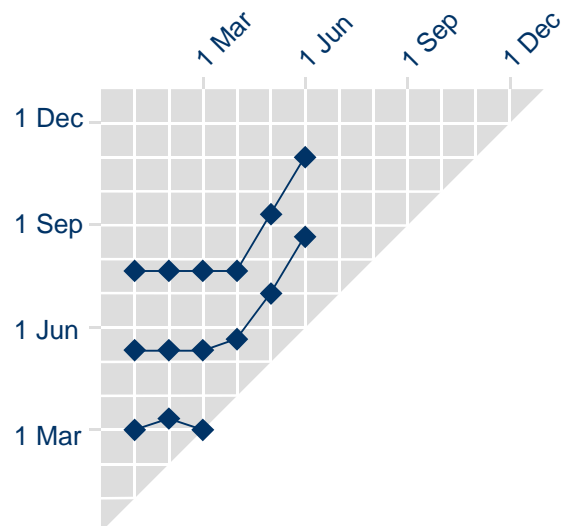
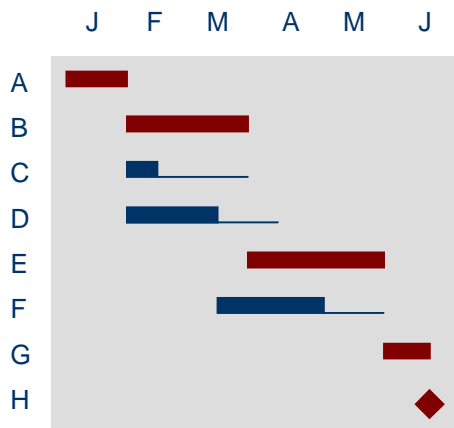
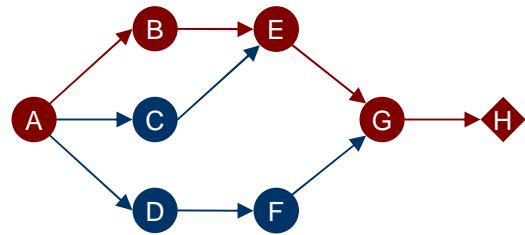
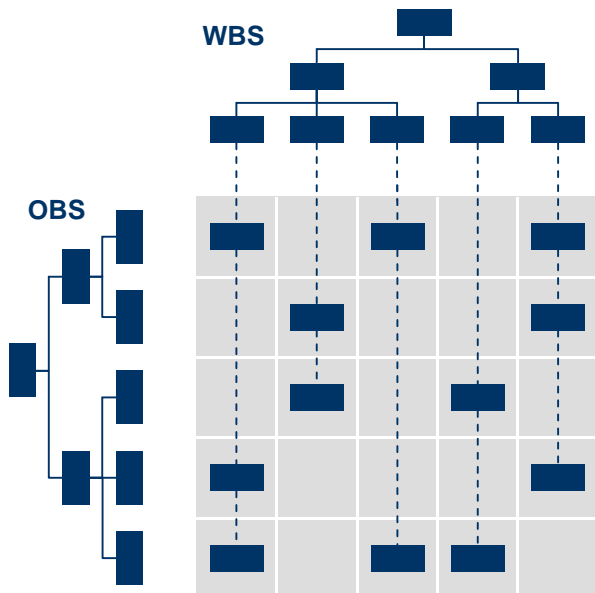


Project Planning and Control



PROCESS GUIDE



What is a project plan?

- A project plan is a model of the process that the project team intends to follow to realise the project objectives. It brings together a number of important aspects of this process including its scope, timing, cost, and associated risks.
- The project plan can be viewed as a type of “contract” between the project team members and other stakeholders. It defines the process by which the objectives will be achieved, and the responsibilities in carrying out this process.
- Project plans also underpin a number of other key project management functions including estimating and forecasting, options analysis and decision-making, and performance monitoring and control.

Who is responsible for planning?

