards are introduced. The splitting of the project management lifecycle into various phases or stages concluded by a stage gate at the end of each phase is the way in which a structured project management process is developed. The step from project management towards management of projects is a consequence of an integrated approach including the early involvement of all major stakeholders. Despite this approach and this knowledge, projects still fail by spectacular numbers. Focus on the people aspects, the front end development and a fit for purpose approach is the solution to improve project performance.
The management of projects is continuously improving by learning from completed projects and through benchmarking projects across different industries.

Chapter 1 | outline

1.1 The definition of a project
1.2 The origin of project management
1.3 From 'over the fence' management to project management
1.4 Project management standards
1.5 Project management lifecycle
1.6 Towards management of projects
1.7 Projects fail by spectacular numbers
1.8 People are key in the management of projects
1.9 Fit for purpose management of projects
1.10 Learning from projects
1.11 The case study

Chapter 1

Introduction

by Hans Bakker

1.1 | Definition of a project

What exactly is a project? In literature, a multitude of definitions can be found. On the internet an even wider variety is presented. Even with the existence of the nowadays more or less accepted 'bodies of knowledge', there is no general consensus on the definition of a project. The most comprehensive definition is given by Turner (1999):

> *'A project is an endeavour in which human, financial and material resources are organised in a novel way to undertake a unique scope of work, of given specification, within constraints of cost and time, so as to achieve beneficial change defined by quantitative and qualitative objectives.'*

The PMI (Project Management Institute) definition is slightly shorter: 'A project is a temporary group activity designed to produce a unique product, service or result.'
The largest professional body for project managers in the UK, the Association for Project Management (APM, 2004), uses the following definition: 'Projects are unique, transient endeavours undertaken to achieve a desired outcome.'
The PRINCE2 definition of a project is: 'A temporary organisation that has been created with the purpose to deliver one or more business products according to a predefined business case.'

For the purpose of this book these definitions suffice. It is important to realise that what is meant with the word project, is a temporary organisation (with defined start and end dates) brought to life in order to deliver a unique (once-off) scope within given boundary conditions (schedule, cost and quality). In that sense, Turner's definition is the most complete definition and therefore it is the one that has been adopted for this book.

Following this definition, a variety of activities can be described as projects. Moving house or building your own home, buying a car, completing a PhD thesis, building a refinery, designing a new coffee machine, or reorganising your department. You name it and the endeavour can be considered a project. That makes life probably somewhat too difficult. Therefore, the book will be focusing on engineering projects.

1.2 | The origin of project management

Some authors claim that project management really started with the advance of the chemical industry in the early thirties of the twentieth century. Others believe that it was the period of the arms race during the Cold War that created a demand for and focus on project management. Notwithstanding the above, it is generally accepted that modern-day project management began with the advent of the Critical Path Method (CPM, 1957 – Dupont) and the Programme Evaluation and Review Technique (PERT, 1955 – Booz-Allen-Hamilton). Both originated from the defence and aerospace industries and were subsequently taken up by the construction industry. However you look at it, project management in itself is a relatively young discipline. In literature most of the time four periods in project management evolution have been identified (Kwak, 2005). The history of project management is separated in the period leading up to 1957, the period between 1958 and 1979, the period from 1980 till 1994 and from 1994 onwards. The milestones marking these periods are the large technological developments that had major impact on society in general: the invention of the plain paper copying machine by Xerox (1957), the launch of the XT personal computer by IBM (around 1980) and the wider spread of internet to the public from 1994. The evolution of project management is graphically represented in Figure 1.1.

Throughout history significant infrastructural endeavours have been successfully accomplished. The pyramid of Giza and the Great Wall of China are great examples. More recently, the building of the Pacific Railroad across the United States in the 19th century remarkably represents technical courage and perseverance, although construction did involve delays and surprises. The building of the Hoover Dam was considered a successful project. In total 5,200 workers were employed. It was built between 1931 and 1936 within budget and ahead of schedule, but 96 workers were killed during construction.

The oldest tool still in use in modern day project management was developed during this period by Henry Gantt (1861 – 1919). The so-called Gantt chart outlines the sequence and duration of events/tasks in a process and it was used during the construction of the Hoover Dam and the Interstate Highway system (USA).

Another famous example of a project 'avant la lettre' is the Manhattan Project: the research into and the development of the first two atom bombs that ended World War II. This project involved 125,000 workers and spent a staggering € 2 billion. Dutch projects in this same period are the creation of the IJsselmeer with the Afsluitdijk and the start of the Delta Werken, the big infrastructural project to protect the southern part of the Netherlands against flooding. These were successful endeavours indeed, however the phrase project management was not launched until 1954. In fact, Bernard Schriever, a brigadier-general of the US Air Force, was the first to coin the title 'project manager'. And because of that, he made it onto the cover of Time Magazine.

In the second period (1958 – 1979), a large number of technological developments influenced society and as a consequence also the management of projects. The introduction of the plain paper copier and the development of silicon chips and minicomputers had a revolutionary impact on the way we are doing business. The best known projects in this era were all based in the defence

