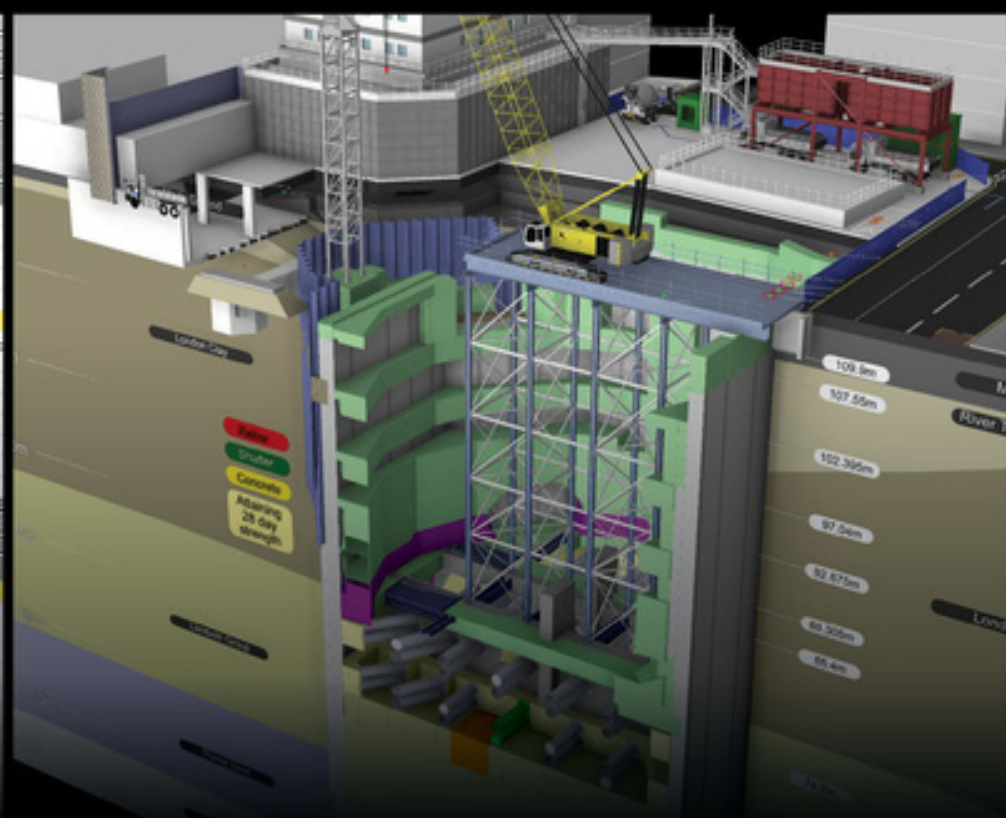


THE CHARTERED
INSTITUTE OF BUILDING

GUIDE TO GOOD PRACTICE IN THE MANAGEMENT OF TIME IN MAJOR PROJECTS

DYNAMIC TIME MODELLING



SECOND EDITION

Guide to Good Practice in

The Management of Time

in Major Projects

Guide to Good Practice in

The Management of Time

in Major Projects

Dynamic Time Modelling

Second Edition

The Chartered Institute of Building



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Preface

As with a well-cut diamond, project success has many facets that work in unison to create a brilliant result; and as with a well-cut diamond, some facets contribute far more to the overall impression than others. This book is focused on a major facet of project success, effective project time management, which underpins the cost-effective use of resources and contributes to achieving a time- and cost-efficient project without compromising quality, safety or risk management objectives.

This book is the second edition (retitled to better reflect its objective) of CIOB's highly successful *Guide to Good Practice in the Management of Time in Complex Projects*,¹ first published in 2011. Since 2011, leading authorities globally have increasingly recognised 'schedule is king'² and have placed increased emphasis on the proactive management of time, using dynamic modelling, as a precursor to project success. In keeping with this theme, the USA Government Accountability Office (GAO) published its *Schedule Assessment Guide: Best Practices for Project Schedules*³ in 2015 to complement its well-regarded *Cost Estimating and Assessment Guide*.⁴ The CIOB has also updated its *Complex Projects Contract, 2013*⁵ as the *Time and Cost Management Contract suite 2015*,⁶ including back-to-back Consultancy Appointment and Subcontract, and many other standards and guides requiring effective project time management have also been updated or published since the first edition of the Guide was released.