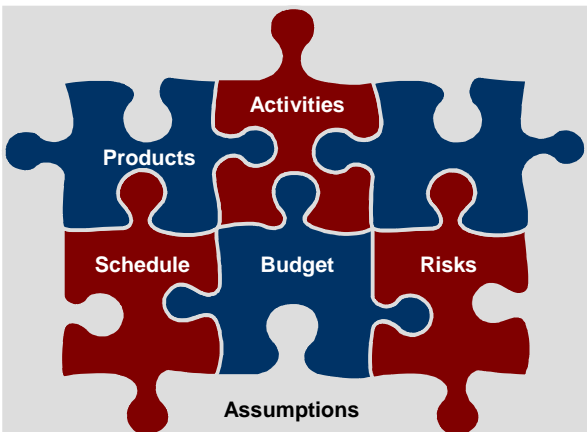
- Everyone in the project team should be involved in developing the plan. It should be a collaborative effort.
- The project manager should provide leadership in this area but may delegate some of the administrative aspects and detailed analysis to a project support role.
- On larger projects there may be one or more dedicated planners.

What are the benefits of planning?

- It is more likely to lead to success and is more cost-effective than a “just do it” approach.
- It develops greater mutual understanding and more commitment to achieving the objectives within the project team.
- It provides an “early warning system” so that problems are identified while there is still time to do something about them.

Key elements of a plan

Key elements of a plan – it’s not just a Gantt chart



Key elements of a plan are:

- Products – What products must the project deliver? What are the quality requirements associated with the products?
- Activities – What activities are needed to deliver the products?
- Resources – What resources are needed to carry out the activities?
- Schedule – In what sequence should we carry out the activities? How long will the activities take to complete? Are the required resources available? How long will the project take overall?
- Budget – What are the time-phased resource requirements and financial costs? How much will the project cost overall?
- Risks – Are we taking unnecessary risks? Is the level of risk exposure commensurate with the risk appetite? Are there any opportunities that could be exploited?
- Assumptions – What are the underlying assumptions associated with the plan?

The planning process

What is the process for developing a plan?

There are four key stages in developing a robust plan:

1. Identify, structure and define the products needed to achieve the project objectives. Break down the work needed to deliver the products into discrete work packages. Define the responsibilities of the individuals or teams who will deliver the work packages.
2. Identify the activities and resources needed to deliver the work packages. Construct a schedule that takes account of the logical dependencies between activities, and the availability of resources.
3. Estimate the quantity of resources and financial costs associated with each work package, and use this information in conjunction with the schedule to develop time-phased budgets.
4. Identify and analyse the risks associated with each work package and evaluate a range of options for handling them. Select the most cost-effective combination of risk management actions and incorporate them into the plan.

Stage 1

Defining scope & responsibilities

Stage 2

Scheduling & time/resource analysis

Stage 3

Cost estimating & budgeting

Stage 4

Risk analysis & response planning

Stage 1 – Defining scope and responsibilities

v 1.2

Objectives

- To ensure that all the work and products needed to achieve the project objectives are included in the plan.
- To develop a hierarchical framework for integrating the key planning and control functions (scope, quality, cost, time, risk) at different levels of management.
- To specify the organisation and responsibilities for managing the work and delivering the products.

Fundamental principles

- Break down the project work into cohesive work packages, using the WBS as an integrating framework.
- Define the required results (i.e., the products) before considering how to achieve them.
- Encourage collaborative planning and commitment to achieving results by negotiating and agreeing responsibilities at an early stage.

Process description

- 1.1 Identify and structure the products needed to achieve the project objectives using a Product Breakdown Structure (PBS). Define the products and specify their purpose, quality requirements and acceptance criteria, using Product Descriptions (PD).
- 1.2 Break down the work needed to deliver the products into discrete work packages using a Work Breakdown Structure (WBS). Define the work packages and specify their products, quality requirements, acceptance criteria, assumptions, risks, and opportunities, using Work Package Descriptions (WPD).
- 1.3 Specify the organisation that will carry out and manage the work contained in the WBS, using an Organisational Breakdown Structure (OBS). Define the responsibilities of individuals or teams in the OBS (with respect to elements of the WBS) using a Responsibility Assignment Matrix (RAM).