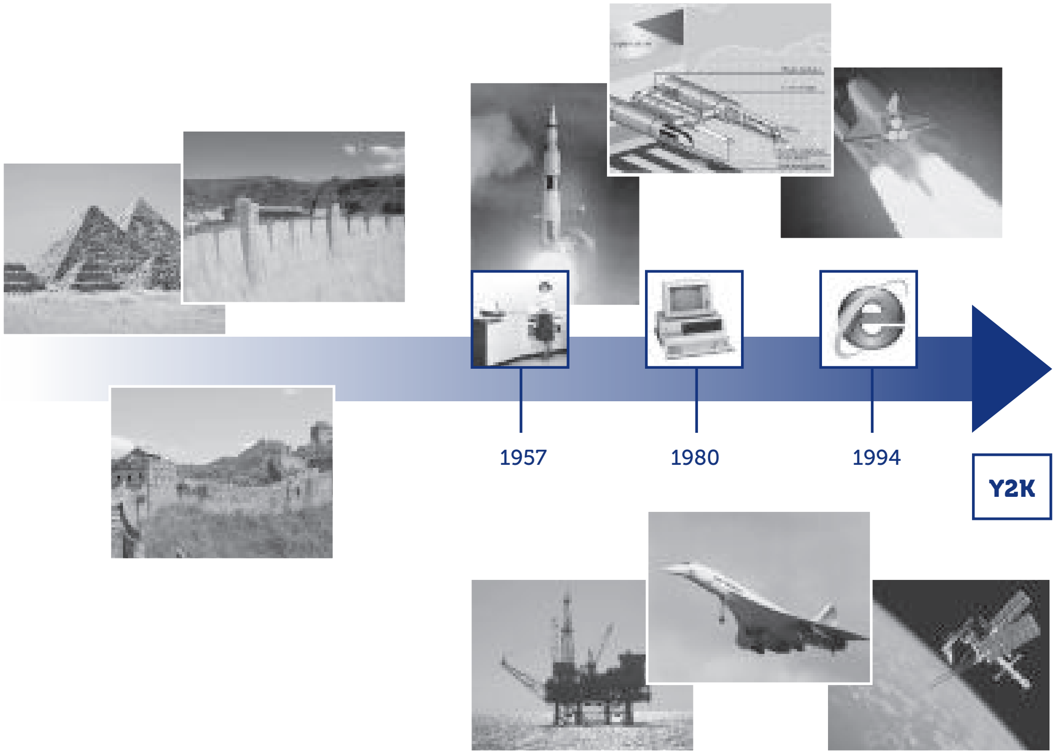

Figure 1.1: Evolution of project management

and aerospace industries. Examples of large-scale technological projects that stand out are the development of nuclear missiles during the Cold War (Polaris and Minute man), the Apollo project by NASA and the design and construction of the Concorde. In the oil and gas industry, the exploration and production of North Sea oil was a huge undertaking for a multitude of companies that lasted well into the next period.

During the third period (1980 – 1994), the advancement of technology in our businesses and our daily lives accelerated enormously. The personal computer made its way into our offices and eventually into our homes. Following this, project management tools and software became widely available for the personal computer, which made project management techniques more easily accessible for the larger community. Now for the first time the techniques that had been developed for the big projects mentioned above became accessible for almost every project engineer or project manager. Obviously, big projects continued to develop and apply the techniques with high levels of sophistication. The building of the Channel Tunnel, Space Station and Space Shuttle Challenger are most probably the showcases of this era. Many articles have been written on the project management aspects of these developments. The growth of the membership of the various project management institutes starts to develop almost exponentially from here on.

The fourth and present era (1994 onwards) shows an unprecedented availability of and accessibility to information. With the advent of the Internet and its spread across the globe, the project management community has become more efficient in controlling and managing the various aspects of projects.

The first time that the general public in its entirety was confronted with project management and its side effects was around the transition into the new millennium, also known as the Y2K project or the Millennium Bug. The Y2K project was instigated by the belief that on January 1st, 2000, most computer programmes would not function correctly anymore. Many organisations adopted project management tools and techniques to execute their own Y2K project.

In this same period, the oil and gas industry started developing even larger major capital investment projects in order to keep up with the ever growing energy demand of the world. Easy oil has long been discovered and the explorations and developments must now take place in new and unknown territories. Projects are becoming more complex with even bigger technological challenges. Examples include deep-water exploration and production near Brazil, in the Gulf of Mexico and Malaysia (~ 3 km of water depth), ever larger Liquid Natural Gas plants in the Middle East and the far east of Russia (liquefying natural gas at low temperature and transporting it by ship) and the Gas to Liquid plants in South Africa and in Qatar (making liquid products out of gas via the Fischer-Tropsch process).

1.3 | From 'over the fence' management to project management

Over-the-fence management (Kerzner, 2005) preceded contemporary project management. Traditionally, each discipline or function took care of its own activities. When the task was completed, the job was given to the next function in the line ('thrown over the fence'). This means that all the work was completely sequentially in nature and the last in line would most probably get all the blame if the project went off-track. As a consequence schedule improvement was hard to realise. The majority of project activities were performed by line managers who were more interested in the advancement of their own departments than the success of the task at hand. In fact, nobody was truly looking after the best interest of the project. Project management did not really exist.

Another disadvantage of this sequential approach was that it was very difficult for customers to keep track of where their 'project' was. Therefore at a certain stage, customers (and looking at the earlier examples this was most often the government) demanded a single point of contact throughout the 'project', a person who would be part of the development process during the entire lifecycle. When this happened in the 1950s, the project manager was born. Initially, this came with much resistance from senior managers as well as sales and marketing staff, since all were afraid of losing their influence.

From there on the whole project management approach has been mostly based on best practice sharing and handing over of experience from manager to manager. This system has quite a number of similarities with the traditional medieval master/fellow relation, although project management is a much younger discipline.

1.4 | Project management standards

Projects require effective management from inception to completion if they are to be completed safely, on time and within budget and to meet additional business objectives as well. Therefore, project management is nothing more than the controlled execution of an activity to complete an agreed scope of work and meet predefined targets. The main objective of project management is to deliver all the project goals and targets for the customer and possibly other stakeholders involved within the boundary conditions given. Consequently, the management of engineering projects is the controlled execution of design, engineering and construction activities for an engineering project in such a manner that the project can be realised to meet the requirements of the customer, technical or otherwise, within the given constraints such as safety, cost, time, quality, resource, etc.

Project management is all about structure, standards and processes. Since the birth of the project management discipline at the end of the 1950s, the various project management bodies have grown exponentially. They all have produced best practices, guides and supporting tools to further develop the project management discipline. At the moment a variety of standards and disciplines are available for managing projects. Probably the oldest and best established is the Project Management Body of Knowledge (PMBoK, 2008). The PMBoK Guide as developed, maintained and published by PMI (Project Management Institute) is the preeminent global standard for project management. It provides project managers with the fundamental practices needed to achieve organisational results and excellence in the practice of project management.
Their counterpart, the International Project Management Association (IPMA) has developed the International Competence Baseline (ICB) Version 3.0. The ICB provides the official definition of the competences expected from project management personnel by IPMA for certification within the IPMA certification system.