This *Guide to Good Practice in the Management of Time in Major Projects – Dynamic Time Modelling* does not seek to duplicate these standards; rather it provides the practical and rigorous framework needed to guide scheduling practice to achieve the objectives defined by these standards. Applying the guidance contained in this book will offer any project team the best way to achieve the effective management of the time available to complete their project, conform to recognised good practices, and consequently create the best opportunity for a successful project outcome.

¹ <http://www.ciob.org/time-management> (accessed 10 December 2017).

² Stephen Gumley, former CEO, Defence Material Organisation.

³ <https://www.gao.gov/products/GAO-16-89G> (accessed 10 December 2017).

⁴ <http://www.gao.gov/products/GAO-09-3SP> (accessed 10 December 2017).

⁵ <http://www.ciob.org/insight/contract-complex-projects> (accessed 10 December 2017).

⁶ <http://www.ciob.org/insight/time-and-cost-management-contract-suite> (accessed 10 December 2017).

Introduction to Second Edition

The *Guide to Time Management in Major Projects – Dynamic Time Modelling* (the Guide) is a revised edition of what was previously the CIOB's *Guide to Good Practice in the Management of Time in Complex Projects*, published in 2011.¹ The name has been changed to reflect more clearly the core strengths of the Guide and its application to the management of major projects; however, whilst the Guide is focused on construction and engineering projects, the concepts and procedures can be adapted for use in any type of project.

The Guide is a practical treatise on the processes to be followed and standards to be achieved in the effective management of time. Subject to the amendment of existing forms of contract to remove inconsistencies, the Guide can be used in any jurisdiction, under any form of contract, with any type of project.

The Guide promotes competence in critical path network modelling, resource allocation and productivity analysis by the use of a dynamic time model (DTM).² The Guide does not recommend a single density,³ static baseline target programme, but requires a dynamic critical path network, in differing densities, updated and revised on the rolling wave principle which constantly predicts the currently attainable completion date, sectional completion dates and key dates as a result of the current sequencing.

Although the Guide is not based upon any contractual regime or procurement process, the CIOB's 'Time and Cost Management Contract' suite (2015)⁴ has been written for use with the Guide to provide a uniform approach to cost and time risk management from initiation to completion of major building and engineering projects in accordance with the Guide's recommendations.

¹ <http://www.ciob.org/time-management> (accessed 10 December 2017).

² A dynamic time model is a critical path network of which the essential characteristics are: 1.a high-quality critical path network without any constraints that will inhibit the schedule from reacting dynamically to change; 2.a combination of the short-term look ahead using resource and location based logic in High Density with the schedule for the whole of the work using activity based logic in Medium Density and Low Density; 3. activity durations in the High Density part of the network are calculated by reference to the planned resources and their expected productivity and updated with records of the resources actually used and the amount of work actually achieved in the update period; 4. the schedule is revised to incorporate fuller and better information as it becomes available on a 'rolling wave' principle going forward so that the next 3 months work is always scheduled in High Density; 5. the schedule is impacted by intervening events that have occurred, are occurring or are likely to occur in the future in order that their predicted effect can be managed. See also Parts 1 and 3 and Appendix 4 for a description of the dynamic time model in use.

³ Density refers to the level of detail contained in the schedule, see Section 4.2.

⁴ See <http://www.ciob.org/insight/time-and-cost-management-contract-suite> (accessed 10 December 2017).

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1

Introduction

1.1 Core principles of time management

1.1.1 Effective time management is essential to resource management, cost management and the allocation of liability for slippage, its recovery and accountability.

1.1.2 In order to achieve effective time management there must be:

- a carefully considered planning method statement that directs and maintains the use of the dynamic time model (DTM);¹
- a competent appraisal of the risks which are likely to have a significant effect on the progress of the work in the future;²
- a design which permits the work sequences that are likely to be severely disrupted and/or delayed by foreseeable risks to be separated into parallel, rather than sequential paths;³
- a dynamic time model for the project against which progress, or lack of it, can be measured, accounted for and the consequences of it predicted;⁴
- a practically achievable strategy for dealing with intervening events during the design, procurement and construction processes.⁵

1.1.3 The word ‘programme’, often used in the past to describe a static baseline target (usually printed on paper and containing a list of dates on which the proposed activities might be carried out) is not used in connection with the management of time in major projects.

1.1.4 The word ‘schedule’ is used in the Guide to describe a dynamic time model comprising the computerised calculated activity dates and logic. The process is to be referred to as scheduling and the occupation that of the scheduler. The schedule is manifest in an editable computer file.