Step 1.1

Define & analyse products

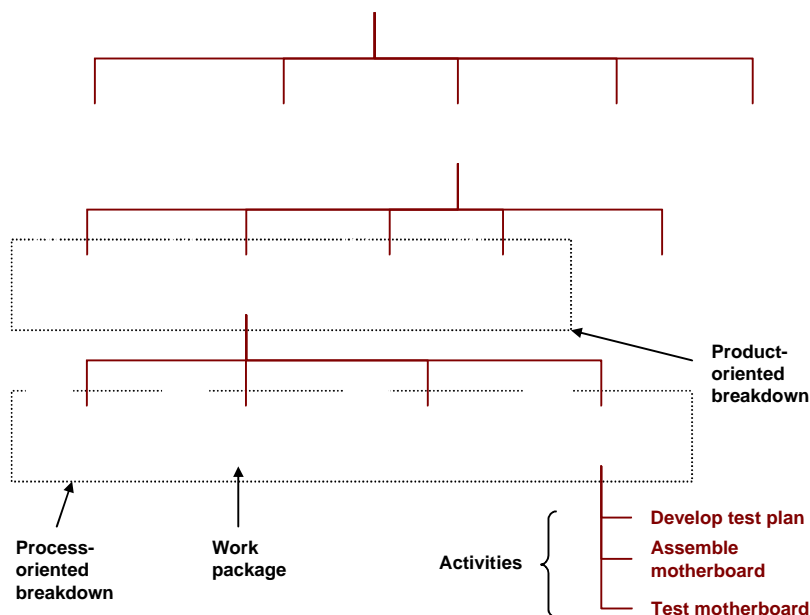
Step 1.2

Develop work breakdown structure

Step 1.3

Specify organisation & responsibilities

Work breakdown structure



Primary outputs

- Product Breakdown Structure (PBS)
- Product Descriptions (PD)
- Work Breakdown Structure (WBS)
- Work Package Descriptions (WPD)
- Organisational Breakdown Structure (OBS)
- Responsibility Assignment Matrix (RAM)
- Assumptions

Supplementary outputs

- Product Flow Diagram (PFD)
- Work Flow Diagram (WFD)
- WBS Dictionary
- Control Accounts (CA)
- Dependency Structure Matrix (DSM)

Key criteria

- Does the PBS include all of the products needed to achieve the objectives?
- Does the WBS include all of the work needed to deliver the products in the PBS?
- Has the PBS/WBS been broken down in sufficient detail?
- Has an appropriate PBS/WBS coding scheme been defined?
- Have all the products and work packages been defined?
- Have the organisation and responsibilities been agreed?

Hints and tips

- Sometimes the structure of the PBS is embedded in the WBS by breaking down the work along product lines and labelling elements of the WBS with their products rather than a description of the work. This type of WBS is often referred to as a "product-oriented" WBS.
- Using Post-It Notes in a workshop environment can be an effective way of developing a PBS and WBS.
- Investigate alternative ways of breaking down the products and work rather than just choosing the first one that comes to mind.

Objectives

- To identify the activities needed to deliver each work package, and sequence them according to their logical dependencies.
- To estimate the time and resources needed to carry out the activities in the specified sequence.
- To construct a schedule that takes account of logical dependencies and resource availability.

