Essentials of Construction Planning and Scheduling

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About the author

Graham Robertson BEng, CEng, MICE has over 40 years' experience in the construction industry.

He started as a sponsored trainee with George Wimpey Major Projects, studying civil engineering, and worked his way up through the ranks to the level of project manager, working on projects across the UK with Wimpey. Graham decided to specialise in planning and project controls; this provided opportunities to work all over the UK and overseas, in France and Canada. In 1993, he moved to Germany to help set up a business for Wimpey.

Returning to the UK in 1996, Graham joined Bovis Lend Lease as Technical Manager in Scotland. While in Scotland, he worked on some very prestigious projects, including the Museum of Scotland, Braehead, Overgate Dundee, Robert Gordon University, BBC Scotland at Pacific Quay and the Scottish Parliament. In 2005, Graham moved to the role of UK Head of Planning for Bovis Lend Lease, setting the planning strategy for the business and carrying out detailed project reviews, both at early feasibility stage and during construction across the UK business.

In 2007, he established his own construction planning consultancy, Plan Delivery Ltd, focusing on strategic and master planning from concept to delivery, as well as developing individual projects or multi-project programmes, planning and reviewing projects at a strategic or detailed level to advise clients on project delivery outcomes. Plan Delivery also regularly conducts audits and reviews of projects at all stages from feasibility to handover to identify areas of concern. Graham often provides support to major infrastructure projects to assist in successful delivery.

Graham develops and presents planning training courses to a wide variety of companies across the UK; from large main contractors to small subcontractors, consultants and industry bodies. He is also a guest lecturer at Glasgow Caledonian University, covering all aspects of planning projects from preconstruction through to commissioning and handover. Moreover, he has enjoyed several years volunteering as a STEM ambassador, encouraging young people into a career in civil engineering.

Graham also works as a planning expert witness for construction-related disputes over, for example, roads, bridges, wind farms, buildings and process facilities, with a particular focus on the planning aspects of the NEC suite of contracts. He has expert witness accreditation and extensive experience of undertaking detailed delay analysis reviews and presenting his findings at mediation and adjudication.

Glossary and abbreviations

4D video	3D presentation linked to the fourth dimension of time to demonstrate the 3D model building in time
Acceleration	The process of speeding up the work of a contractor so that a particular activity, or the project as a whole, can be completed before the date required under the contract
Accepted programme	Within the NEC Engineering and Construction Contract (ECC), the contractor prepares a programme for the works, which is then submitted to the project manager for approval; once approved, it becomes the 'accepted programme'
Activity	A singular task required to be completed as part of the overall programme of work
Activity coding	This is used by certain types of programming software to group similar activities, provide colour coding for programmes or filter activities to smaller programmes
Activity day count	The number of activities that are planned to happen on a particular day during the project duration; they are often added to show weekly and cumulative graphs of planned against actual activity day count
Activity management	The proactive management of how activities are added and deleted from the database of a piece of programme software
As-built programme	The record of the history of the construction project in the form of a programme; the <i>as-built programme</i> does not necessarily have any logic links; it can be merely a bar chart of the start and end dates of every activity that actually took place
Bar chart or Gantt chart	This is used in the representation of a project; the activities are represented by horizontal segments, of which the length is proportional to the time necessary to conclude the task in question
Baseline programme	The direct copy of the original planned tasks with their associated planned start and finish dates; it is used to compare progress to date against the original plan
Benchmarking	The process of comparing what has actually been achieved for a task, set of tasks or whole building against the current plan or forecast
BMS	Building management system

Change management	The process adopted by the project team to manage change to the works information and to record its effects on project delivery, for both budget and time
Commissioning programme	The programme developed to manage the ME&P testing and commissioning process for the various systems and their final integration
Constraints	Things that stop or hinder the process of the works; in programme software, a constraint holds an activity in time over and above the logical linkage to or from that activity
Contract programme	This is submitted by the main contractor at the commencement of the project; it is the common platform against which project progress is monitored and the extent and cause of delay (and any related extension of time entitlement) is assessed
CPM	Critical path method
Critical path	The longest sequence of activities in a programme that must be completed on time for the project to complete on the due date; if an activity on the critical path is delayed for a day, the entire project will be delayed for a day unless the following activities on the critical path are completed a day earlier
Cycle times	These are commonly used to measure the time it takes to manufacture or produce one unit of output of construction; for example, the time it takes to lift a piece of steel from the offload area to the workface and return it to the offload area
Dashboard reporting	A process used to represent key performance indicators and relevant business data in a visual, interactive way
Data date	The date being used by the programme software as the current programme or schedule status; for initial programmes or schedules, this is the project commencement date
Delay analysis	Delay analysis identifies why delays occur in a construction project and the impact they are expected to have on the overall programme; the outcome of the analysis may lead to legal action brought by one party to the contract
Delivery programme	An integrated programme that the site team use to deliver the project under a traditional contract; the contract