1.1.5 Planning and scheduling are separate disciplines. Project planning is largely an experience-based art, a group process requiring contribution from all affected parties for its success. The output from planning is documented decisions on how the work of the project will be accomplished. Scheduling is the science of using mathematical calculations and logic to model the project plan to predict when and where

¹ See Section 1.2, Part 3 and Appendix 4 for a description of the DTM in use.

² See Appendix 1 for a listing of those generic risks normally borne by the employer.

³ See Appendix 2 for case studies illustrating the importance of considering planning strategy during the design stage.

⁴ See Section 1.2, Part 3 and Appendix 4 for a description of the process and use of the DTM.

⁵ See ‘Managing the dynamic time model’ at Part 5.

work is to be carried out in an efficient and time effective sequence. The output from scheduling is a dynamic project schedule.

1.1.6 Planning must precede scheduling. They cannot be carried out in parallel, nor can scheduling precede planning.

1.1.7 Schedule preparation must be a quality assured process against a standard which will ensure the integrity of the schedule, so that it can function as a time model.

1.1.8 The schedule (and any revisions and updates) should be audited, independently of any contractual obligation, for integrity and technical competence.

1.1.9 Time management starts with the conceptual design of the project. If the design does not permit the work to be carried out efficiently, and hence is not time effective, no procurement strategy will rescue it.⁶

1.1.10 Time management of major projects necessarily encompasses the management of design, manufacture, procurement, subcontract and separate contractor work packages, information flow, quality control, safety management and the achievement of multiple key dates, sectional completion dates and multiple projects.

1.1.11 A time risk appraisal is to be carried out at inception and constantly updated throughout the life of the project.

1.1.12 Time contingencies for the employer's, the design team's and the contractor's risks must be a part of the strategy for effective time control. The basis for assessing each of the contingencies must be described.

1.1.13 In order to identify the cost advantages of various development strategies, and hence the most efficient overall approach to the work, the value of the time contingencies allowed against foreseeable risks must be included in the project budget.

1.1.14 The Guide differentiates between the development schedule, prepared before a contractor is appointed, and the working schedule used in connection with construction.

1.1.15 The development schedule cannot be prepared in one process at a single density, or degree of detail, at inception. It must be prepared in varying densities⁷ consistent with the information available from time to time, and reviewed and revised at regular intervals, as better and more certain information becomes available.

1.1.16 The working schedule must follow from the development schedule and must also be prepared in varying densities consistent with the information available from time to time. It must also be reviewed and revised at regular intervals as better and more certain information becomes available.

1.1.17 Consultants', specialist contractors' and subcontractors' schedules must be prepared in the same software as the development and working schedules and integrated with them.⁸

1.1.18 The work to be carried out in the short term must be scheduled according to the resources actually available and the productivity expected from the resources for the various work types to be carried out.

⁶ For examples of this principle in practice, see Appendix 2 'Case studies in strategic planning'.

⁷ For guidance on schedule density, see Section 4.2.

⁸ For guidance on schedule integration, see Section 4.8.

1.1.19 Where the work is to be or has been designed in a BIM environment, the 3D virtual model can be used to assist with quantifying the work for each activity in the High Density part of the schedule.

1.1.20 If the 3D virtual model is linked to time-related information to produce a 4D model, the alignment of objects in the 3D model to the schedule can help to reduce difficulties arising out of incompleteness of design and/or schedule information.

1.1.21 Baselines exist to permit status reporting rather than the dynamic management of time. Therefore, where baselines are used they must be maintained to reflect changes to the content of the work and development of schedule density as the project proceeds.

1.1.22 Progress monitoring techniques, which are rooted in comparison of estimated progress against a static baseline target, have limited value in the management of time in major projects (in which the work content, resources and sequence necessarily change from time to time).

1.1.23 Progress records must be kept on a database that will provide instantaneous access and retrieval of as-built data for the purpose of checking the reliability of productivity assessments in varying repetitive work cycles, and hence the reliability of Medium Density and Low Density scheduling.

1.1.24 Because progress data will be recorded only against the fully resourced, High Density part of the schedule, the as-built record will provide data standards and productivity feedback for future benchmarking, which will improve predictability and hence reliability of short-term scheduling.

1.1.25 Quality control and information flow should be managed via the same database as that used for the maintenance of progress records.

1.1.26 The dynamic management of time necessarily includes the management of the consequences of delays to progress caused by of all types of events, referred to as 'intervening events' in the Guide.

1.1.27 Activities representing the intervening events are to be inserted into the relevant schedule and the likely consequences of the event calculated. This assessment should be undertaken as soon as the intervening event is identified, with adjustments made as the situation unfolds. Where practical, mitigation should be planned, agreed and included in the schedule.

