Chapter 1
Introduction

Modern management in construction addresses four principal areas of the industry:

- Management of the physical production phase or site construction management;
- Management of the various functions that make up and contribute to the delivery of projects, or total project and programme management;
- Management of the corporate establishments involved in the delivery of the constructed facilities and services or organisational management;
- Management of the industry to create an enabling commercial, regulatory, and conducive socio-economic environment, or sector management.

Construction Management addresses the effective planning, organisation, application, coordination, monitoring, control, and reporting of the core business processes of marketing, procurement, production, administration, accounts, and finance necessary to achieve economic success and/or profitability for an enterprise or organisation engaged in the provision of construction facilities. The functions may be performed by a client, contracting company, consultant firm, public body or a combination of such stakeholders contracted to bring a project or series of projects to safe completion on time, to budget, to the set quality and expected innovative, aesthetic, socially responsible, and environmental impact.

Construction Project Management focuses on the delivery of a specific solution by contracting with stakeholders who undertake combinations of the following indicative sub-processes relating to a specific project:

- Scoping and budgeting the project;
- Design coordination/management;
- Establishing the management structure of the management team;
- Marketing and procurement;
- Defining roles and responsibilities;
- Estimating and tendering;
- Stakeholder management;
- Project and construction methods planning, coordination, and control;
- Value and risk management;
- Organising, leading, and implementing controls;
- Production and productivity management;
- Management of labour resources, temporary works provision, equipment, plant, subcontractors, and suppliers;

Modern Construction Management, Eighth Edition. Frank Harris, Ronald McCaffer, Andrew Baldwin and Francis Edum-Fotwe.

Companion website: www.wiley.com/go/MCM8

- Time and subcontractor interface management;
- Cost and budgetary control, including cash flow forecasting;
- Quality management;
- Contract and progress payments administration;
- Legal issues;
- Information and communications technology (ICT) management;
- Health and Safety management, education, training and welfare provision;
- Corporate Social Responsibility (CSR);
- Management of the potential environmental impacts of construction;
- Commissioning, auditing, and recording of the project(s).

The Chartered Institute of Buildings, CIOB, provide a comprehensive set of definitions of Construction (Project) Management (CIOB 2014).

Significantly, as recent Constructing Excellence (CE) and government reports emphasise, the marked shift towards modern forms of contracting, rapid technological change, and greater environmental, social and economic accountability of construction pose ever-growing competition in a world of intensified global trading – not least the Corporate Social Responsibility notion of 'doing well by doing good' to enhance competitive advantage. Hence, an intelligent client will increasingly need to focus on achieving value at the operational and business levels through the appointment of a robust integrated 'best in class' supply chain of stakeholders, able to deliver the listed project services with the fresh, practicable, robust, measurable and auditable core competences and management processes.

Structure of the book

This book covers the principal responsibilities of Construction Management divided into four main sections; in addition, Chapters 1 and 2, which do not form part of the main sections, give specific consideration at the outset to the philosophy of the book as a means of explaining the succeeding chapters.

In particular, Chapter 2, *Quality management in construction* provides the platform for the succeeding chapters and describes the evolution of quality management from quality control through quality assurance to total quality management (TQM), as well as the current standards employed by construction organisations. It illustrates how quality is intertwined as a thread running through all subsequent sections and explores the emerging strategic role of quality as a driver for competitive advantage in construction. Looking at quality from the project perspective, it advocates a concerted effort by both client and contractor to make any quality agenda a reality, and explores a systems approach to attaining such an agenda. It concludes with a look at initiatives by the professional bodies associated with the construction to support and promote quality attainment and management.

- Section I deals with techniques relating to project production management.
- Section II covers the business aspects of management at both project and company levels, including environmental management and legislation guidelines.
- Section III addresses the executive management responsibilities for overall corporate control.

- Section IV brings together a selection of self-learning problems complemented with complete worked solutions for use in the classroom environment, tutorial exercises and seminar discussions, which are provided on the companion website.