Some governments developed over the years their own project management systems. The best-known example is PRINCE2. PRINCE2 (**P**rojects **IN C**ontrolled **E**nvironments, 2009) is a de facto standard developed and used extensively by the UK government and is widely recognised and applied in the private sector, both in the UK and internationally. It embodies established and proven best practice in project management.
Since mid-2012 the voluntary International Standard Organisation (ISO) has issued the ISO 21500 Guidance on Project Management. The latter has been developed by participants from over 30 countries. It can be used by any type of organisation including public, private or community organisations, and for any type of project irrespective of complexity, size and duration. ISO 21500 provides a high-level description of concepts and processes that are considered to form good practice in project management. New project managers as well as experienced managers will be able to use the project management guidance in this standard to improve project success and achieve business results.

Not only governments developed their own project management systems and procedures but also, large industrial companies decided to translate their own successful working practices in the field of project management into a project management system. Those pragmatic and practice-oriented systems for managing projects form the basis of the approach chosen in this book.

1.5 | Project management lifecycle

Whatever the unique character of a project is, it will always have a number of distinct phases. Turner (1999), for instance, distinguishes four phases from proposal and initiation, through design and appraisal, execution and control to finalisation and closeout. Others split the whole project lifecycle up in 5 or even 8 phases. Some examples that are given in Figure 1.2 originate from the exploration and production industry, the refining industry, IPA (Independent Project Analysis) and the process industry respectively.

The project management lifecycle as defined in this book is based on and aligned with the general business process. In the first step a potential future project – called an opportunity in this phase – is identified, the potential value is assessed and the alignment with the business strategy is verified. There might be a number of ways in which this opportunity can be realised. Each of the potential solutions will have positive and negative side effects and in the second phase the most optimal – preferred – solution is selected. In the third phase the scope, engineering together with the costs and the schedule, should be further detailed and defined and finally funding to realise the opportunity need to be obtained. If and when all the pre-work or the front-end

Industry	Phases					
Exploration	Identify and Assess	Select	Define	Execute	Operate	Abandon
Oil / Chem	Scouting	FED 1 / FED 2	FED 3	Implementation	Operation	Abandon
IPA	Strategy / Exploitation Alignment of functions Leading technology	Development Front End Development Use of VIPs Minimum Scope of Bussiness Needs		Commitment Executed with Minimal Change Detailed Planning and Control Processes	Results Safety IRR	
Dutch process industry	Business Scenario	Conceptual Design	Basic Engineering	Det. Eng. / Pro-cure-ment / Con-struc-tion		
	Business Planning & Project Strategy	Front-End Development		Implemen-tation & Operational Readiness	Startup & Operation	Abandonment & Demolition

Deliverables

Engineering	Scouting or Feasibility Report	Basic of Design	Front-End Eng. & Design	Handover Documentation		Scouting or Feasibility Report
Project	Project Execution Strategy (PES)	Project Execution Plan (PEP)	Project Implemt. Plan (PIP) / FID	Start-up Documentation	Post Investment Review (PIR)	New Project

Figure 1.2: Phase nomenclature in various industries together with an indication of engineering and project management deliverables

development work is properly executed and sufficiently detailed, this will result in a positive final (or financial) investment decision. In the fourth phase the project is executed and it has to produce an operating asset within the boundaries of cost, schedule and scope as defined in the earlier phases. In the fifth phase, the asset will be commissioned, started up and continuously operated. A couple of months into this phase the operation will be evaluated to ensure that the asset performs as forecasted and in line with the customer's expectations, the so-called post-investment review or PIR.

The PIR is one of the many documents that will be produced in the execution of a project. In Figure 1.2 some of the engineering documents or deliverables are indicated for each of the phases. Gradually the level of detail in these documents will grow and the accuracy of the scope, the cost estimate and the planning will increase in parallel.

Only a couple of years ago, an additional phase was added to the project management lifecycle. This phase is called the abandonment phase. With the growing environmental concerns as advocated by e.g. the nongovernmental organisations, attention has to be given as to how the assets will be dealt with once their production life is over. One solution could be to extend the production life, but once this is not economically feasible the asset has to be abandoned or demolished. It is good practice nowadays to think about these issues already during the design of an asset and the development of the project. In the design phase, decisions can be taken that will simplify abandonment three or four decades later. In the actual project management practice, this abandonment project will be a separate project well into the future.

Despite the varying names or titles, what the project management lifecycles from various industries all have in common is considerable attention for the front-end development phase of the project. In other words, if done correctly a lot of attention, time and effort is invested in defining and designing whatever needs to be accomplished with the project before any spade is put into the ground or any weld is laid. The main reason for that is that the scope at this front-end stage can still be changed relatively easy without too much impact on the overall costs and schedule. Later on, a change can potentially be very costly and even derail the project.

The effect of influence and costs on project lifecycles is schematically indicated in Figure 1.3. Prior to the final investment decision most of the work performed is paper-based. Scope has been worked out and design has been further detailed. In the worst case a lot of man hours are wasted if the project does not continue or another option is selected at a late stage. However after the final investment decision equipment will be ordered, certainly the long-delivery items, perhaps even before the detailed design is finalised. Especially in the industrial mega projects, these preorders will be a large part of the execution budget. Changes in the project after preordering the long lead items will have a disastrous impact on the project.
Nevertheless, the reasoning for a good front-end development phase is not only financially based. Spending sufficient time on all the aspects of a project in the early phase will have an enormous influence on the execution of the project and the final result. A project well-defined in the front-end development phase has a chance of becoming successful provided the execution is also well managed. An ill-defined project can never be turned around for the better during execution however good the management of the execution is. But a well-defined project can certainly be derailed and even destroyed during an improperly managed execution phase.