	programme should form the basis of the delivery programme, with the delivery programme taking the overall project philosophy and breaking the work down into greater detail, but following the same sequence
Detailed progress analysis	This is a vital stage; it is the detailed review of the forecast impact that progress to date has on the remaining activities in the programme: if the reason for the delay is an anomaly in the original logic, this can be rectified; if it is a delay caused by any other reason, such as client approval, design release, material fabrication or subcontractor performance, this should be assessed and reported to the party or parties involved
Disruption	Loss of productivity, disturbance or interruption to progress; loss of working rhythm; stacking of trades in a working area causing congestion or out-of-sequence working
Driving logic	The logic linking to an activity that drives where the activity sits in time
Duration	The estimated time to carry out an activity based on the quantity of work involved and the resources assigned to carry out the work
Early dates	The earliest start and finish dates that the activities can begin or be completed, as calculated by the forward pass through the logic within the programme or schedule (see also late dates)
Early warnings	Under the NEC contracts, the contractor or project manager is obliged to give an early warning of any matter that might increase prices, delay completion, delay meeting a key date or impair the performance of the works in use
Earned value	A project management technique for measuring project performance and progress; it has the ability to combine measurements of the project management triangle – scope, time and costs – and compares planned value against earned value
Earthworks	The work involved with excavating, moving and compacting soils from one area to another; it is necessary to review the machinery required and the process to carry out the works

Ecology	A branch of biology concerning interactions between organisms and their biophysical environment; in construction terms, it is understanding and managing the impact that construction has on the natural world around us
Efficiency	Efficiency is associated with the production output of an activity when estimating its duration; the output is typically an average and the efficiency is the percentage increase or decrease from the average associated with the risk of the particular task
Extension of time (EoT)	A provision in most standard forms of contract for an amendment of the scheduled practical completion date due to unforeseen circumstances; it is usually requested by the main contractor
Filter	The opportunity in programming or scheduling software to separate out activities with similar traits, such as area, resource, trade or timescale
Finish milestone	Milestones in a programme or schedule that are the logical end to either a string of work or the overall completion of the works
First 100 day programme	This identifies the tasks that are planned to take place during the first 100 days after award of the contract
Forecast	Having input the progress to date in the current programme, you then forecast the effect that that progress has on the remaining elements of the programme; this rescheduled version of the programme shows what would happen to the remaining activities based on the current logic and progress
Forward plan	A schedule used to monitor the progress of off-site steps for an activity leading to its installation on site
Free float	The amount of time that an activity in a programme or schedule can be delayed before it delays another activity
Group and sort	Functionalities in programming or scheduling software that allows the user to bring activities together that are associated with one another; for example, activities can be grouped by area or sorted by early start date
Handover programme	This displays the activities that are required at the end of the project; for example, snagging the installation to ensure

	compliance with specifications and handing over paperwork, such as operation and maintenance manuals and as-built drawings
Histogram	A graphical display of resources against a timescale to show the amount of resources required at any given time on the project
Hoist analysis	The estimate of the number, size and speed required for hoists to transport labour and materials vertically during the project build phase
Hook time analysis	The estimate of the type, size, speed and location of crange required in a project to vertically move materials to the workface throughout the build phase
HS&E Integrated programme	Health, safety and environment This covers every stage of the project, covering design, procurement, construction, commissioning and handover
Jagged line	A technique used by some types of programming or scheduling software to demonstrate the progress to date against the planned activities; significantly, it does not forecast the effect that the progress to date has on the remaining works
Key date	A date by which a certain condition must be fulfilled, as defined in the contract data
Key performance indicators (KPIs)	A set of quantifiable measurements used to gauge a project's overall performance; specifically, KPIs help determine a project's operational achievements, compared with the original plan
Lag	The time gap or delay between one task ending and its successor starting; for example, a lag may be introduced after a concreting task to allow for concrete curing
Late dates	The latest start and finish dates that the activities can begin or complete, as calculated by the backward pass through the logic within the programme or schedule; the late dates are the latest dates the activity can be completed in time without affecting the overall end date of the project
Line of balance (LOB)	A way of adding location to a project of a repetitive nature, such as high-rise buildings, housing, pipelines, tunnels or railways; an LOB diagram shows the repetitive project work as a single line on a graph