Fundamental principles

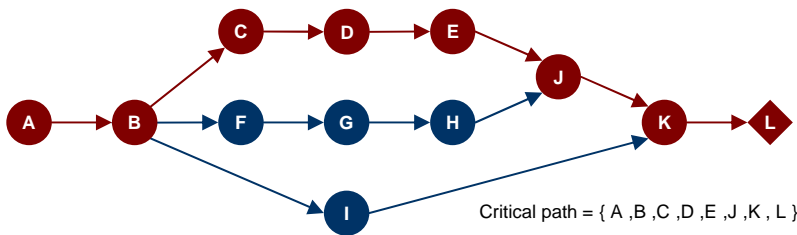
- The time and resources needed to complete each activity usually depend on the sequence in which the activities are carried out.
- Since the time and resources needed to complete an activity are usually interdependent, it makes sense to estimate both of these at the same time.
- Scheduling must take account of resource availability.

Process description

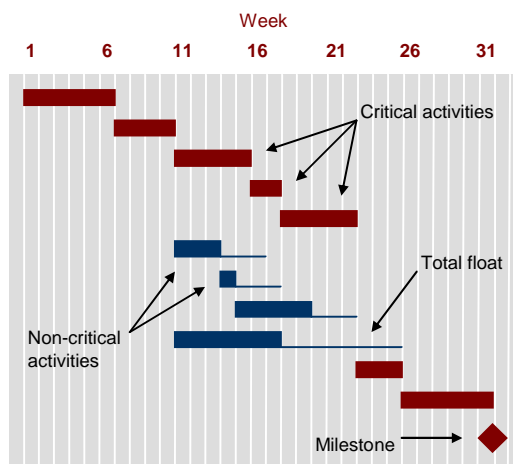
- Identify the activities needed to deliver each work package. Also identify any key events (milestones) associated with the delivery of products, important decisions, or external dependencies. Sequence the activities and milestones according to their logical dependencies, to create an activity network.
- Estimate the time and resources needed to complete each activity and record the underlying assumptions as a Basis of Estimate (BoE).
- Develop an initial schedule that takes account of the logical dependencies between activities. Calculate the Total Float for each activity and identify the Critical Path(s). If the initial schedule does not meet the required timescales then investigate alternative schedules or consider making tradeoffs. Analyse the time-phased resource requirements and, if necessary, adjust the schedule to take account of resource availability or to improve resource utilisation.

- Step 2.1** Identify activities & dependencies
- Step 2.2** Estimate time & resources
- Step 2.3** Develop & analyse schedule

Activity network and schedule



- A: Design PCB layout**
- B: Simulate & tune layout**
- C: Manufacture PCB**
- D: Fix sockets & connectors**
- E: Test PCB**
- F: Select component supplier**
- G: Place order for components**
- H: Await component delivery**
- I : Develop test plan**
- J: Assemble motherboard**
- K: Test motherboard**
- L: Motherboard complete**



Primary outputs

- Activity network
- Time/resource estimates
- Time/resource analysis
- Activity schedule
- Assumptions

Supplementary outputs

- Milestone schedule
- Range/three-point estimates
- Probabilistic schedule analysis
- Critical Chain schedule
- Resource schedules/profiles

Key criteria

- Have all the activities needed to deliver the work packages been identified?
- Have all logical dependencies (including external dependencies) been identified?
- Has a Basis of Estimate been recorded for each estimate?
- Have the critical path(s) and near-critical activities been identified?
- Does the schedule take account of resource availability?
- Have resources with long lead times been identified?

Hints and tips

- Use range estimates or three-point estimates to identify areas of ambiguity or uncertainty.
- Where possible, estimates should be developed by the people who will be carrying out the work, in consultation with the project manager or work package manager.
- Don't try and analyse the time-phased resource requirements for every single resource: it is normally fairly clear, in advance, which resources are likely to constrain the schedule.

Objectives

- To develop a hierarchical framework for planning and controlling resource consumption and financial costs.
- To estimate the quantities and financial costs of the resources needed to deliver each work package.
- To develop time-phased budgets as a basis for performance monitoring and control.

Fundamental principles

- Since budgets are normally constrained, we need to monitor actual costs against planned costs on a regular basis to ensure that timely corrective action can be taken if there is a significant variance.
- Making good progress against the schedule is often not enough to guarantee success. It is also important to monitor the planned and actual resource consumption (or financial costs) in relation to the progress made.