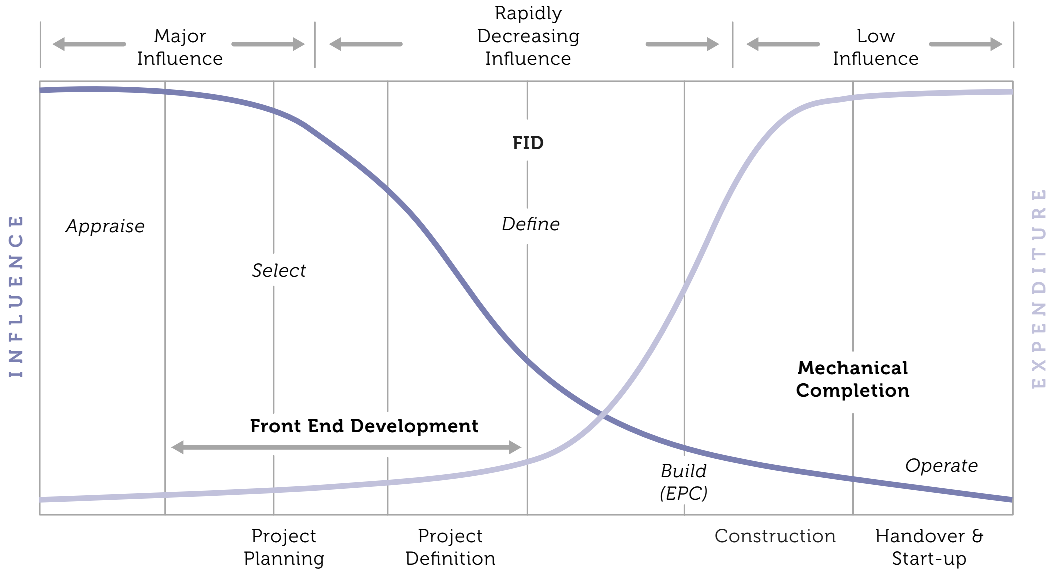

Figure 1.3: Relation between influence and cost during the lifetime of a project

Based on the business alignment, the project phases as defined in this book are represented in Figure 1.4. Since the abandon phase is most often considered a separate project, the decision was taken to exclude this phase and limit the project management lifecycle to five phases in total.

Each of these phases is completed with what has become known as a stage gate or a review point. The purpose of such a stage gate is to assess and assure that all the necessary conditions and pre-work have been fulfilled before stepping into the next phase and further detailing the project (thus spending more money and time). Normally this assessment is done by a person or a team independent from the project team. By performing this assessment independently a fresh look will be given to the deliverables and progress can be measured against the agreed project management processes as they exist in the company. By carrying out this assessment really independently and seriously, mishaps and omissions can be prevented which might later on result in derailed projects.

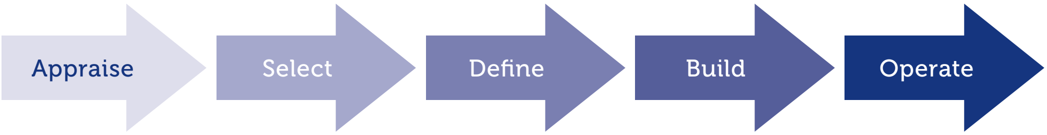

Figure 1.4: The phases of the project management lifecycle as adopted in this book

Strategic	Const'n	IT	Def. Aero	Drug Dev.
Portfolio Management	W	S/M	W	S
Programme Management	W/M	S	S	W/M
Project Strategy	W/M	S	S	S/M
Benefits Management	M/S	S	W	M/S
Value Management	S/M	W	S/M	M
Risk Management	S	S	S	S
Quality Management	S	S	S	M
Health, Safety & Environment	S	W	S	M/S

Commercial	Const'n	IT	Def. Aero	Drug Dev.
Finance	S	M/W	M/W	W
Marketing	W	W	S/M	S
Legal	S	M	S	S
Procurement	S	M/W	S	M/W
(Supply Chain Management)	S	W	S	M
Bidding (Tendering)	S	M	S	W
Contract Administration	S	M	S	W

Technology	Const'n	IT	Def. Aero	Drug Dev.
Requirements Management	W	S	S	M/W
Briefing	S	W	W	W
Technology Management	M	S	S	S
Design Management	S	S	S	N/A
Configuration Management	W	S	S	W
Information Management	S	S	S	S
(Document Management)	S	S	S	S
Production	S	W	S	S
(Supply Chain Management)	S	W	S	M
(Construction Management)	S	N/A	N/A	N/A
(Integrated Logistic Man.)	W	M/W	S	M
Testing	M	S	S	S
(Commissioning)	S	S	S	(S)

Organisation	Const'n	IT	Def. Aero	Drug Dev.
Organisation Structure	S	S	S	S
(Project Development Cycle)	S	S	S	S
Teamwork	S	M	S	S/M
Leadership	S	S	S	S
Negotiating & Influencing	S	M	S	M
Conflict Management	S	M	S	M
Communications	S	S	S	S
(Stakeholder Management)	S	S	S	S
Career Development	M	M	S	M
(Competences)	W	W	S	W
Ethics	M	M	S	S

Control	Const'n	IT	Def. Aero	Drug Dev.
Scope Management	S	S	S	S
(Change Management)	S	S	S	S
Estimating	S	S	S	S
Resource Management	S	S	S	S
Scheduling	S	S	S	S
(Concurrent Engineering)	M	W	S	W
Budgetting	S	S	S	S
Cost Control	S	S	S	S
Integrated Performance Meas.	M	M	S	W/M

KEY
Generalizations are dangerous but the indications are:

S	Strong
M	Medium
W	Weak
N/A	Not applicable

Figure 1.5: Project management practices in the various industries according to PMBoK (according to Morris, 2003)

In the first phase the business analyst together with the asset manager and the business managers will select the right project for the existing business strategy. The question that they will be asking themselves is this: 'Are we doing the right project'. The subsequent phases in the execution and the assessment performed during the stage gates will focus only on whether the project is done right.

1.6 | Towards management of engineering projects

The project management systems are quite often based on ISO9000 principles and therefore the steps taken in the development of a project are documented and the process followed is auditable and continuous learning is embedded. The project management process is quite often supported by value improvement practices and project standards defined for the various activities that are taking place in the course of a project (estimating, cost control, risk management, scheduling etc.). These systems/procedures have been developed over the years and are handed over from one project manager to another. ISO9000 has driven the thorough documentation of these project management systems.