Logic link	This describes the relationship between one activity and another; common types of logic link include: finish-to-start, start-to-start and finish-to-finish
Logistics plan	This demonstrates the logistics required to ensure free-flowing construction, with labour, machinery and deliveries planned to be in the right place at the right time
Mass haul diagram	A graphical view of the earthworks material to be moved, with rising sections showing where excavation exceeds fill and falling sections where fill exceeds excavation
ME&P	Mechanical, electrical and plumbing
ME&P module	A prefabricated horizontal ME&P service run built in a factory; for example, the module may contain electrical containment, ducting and pipework
ME&P riser	A shaft where the ME&P services traverse vertically in a building
Medium-term programme	Medium-term programmes are developed by the site team and cover a period of typically 6–12 weeks of work; they refer back to the contract or delivery programme but are the site team's more detailed breakdown of the works
MEWP	Mobile elevating work platform
Milestone	A zero-day duration task that identifies particular achievement goals at a point in time: some milestones will be contractual; others may be set by the team to provide success steps through the project
Mitigation	To <i>mitigate</i> is to make less severe or serious: this can be important in the construction industry in a number of different circumstances; in relation to project delays, it refers to minimising the impact of a risk event (an event or cause of delay or disruption)
Network analysis	The general name given to certain specific techniques that can be used for the planning, management and control of projects; one example is the critical path method (CPM), which relies on activities with durations linked together by logic links to calculate the overall duration of a project
O&M	Operation and maintenance
Output	A historically measured production output for a particular work task; usually measured as units per day or per hour

Output curve	A graphical presentation of daily or weekly output against time, accompanied with a cumulative output curve to highlight the planned output required to meet the programme
Phase diagram	This uses the data from the contract or delivery programme to show what construction tasks are being undertaken and where across the project over a particular timescale; weekly, monthly or quarterly
Planned completion	The completion milestone that is forecast by the remaining durations and logic links of the programme or schedule activities
Planning	The dictionary definition of <i>planning</i> is ‘a detailed formulation of a series of actions to achieve an end’; planning is logical thought as to how to deliver a project
Planning thoughts document	A document for the planner to simply record key decisions made in developing the plan for the project; the document should be in bullet-point style, with simple clear definitions of the planner’s approach
Plantroom	The location of the main system ME&P plant, such as boilers, air handling units or switchgear
Predecessor	An activity that begins or completes prior to the succeeding activity starting or finishing
Programme	A Gantt chart presentation of the plan
Programme engine	The hierarchy of the various programmes used to work together to assist in successfully delivering a construction project
Programme management	The process that the planner undertakes to manage the electronic programmes; it covers many facets, including programme numbering, programme storage, activity numbering, activity deletion and addition
Programme of work	Series of building projects contracted separately within a framework with the same client
Project control	A process to continuously monitor, forecast and track cost and programme performance against baseline values; the output is often a dashboard including KPI graphs to highlight performance trends
Quantity	The measured amount of work required for a task in the project
Relationships	Logic links between activities within the programme or schedule

Remaining duration	If an activity has progressed during the period, the remaining duration is the period of time required to complete the task
Repetitive tables	A way to demonstrate planned against actual progress for repetitive tasks, such as apartment fit-out steps on floors of a multistorey building
Resources	The assets required to design, install or construct something; for example, labour, plant or materials
RFI	Request for information
Schedule (programme)	A document that shows the chronological sequence of the activities to be completed throughout the whole building process
Sequence diagram	A set of drawings showing the construction of an area of the building, as it progresses over time
Short-term weekly workplan	Typically, a 2–3 week rolling programme, produced by the site team to manage day-to-day production on site
Statutory undertaker	A legal term used to describe those organisations and agencies that have certain legal rights and obligations when carrying out particular development and infrastructure work; typically, they are utilities and telecoms companies
Subcontract planned intent	The programme issued by the main contractor to the bidding subcontractors
Subcontract planned programme	The programme returned by the subcontractor with the bid
Successor	An activity that does not begin or complete prior to the previous activity
Summary programme	This summarises the detailed activity level information (start, finish, duration) as overriding summary tasks; for example, 20 detailed activities for basement construction can be summarised as one basement activity
Take-off	The detailed measurement of quantities by task for the works required under the contract
Task	An activity; an individual work element
Tender handover meeting	This is where the tender team formally hands over the information gathered and worked on during the tendering process to the project team
Tender submission programme	The programme developed at the beginning of the tendering process that lays down the tasks and their timing to complete the tender submission

Time-chainage drawing	A method of graphically presenting a time schedule (programme) for all types of longitudinal projects, such as pipeline, rail, bridge, tunnel, road or transmission line construction; one axis is time and the other is distance
Time-related risk register	This focuses on the risks in a project that have a potential time impact on the project schedule
Time risk allowance	This is attached to the duration of an activity or the duration of a part of the works; these allowances are owned by the contractor as part of realistic planning to cover risks
Total float	The amount of time that an activity can be delayed without affecting the overall project duration; floats are calculated using the critical path method, with forward and backward passes
Total float usage	A technique used to monitor the percentage of programme activities within bands of total float within the programme; the trend of total float eroded within the programme over time is measured
TRA	Time risk allowance
Windows analysis	A forensic technique that involves interim assessment of delays on updated schedules at specific intervals or 'windows'; in applying this methodology, the overall performance period being analysed is partitioned using available contemporaneous progress updates
Work breakdown structure (WBS)	A methodical way of breaking a project down into smaller components
Working hours	The time that work is allowed to take place on a project under the contract conditions