The reasons for this particular presentation are:

(1) Successful construction industry executives have distinct phases in their careers: the initial period is spent on site, followed by middle-management duties at the project level, culminating in a career with executive head-office activities. The sections are intended to cater for these phases.
(2) The construction industry is inherently uncertain as a result of the nature of the industry itself – the competitive tendering process, the company's turnover, site production rates and the weather are all features that are characterised by variability and a degree of uncertainty. To be able to cope with such uncertainty, construction executives need to be acquainted with the relevant knowledge and tools for addressing these features. The management techniques described in this book help reduce variability and thus provide the basis for sound and effective decisions by aspiring executives. For example, with proper planning, the duration of a project is not just an experienced guess. The inevitable residual variability in even the best-run company needs to be controlled by:
    (a) Planning and setting targets;
    (b) Choosing methods to achieve such plans and targets;
    (c) Monitoring progress;
    (d) Taking corrective action when necessary.

This continual monitoring and revision is ultimately the only way to cope with uncertainty and variability.

Objectives and contents

Each chapter deals with a specific topic (which could, if exhaustively treated, form the basis of a whole book; suggestions for further reading appear at the end of each chapter, while references appear in the bibliography at the end of the book).

The level of detail aimed at is that which will provide the reader with a basic working knowledge of the topic, rather than with specialist expertise. For example, the planning section of the book explains the major techniques available for planning both repetitive and non-repetitive works in sufficient detail to allow intelligent engineers to apply them, providing sufficient comprehension for them to converse sensibly with a specialist support group such as a planning department. Engineers and builders need enough knowledge to understand, appreciate and, where necessary, question the work of specialist support staff such as accountants, cost clerks, planners, and plant managers. A grasp of the techniques described in the sections should help in achieving this skill. Specialists must not be allowed to hide safely in their own specialisms. Participation in the exercises in Section IV covering the numerical-based aspects of these techniques provides a deeper and better understanding of the implications of the various approaches to decision making.

The contents of each section are now discussed briefly below.

Section I

Section I relates specifically to project production management, including planning techniques, production process improvement, estimating and tendering, workforce motivation and cost control.

- Chapter 3: *Production process improvement* provides a foundation to the efficient delivery for the operational aspects of construction. The basis for evaluating such efficiency has shifted to include energy use, productivity, and national productivity reports, Building Information modelling (BIM), quality management, lean construction, benchmarking, digital technologies, waste management, asset management, Six Sigma, production measurement and sampling. The chapter also provides examples of the application of the production measurement.
- Chapter 4: *Planning techniques and methods* considers who plans, when, and the methods and techniques that may be adopted. The chapter describes techniques including bar charts, linked bar charts, network analysis and space-diagrams together with methods such as, Last Planner, Critical Chain Project Management and ADePT that provide specialist approaches to the management of both design and construction. Also included is guidance for planning for waste management, Health Safety and Environment in construction. A new section considers modern construction planning including developing the time model, schedule design and structure, monitoring progress and managing the time model. Consideration is given to the impact of emerging information technologies including 4D CAD and BIM.
- Chapter 5: *Workforce motivation* links the use of incentive schemes to motivation theory, which is complimented with a coverage of Theory Z. It also presents the various payment systems for non-financial, semi-financial, and purely financial incentives that can be employed to enhance worker motivation. The introduction of a new audit system for workforce motivation offers a new insight for project and senior executives.
- Chapter 6: *Project cost control* gives guidance on the various cost-control methods available, including profit-related control systems, unit- and standard-costing approaches, cost monitoring of subcontractors, and cost management of carbon emissions.
- Chapter 7: *Management of equipment* considers the financing of plant and gives guidance on plant selection and control of gaseous emissions. Calculating a hire rate and maintenance procedures are also covered. The chapter also addresses an important and emerging aspect on plant management – the need for more human-centred approaches to the management of plant within construction.

Section II

Section II presents business management topics and is intended to assist project-based staff to understand and appreciate the company's attitudes and activities, easing the transition from site to general management. The topics described relate to procurement, bidding, budgets and cash flow, economic assessment and plant management.

- Chapter 8: *Project procurement* introduces the role of project and programme management, stakeholder management, design coordination, and reviews various forms of contract including regulations for public contracts. The latest developments for procuring construction and engineering embraced in the ISO and BS Procurement standards and codes

of practice, design and build, early and optimised contractor involvement, modern PFI, partnering and associated funding mechanisms are also explained. The risk exposure of each of the parties involved in different procurement arrangement is also addressed.