Morris (2003) presented an analysis of the project management practices in the construction industry (our focus in this book) and the implications for the project management societies. What becomes evident from this analysis (see Figure 1.5) is that the classical project management topics such as control, commercial and organisation are very well represented in the bodies of knowledge (PMBoK). However, insufficient emphasis is placed on the strategic and technological aspects of project management. For engineering projects focus will be on the column labelled Const'n (= construction industry). Especially more attention should be given to portfolio management, programme management, project strategy, requirements management, configuration management and logistics management. Morris concludes that project management will only be seen as totally integrated and in control, provided elements such as project definition as well as implementation and early operation are considered as integral parts of the charter of the project manager. That is when focus shifts from project management to management of projects as indicated in Figure 1.6. This basically means that all relevant players should be involved as

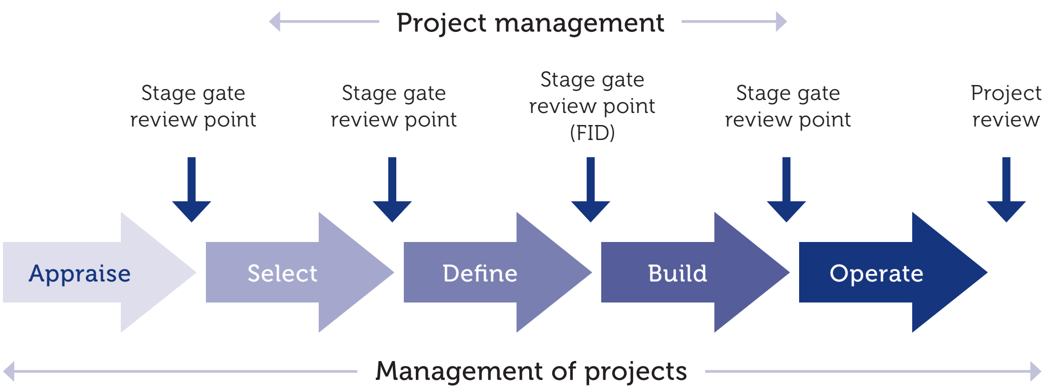

Figure 1.6: Difference between project management and management of projects

early as (reasonably) possible in the definition (of functional requirements) and development of a project.
Ideally, in the future no more handing over from business developer to project manager, to contractor, to operator and finally to maintainer will take place. Instead, all parties should together be involved from the earliest possible stage onwards. In short – and referring back to my earlier statement – project management was born from over-the-fence management and has come a long way, but there are still a few more fences to be demolished. Integration throughout the project lifecycle is key to future success.

As a consequence of this change, a major improvement will be that the business development is done in a more realistic manner taking the construction market and the project management peculiarities more seriously into account. It means that in the appraisal phase (see Figure 1.6) business developer and project manager should be working more closely together to develop a realistic opportunity taking all technical, economical, commercial, organisational and political aspects of the business opportunity into consideration. Also, interaction with the customer (when applicable) should be done in cooperation between business developer or commercial staff and the project manager.

If integration throughout the project lifecycle is taken seriously, it implies that all parties should be involved far earlier than they were used to. Not only the project manager and business developer should join hands at a much earlier stage but also, maintenance staff and operators need to participate in the design and development of the plant in order to guarantee the future operability and maintainability of the asset. In practice it means that developments have almost gone full circle. Traditionally the major oil companies, as an example within the process industry, had almost all disciplines and skills available. Engineering and design offices were part of the headquarters and sometimes even part of the core skills that existed on a refining site. Through the years most of these activities have been outsourced and the oil companies have been focusing

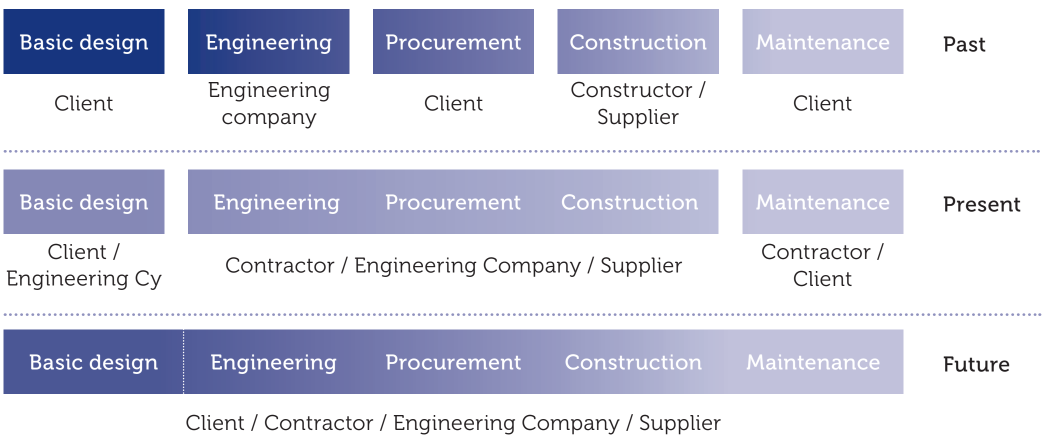

Figure 1.7: Developments in the process industry

Table 1.1: The analysis of 3500 completed projects (from 'The anatomy of major projects')

Study by	Year	Projects studied	Overrun	Principal reasons
General Accounting Office	1979	940 US civil and military projects	75 % cost increase ($346 billion to $607 billion)	Inflation, Quantity increases, engineering changes, schedule changes, underestimating
General Accounting Office	1982	444 US civil and military projects	140 % cost increase ($460 billion to $842 billion)	Quantity changes, inflation, underestimation, support costs, engineering changes, schedule changes
Harman	1970	25 US weapon systems projects	50 – 700 % cost increase	Project size, complexity, technological advance and development strategy
Large	1974	8 US weapon systems projects	200 – 400 % cost increase	Underestimate difficulty and cost
Marshall and Meckling	1959	22 US weapon projects	200 – 300 % cost increase 30 – 50 % schedule increase	Differences in technological advance
Merrow et al.	1979	10 US energy prototype projects	100 – 200 % cost increase	Technology advance uncertainty
Meyers and Devey	1984	55 US process plants (33 having pioneer technology)	140 – 210 % cost increase 0 – 30 months schedule increase	Cost: tecnological innovation and poor project definition. Schedule: concurrency and solid feedstock
Perry et al.	1969	19 US weapon system projects	0 – 460 % cost increase	Government-induced scope changes
Peck and Scherer	1962	12 US weapon systems	0 – 600 % cost increase 0 – 130 % schedule increase	Unforeseen technical difficulties or opportunities to improve technical performance
Perry et al.	1971	36 US weapon systems projects	0 – 220 % overrun	Technological uncertainty (30 %), scope changes (50 %), underestimating (20 %)
Summers	1965	22 US weapon systems projects	15 – 150 % cost overrun	Technological uncertainty and programme length
Blake et al.	1976	Various US power plants	58 – 258 % cost overrun	
Canaday	1980	35 US nuclear power plants	58 – 408 % cost overrun	Inflation, increased safety requirements; interest charges
Cochran	1978	BART, TAPS, SRAM	36 – 200 % cost overrun	Concurrency and resource shortages
General Accounting Office	1981	2 large US coal liquefaction plants	43 % cost overrun	Poorly defined and administered contracts
General Accounting Office	1984	3 US nuclear power plants	362 – 548 % cost overrun	