1.1.28 The Guide contains no guidance for the approximation of a 'fair and reasonable' extension of time or compensation for delay-related costs that might be incurred.

1.1.29 The time management strategy is to be set down in writing in a regularly updated method statement, which is to deal with, amongst other things, the stated strategy and assumptions adopted for:

- project planning
- risk management
- schedule preparation
- schedule review and revision
- progress update
- record keeping
- quality control
- communications.

1.2 The dynamic time model

1.2.1 Production and use of the DTM differs significantly from the traditional method of programming or scheduling. The following list outlines some of the differences.

	Traditional programme or schedule	The dynamic time model
Design risk management	A critical path network schedule is not used to manage the design process and, as a consequence, the design programme or schedule often has faulty or incomplete logic, if any at all. As a result, it is not possible to use the design programme or schedule to manage change, predict consequences or manage risk during the design process.	The time management process commences with the development schedule constructed as a DTM. The development schedule must be a high quality, fully networked schedule of the design and other preconstruction processes, that can be used to predict consequences and manage change during the design and pre-contract services, and which subsequently may be used to inform, in whole or in part, the contractor's working schedule.
Construction risk management	The programme or schedule used by most contractors to manage their work is not required to be a high quality critical path network and, as a consequence, those produced often have faulty or incomplete logic, if any at all. As a result, it has not been possible to use the contractually required programme or schedule to manage change, predict consequences or manage risk during the construction process.	The DTM must be a high quality, fully networked schedule that can be used to predict consequences and to manage change.
Transparency and communication	The contractually required programme or schedule is not always the product of database-driven scheduling software and is generally issued on paper or PDF, without the employer and its consultants having access to the assumptions, data or calculations used to produce it.	The DTM is required to be the product of database-driven scheduling software with a planning method statement identifying the assumptions and calculations in it, and to which full electronic access may be given to all stakeholders and its consultants.
Programming or scheduling for incomplete design	The contractually required programme or schedule describes the whole of the works at a uniform density often in thousands of lines of data. Typically, a high level of detail is required by most construction and engineering contracts, either without provision for (or forbidding) revision without approval.	Work that has not yet been designed cannot be programmed or scheduled in anything other than outline. Accordingly, the DTM comprises activities in different densities, the detail of which depends upon the degree to which the design, resources and productivity can be ascertained. The DTM is then to be revised on a 'rolling wave' basis as more detailed information becomes available

	Traditional programme or schedule	The dynamic time model
Transparency of the short-term look-ahead	The contractually required programme or schedule is not used by the contractor for the purposes of managing the work on site. The contractually required programme or schedule is not always produced before the work has started, changes to it are discouraged and it is used, primarily, in disputes with the client. The contractor may produce an overall programme or schedule for compliance with the contract, but detailed programming or scheduling of the work on site, if done at all, tends to be by use of a separate short-term look-ahead, which is not embedded in the contractually required programme or schedule, is not produced in the same software and access to it is not available to the employer and/or its consultants.	The DTM starts in the design process and continues, through construction to completion. It incorporates a transparent short-term look-ahead in the High Density part of the working schedule for managing the work on site, in which the activities are calculated by reference to the planned resources and productivity, and to which the employer and its consultants may have electronic access.
Integrity of the short-term look-ahead	The contractor's short-term look-ahead is not constructed as a network, is not resource loaded, does not contain any productivity data, and the activity durations are estimated against unspecified data.	The High Density part of the DTM must be resource loaded and the activity durations must be calculated by reference to the resources planned to be applied and the productivity they can be expected to achieve.
Revision of the programme or schedule	The contractually required programme or schedule is not required to be revised, and on major projects, it tends to quickly become out of date and fall into disuse.	The DTM requires that the critical path network be regularly revised to take into consideration the latest available information, on a 'rolling wave' basis, to keep it up to date.
Recording progress of work	Progress achieved is either estimated subjectively, gauged against the performance to intermittent milestones, or calculated by reference to the value of the work estimated to be fit for payment.	The DTM (which has a fully resourced network for the work to be carried out in the short term) requires, as its progress records, databased details of the resources actually used, the quantity of work actually performed and the time period of the record.
Updating the programme or schedule with progress achieved	If progress is marked up on the programme or schedule at all, it is often marked up on a 'jagged line' principle that does not identify the effect of progress achieved on future work.	The DTM requires that the critical path of the updated schedule is recalculated to identify the effect of progress achieved on the key dates, sectional completion dates and the completion date, and to identify any corrective sequence that must be followed.