- Chapter 9: *Estimating and tendering* is an important function in all construction companies that must be conducted with a clear understanding of the resources required and risks involved. The chapter describes the parties involved in the estimating and tendering process, and the four types of cost estimates that may be produced. It outlines the process, decisions, and calculations involved within the traditional estimating practice and the variations adopted for other types of procurement such as Management Contracting, Design and Build, together with cost planning, cost management, whole-life costing and the private finance initiative. The last section of the chapter reviews how BIM contributes to better construction estimating.
- Chapter 10: *Competitive bidding* examines the effect of estimating accuracy, which implies the need for more resources in the estimating department, reviews how to interpret the various available items of data relating to competitors' behaviour and comments on improving estimating accuracy. It also covers electronic bidding and fundamental information on bid evaluation.
- Chapter 11: *Company budgetary control* deals with the preparation of budgets and controlling costs for a company or enterprise, including budgeting for the carbon footprint.
- Chapter 12: *Cash flow and interim valuations* illustrates company cash-flow forecasting and provides guidance on how to do this type of forecasting, the use of computers in cash-flow calculations, the process of interim valuations and the relationship between interim valuations and cash flow. It introduces the concept of invoice financing as a means for achieving positive cash flow for the construction company.
- Chapter 13: *Economic assessments* describes the principles employed in economic comparisons and in measuring rates of return, life-cycle costing, cost-benefit analysis and financial modelling. It also provides an introduction to the use of multi-criteria analysis for appraising projects.

Section III

Section III presents the executive management responsibilities largely concerning head-office activities, including organisation, business development, global construction, and the emerging role of information as a major construction resource and finance.

- Chapter 14: *Company organisation* contains a description and explanation of company structure, organisation and managerial responsibilities, training and vocational qualifications, R&D, environmental management and international agreements. The chapter also covers working in an age of connectedness.
- Chapter 15: *Market planning and business development* describes a marketing approach to construction and the benefits likely to be derived and methods of selling including green/low-carbon marketing, modern web blogging and social networking.
- Chapter 16: *International construction and logistics* risks provides an overview of the problems in globalisation of trade, raising finance, dealing with unfamiliar conditions of contract and legal systems, transport of goods, payment procedures and local labour, resources and security.

- Chapter 17: *Towards BIM and digital construction* considers the changing role of information in construction, the adoption of information technologies, information management including information strategy options, and outlines principles for investing in information systems, their implementation and management. The importance of information security and data protections is stressed. Full consideration is given to the emergence of BIM, BIM-maturity levels, and the future of BIM. The chapter ends with a review of digital construction including digitisation, artificial intelligence and the use of drones and other new technologies.
- Chapter 18: *Financial management* describes the workings of the national economy, company types and formation, banking and money, sources and means of acquiring capital funds and the use of balance sheets, profit-and-loss accounts, ratio analysis and financial regulation.

Section IV

This section presents tutorial examples with complete worked solutions for students in construction disciplines. It is separated into three chapters, with the first, Chapter 19, covering the worked examples from Chapters 3 to 18. Chapter 20 provides worked examples on operational research techniques. Chapter 21 similarly introduces Six Sigma statistical examples supportive of Lean Sigma application to productivity improvement analysis.

Students learn by reading texts and attending lectures. However, they need to test their new-found knowledge or skill by attempting to work through example problems, and several textbooks are available that offer such examples, either with or without answers. Where an answer is provided, the student's own answer is frequently at variance and they are then faced by a dilemma: is the textbook in error or has the author made different, but valid, assumptions? In this book, a complete worked solution to each example is given so that the student has full guidance through the analysis.

The topics covered in Section IV are those aspects of construction management that may be treated numerically:

- Production analysis;
- Planning;
- Estimating;
- Motivation schemes;
- Control of project costs;
- Budgetary control;
- Cash-flow forecasting;
- Discounted cash flow;
- Investment analysis;
- Plant management;
- Setting of plant-hire rates;
- Financial management;
- Development economics;
- Construction methods;
- Operational research;
- Six Sigma for construction.

The intention is for the students to test their knowledge by trying the examples and comparing the solutions with those offered in the book. Any differences between the student's solutions and those presented here may be discussed with the tutor and, in this way, tutorial discussions may be used advantageously for resolving difficulties rather than for routine learning. It should be remembered that these are tutorial examples and that each one deals with a limited number of variables and principles, sometimes making simplifying assumptions. Thus, students may test their understanding of the principles and ability to manipulate the variables.