on their core skills more and more. With the advent of EPC (engineering, procurement, construction) type contracts a number of the activities were already becoming more integrated in their execution, be it outside the original company. Design and operations remained at least to some extent part of the core activities. With the call for further integration the remaining borderlines between design and EPC and between EPC and operations will be gradually reduced. By then the oil companies will have come almost full circle in their evolution, not as an all-encompassing single company, but as part of an integrated project team responsible for Design, Build, Execute and Operate of the future assets together with a number of complementary companies. One might even argue that when the execution is really integrated, the third bar will probably become shorter due to higher efficiency, effectiveness and less rework.

This is easier said than done. Over the last few decades many of these activities have been outsourced by major companies. To integrate these activities more closely may now seem counterintuitive, but the only way forward. The project manager might be swimming against the stream wanting to accomplish matters. Nevertheless, the goal will be better overall project performance based on early and full integration. Quite often the cooperation between parties is governed by the contract and the way the work has been outsourced. In order to overcome this, different relations should be forged that are built on trust and mutual understanding and that are not only driven by the contractual conditions. The approach needs to be truly integrated between all companies and all participating parties in order to be successful. A team without boundaries is required from the earliest possibility in the life of the project. This is still a real challenge.

1.7 | Projects fail by spectacular numbers

What does the general public know about engineering projects, project management and project success? If a survey were to be organised today, the majority would probably quote newspapers and state that projects are generally completed far later than originally planned and that they cost a bundle more.

And honestly, they would not be far out, even based on the professional literature available. Recent infrastructural projects, projects in the oil and gas industry, the IT industry, but also many projects in the aerospace and defence industry over the last couple of decades are not the best examples that might be expected.

Of course, what made it to the newspapers are the mishaps, the disasters. Most often contributed to the project manager or project management. The news value of a project delivered in time and within budget is still relatively low and in that case it is due to the foresight and vision of the owner and his organisation. But even from the perspective of the practitioners themselves the project management profession is traditionally not seen as the discipline with the most appeal (Van de Laar, 2007). Quite often in the business world people prefer a career in line management rather than a career in project management.

The project management discipline as a whole does not have an incredibly good track record. Morris and Hough (1987) have analysed a large number of projects – some 3,500 projects from all over the world – realised in the period 1959 till 1984 (see Table 1.1). These projects were executed in both the civil and military industry as well as in the power and nuclear industry. They came to the staggering conclusion that these projects showed typical overruns in expenditure and schedule between 40 and 200 % (and bigger overruns have been seen).

The independent international benchmarking company IPA produces an annual benchmarking comparison of the projects that have been completed by their member (subscribing) companies the previous year. By now, IPA has a database of more than 12,000 projects from within the industry (oil, gas, fine chemical, petrochemical and pharmaceutical). Their analyses, although more recent, show the same sobering results. Their conclusions are that since 1993 more than 50 % of the conventional oil and gas projects have been disasters. Disasters in this sense are described as having more than 30 % cost growth and/or more than 38 % schedule slippage. On top of that, less than 39 % of projects lived up to their promises during the first year of operation. Another more recent example is the analysis of Flyvbjerg (2007) showing a similar trend in cost overruns in large infrastructural projects: 9 out of 10 projects have a cost overrun.

In Figure 1.8 a plot of 19 anonymised large engineering projects – executed in the period 1992 till 2007, and collected by the author – is presented. These were the megaprojects of those days, the construction of process plants with total investment costs ranging from € 500 million to 2 billion. On the y-axis the actual costs over the estimated costs is shown as a percentage. On the x-axis the actual duration over the estimated duration is shown in a similar manner. The working assumption is that a result within ± 10 % of the cost and duration is considered to be a successful project (within the small dotted rectangle). As can be seen from the graph, only 9 out of the 19 projects can be considered successful according to this definition: a very disappointing 58 % failure rate. An underspending of more than 10 % is also considered unfavourable, because money was tight up unnecessarily in the project that could have been used for other investments.
These results, whilst dated in some cases, are shocking. The most concerning fact is that over the last 30 years the performance of the projects delivered has hardly improved. The results are totally in line with the perception of the general public regarding projects and project management as given at the start of this paragraph. The main question is now what can be done further or maybe differently to change this situation.

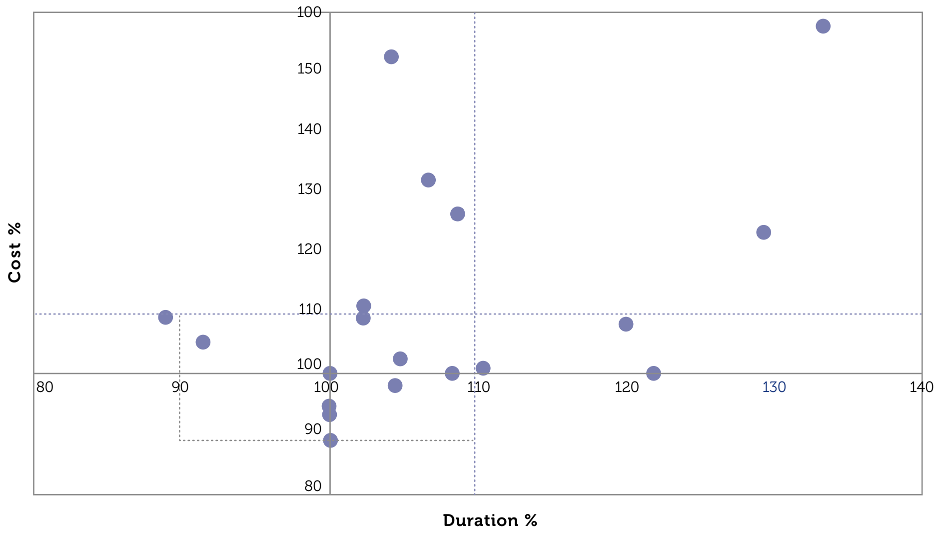

Figure 1.8: Results from a portfolio of engineering projects

1.8 | People are key in the management of projects

What has already been touched upon in the previous paragraphs is that successful projects are integrated throughout the project lifecycle. The early involvement of the project manager is essential to ensure full alignment with the business case. But early involvement of contractors and suppliers as well as maintenance and operations staff is also essential.

Timely involvement of suppliers and contractors is important to have a smooth design process focused on constructability later on in the project cycle. Bringing maintenance and operations staff in early in the project will contribute to an effective handover and start-up process and will support the future maintainability of the plant. In short, if the project manager is able to build together with his contractors and subcontractors a fully integrated team, or in other words if the project manager is able to build a team that operates as one entity – a seamless team – evidence shows (Bosch, 2011) that such a project team is most likely to be successful. It is also strongly recommended to early invite the assurance staff who will perform the stage gate reviews in order to agree which process steps to follow and which deliverables will be adhered to.

Finally, more stakeholders would benefit from an early involvement. Project management is considered to be good if the communication with stakeholders is an integral part of the activities in order to prevent unpleasant surprises by the time the project is ready to be started up. Managing the project is in fact managing all the people involved, keeping them informed and aligned and making the best use of their collective capabilities. Obviously tools, techniques and procedures will be essential to deliver the project, but the success of the project depends for the greatest part on the fruitful collaboration of all the parties involved. Fewer boundaries – perceived or real – between the various parties will have a positive effect on the outcome.

Future relationships should become real partnerships built on trust and mutual understanding. Building those relationships will require an enormous amount of effort and time in order to change the existing culture of collaboration. Relationships are the foundation of future accomplishments. Examples of excellent relationships actually have been realised, yet it requires concerted effort from all parties and it is far from easy to accomplish.

1.9 | Fit for purpose management of projects

In the previous paragraphs a number of fit for purpose approaches have already been mentioned.

- First of all, spending enough time on the design and the development of the project is the main requirement for a successful project outcome. Spending sufficient time and effort on the development of the front end is essential and is more than anything else a fit for purpose step. As mentioned before, the management approach should be commensurate with the size and complexity of the project.
- The second step is to agree with the assurance staff executing the stage gate reviews what the deliverables for each phase of the project will be. Depending on the size and complexity of the project the deliverables can be adjusted. As an example, for simple and small-scale projects sometimes a decision is taken to combine the FED1 and FED2 phases as indicated in Figure 1.2. For that same simple and small-scale project it could be OK to make only one estimate and not go through the steps of a number of estimates with increasing accuracy. One size does not fit all. For a mega-project on the other hand the decision could be that a number of the

value improving processes will be executed more frequently, for instance in every phase of the project before every stage gate.
- If the project team is truly integrated, the selection of staff is an issue that needs to be addressed. At this point the focus on people and the fit for purpose approach come together. In such an integrated team one might not need a planner from the contractor and a planner from the owner. Various tasks can be distributed amongst the contributing parties. One needs to make sure the team does not become too heavily loaded. Whether this is feasible depends on the amount of integration and the trust between the parties. LEAN techniques might be beneficial and would certainly support a fit for purpose management approach.
- Collaboration in these integrated project teams will require a real shift in paradigm. The success of the project should be driving individual behaviour and reward, not necessarily the success of the individual companies, owner or contractor. This will require a massive shift in doing business.

1.10 | Learning from projects

Project management could make a big step forward if only at the end of the project lifecycle sufficient time would be set aside to report on the accomplishments of the project and the project management. Quite often and certainly in the present market, demand for human resources is so high that even before the project is completed there is already a pull to transfer the project manager to a new project and let his deputy complete the last details and the last few months. Of course that can be done and it is as a matter of fact an excellent learning opportunity for the deputy, but what really suffers is the managerial learning process (Storm & Savelsbergh, 2005).

A concerted effort should be made to capture all the lessons learnt from the project, report them back and where feasible incorporate them in future procedures, tools and systems. This is done, first of all for economic reasons. Has the project really delivered what was originally promised in the business case? But this should also be done from a project management perspective. Have new methods and approaches been applied successfully in this project that are worth replicating in future similar projects or in general? A loud and clear plea is made that time should be set aside after project completion to seriously capture the lessons learnt together with the relevant high-level data.

Where possible it should be considered to make a case study out of these lessons for the education of future project managers and other project professionals. Securing that this actually happens is probably the biggest challenge for the future of management of projects. Often solutions might have been developed by a project team and are being applied unnoticed for other projects, because of the extreme focus on delivery.

This lack of managerial learning is a potential cause for project failure which for unknown reasons hardly ever shows up in the top-ten reasons for project failure (also absent in Table 1.2). Cooper (2002) has given a number of reasons that hamper the managerial learning. His remarks as quoted below clearly resonate with and have been augmented by the author's own experiences and beliefs:
- The misguided prevalent belief that every project is different
- The difficulty in determining the true causes of project performance

- Projects are transient phenomena and few companies have sufficient resources for the very purpose of gleaning and improving upon transferable lessons of project management
- While there are individuals who learn, their limited span and career paths make systematic assessments and learning of transferable lessons that get incorporated in subsequent projects extremely difficult
- The nature and character of project managers

In order to broaden project management from a skill to a discipline it is essential that the learning in all phases and at all levels is institutionalised. This requires that time is set aside for capturing the learning of individuals, teams and the project as a whole and to analyse in an open and honest manner where improvements still could be made and what should have been done differently in case of a mishap. This should not be done in isolation, only amongst the project professionals, but in a concerted effort with all players with the aim of further improving the management of projects as a professional discipline. Another way of transferring learning is that a project team takes a young upcoming project professional on-board to train them on the job. Handing over the experience and integrating the learning in the execution of a project is essential for future success.

There is already vast experience on what can go and what has gone wrong in projects. The Independent Project Analysis (IPA) company founded by Ed Merrow has gathered an enormous amount of data via their annual benchmarking process. The top 18 reasons for project failure as indicated by IPA are shown in Table 1.2. These data have surely matured over time and are by now based on a very extensive portfolio of completed projects.

Earlier Pinto (1997) showed that lessons could be learnt from past failures (see Table 1.3). In his article he uses previous project failures as triggers for potential future risks and the accompanying mitigating actions to overcome these. It is concerning that seventeen years later and after having spent an incredible amount of money, the same mistakes are still being made. Some of

Table 1.2: Reasons for project failure as gathered by IPA

Schedule is calendar driven rather than date driven	Optimistic forecasting
Overly aggressive appraisal strategy	Wrong contracting strategy
Lack of front end loading	Wrong contractors
Lack of clearly defined scope	Lack of adequate resources (skills and / or numbers)
Lack of adequate analysis of potential solutions	Personnel changes
High degree of complexity / innovation	Personality clashes
Incomplete design / design errors	Inadequate risk management
Unrealistic plan	Lack of adequate change control
Unrealistic budget	Lack of understanding of stakeholders aspirations

Table 1.3: Twelve ways to ruin a project (Pinto, 1997)

Ignore the project environment (including stakeholders)
Push a new technology to market too quickly
Do not bother building in fall back options
When problems occur, shoot the most visible
Let new ideas starve to death through inertia
Never bother conducting feasibility studies
Never admit a project is a failure
Over-manage your project managers and your project teams
Never, never conduct post-failure reviews
Never bother to understand project trade-offs
Allow political expediency to dictate important project decisions
Make sure the project is run by a weak leader

the failures stated by Pinto do overlap with the IPA findings, but the latter ones are slightly more detailed and already more focused on the front-end loading, where the difference can be made as explained earlier in this chapter.

Recently Merrow (2011) published a book on industrial megaprojects. In the introductory chapter of this book he argues that he has seen megaprojects going off the rails due to big mistakes made by senior managers in the owner companies, not necessarily by the project managers. The main reason for these mistakes is that these managers or executives have control over the issues that have the most impact: strategy, money and people. The relationship that has the most influence amongst the hundreds of relationships a project manager is maintaining, is the relation with his sponsoring business director. The behaviour of these executives with respect to projects and their execution has been summarised by Merrow as the 'Sorry Seven'.

- I want to keep it all
- I want it NOW
- Don't worry; we'll work out the details of the deal later
- Why do we have to spend so much up front?
- We need to shave 20 percent off that number
- The contractor should carry the risk; they're doing the project
- Fire those #$@$^! project managers who overrun our projects

These seven mega-mistakes are very recognisable to most project managers. The seven mistakes again in a way support the plea to spend sufficient time on the front-end development, make sure that we only design what is really required and come up with realistic estimates and build true relationships with our contractors and suppliers.

1.11 | The case study

In order to explain the principles that will be shown throughout this book a case study has been created to help clarify most of the processes, tools or procedures. The authors are convinced that some practical examples will help to remember and understand the subjects more easily. In this paragraph the background of the case is explained and the relevant parties are introduced. The fictitious case is based on the data of a real project in its front-end development phase. Some sensitive specifics like numbers and names have been changed for confidentiality reasons. In the subsequent chapters an effort will be made to explain the content of the chapter by means of the case. This part of the chapters is titled The Wind Farm and looks like the next page.

The Wind Farm

Allwind Energy is the world's largest supplier of a complete range of products, services and solutions for the use of renewable energy and power transmission in grids. Last fiscal year they employed almost 86,000 people and posted sales of € 27.5 billion.
Allwind has greatly expanded its wind power business since several acquisitions.
The number of employees in its wind power division has increased tenfold from 2000 to approximately 20,000 and sales have increased twelvefold to approximately € 16 billion.
Allwind ranks second in Europe which is considered one of the most important markets in the world for offshore wind power.
The Wind Farm Energy Polder is a combined onshore and near-shore wind farm under development in Vento, in the northern part of the Netherlands. Upon completion it will be the largest wind farm in the country. Owner-operators are members of the Participants Windenergy Vento, a partnership of more than 100 agricultural entrepreneurs from Vento and the energy company Esenca.
Due to the size of the Wind Farm Energy Polder and its contribution to the countries renewable energy target both the spatial planning process and the necessary licences are subject to a special procedure known as the Government Coordination Scheme. The draft decisions for the wind farm have been made available for public inspection. All local residents and other parties concerned have been given the opportunity to submit their opinion.
Construction of access roads will soon begin as well as the expansion of the 110kV transport network in order to connect the wind farm (done by the grid operator and formally outside the project scope).
The wind farm will be located along the coast. A total of 80 wind turbines will be erected; 50 will be sited near-shore (Allwind, 3 MW) and 30 onshore (Nishati, 8 MW).
The wind farm will produce 1TWh of electricity annually, enough to provide electricity to 400,000 households.
There are currently already 50 wind turbines on the coast shore. The new wind farm will generate significantly more electricity than the current one, thanks to improved wind turbine technology. One new onshore wind turbine provides as much electricity as the current 50 wind turbines put together. It is planned to dismantle the existing wind turbines once the new farm is constructed.
An estimated total investment of about € 1 billion is required for the construction of the wind farm (for all 80). Residents in the proximity of the Energy Polder may also financially participate in a section of the wind farm through an equity participation scheme. The project will provide a sustainable boost to the local economy. The construction of the wind farm will ensure employment opportunities. During the construction phase, around 300 new jobs will become available. Once it has been built, the wind farm will help provide about 100 permanent jobs.
Allwind will be responsible for the turnkey realisation of the near-shore part of the Wind Farm Energy Polder, including the design, supply, delivery, installation, commissioning and testing, service, operations as well as maintenance of this 150 MW wind farm in compliance with all the permits, consents and other agreements. Besides the turnkey realisation of the wind farm, a 20-year maintenance contract will be signed as well.