Process description

- 3.1 Develop a Cost Breakdown Structure (CBS) to hierarchically decompose the project resources and their financial costs into components that can be estimated for each work package and subsequently aggregated up the various breakdown structures. For each of the lowest level elements in the CBS, define any rates needed to convert from native resource quantities (e.g., units or unit-hours) to financial costs.
- 3.2 Estimate the quantities (e.g., in units or unit-hours) and financial costs of the resources needed to deliver each work package, and aggregate these estimates up the various breakdown structures. Record the underlying assumptions as a Basis of Estimate (BoE).
- 3.3 By associating resource and cost estimates with elements of the schedule, develop time-phased budgets (periodic and cumulative) for the work packages and other key control points (e.g., Control Accounts) on the various breakdown structures.

Step 3.1

Develop cost breakdown structure

Step 3.2

Estimate costs

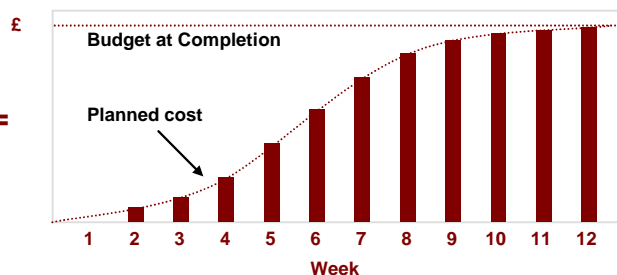
Step 3.3

Create time-phased budgets

Cost breakdown and (cumulative) time-phased budget

Activity /
Work
Package

+ schedule =



Primary outputs

- Cost Breakdown Structure (CBS)
- Resource/cost estimates
- Time-phased budgets
- Assumptions

Supplementary outputs

- Range/three-point estimates
- Probabilistic cost analysis
- Cash flow forecasts

Key criteria

- Have all the resources needed to deliver the work packages been mapped onto the CBS?
- Does the CBS include discrete elements for the constrained components of the budget?
- Does the CBS include discrete elements and their attributes for key performance indicators (e.g., the total human resource requirement, measured in man-hours)?
- Has a Basis of Estimate been recorded for each estimate?

Hints and tips

- Use range estimates or three-point estimates to identify areas of ambiguity or uncertainty.
- Not all project managers are responsible for a financial budget. However, they still need to monitor resource consumption to provide early warning of problems.
- Whatever structure is used to create the budgets, it must be applied consistently against each work package.
- You may not need to create a new CBS for each project. Some organisations use standardised forms of CBS for particular types of project.

Stage 4 – Risk analysis and response planning

v 1.2

Objectives

- To identify the risks associated with each work package.
- To determine the overall risk exposure and the contribution of individual risks.
- To prioritise risks for further management.
- To develop cost-effective risk management actions (responses) and incorporate them into the plan.

Fundamental principles

- Once the plan has been developed it should still be considered a draft until its risk content has been analysed. This analysis may lead to the plan being modified to include risk management actions.
- Plans should be risk-efficient (i.e., should include no more risk than is necessary to provide a given level of "return"), and the risk exposure should be commensurate with the risk appetite.

Process description

- 4.1 Identify the risks associated with each work package, and any dependencies between risks. Also identify the causes of each risk, and the effects (consequences) if it should occur.
- 4.2 Evaluate the risks in terms of: their probability of occurrence; impact on the schedule, budget and scope (i.e., in terms of time, cost and performance); proximity in time; and the ease with which they can be detected before the impact is realised. Prioritise the risks for further management according to the values of these attributes. Agree who will be responsible for managing each risk.
- 4.3 Identify and evaluate a range of options for handling the risks. These actions will typically fall under a number of generic response strategies (e.g., ignore, avoid, accept, transfer, include as assumption, mitigate, develop contingency plan). Select the most cost-effective combination of risk management actions and incorporate them into the plan.

Step 4.1

Identify risks

Step 4.2

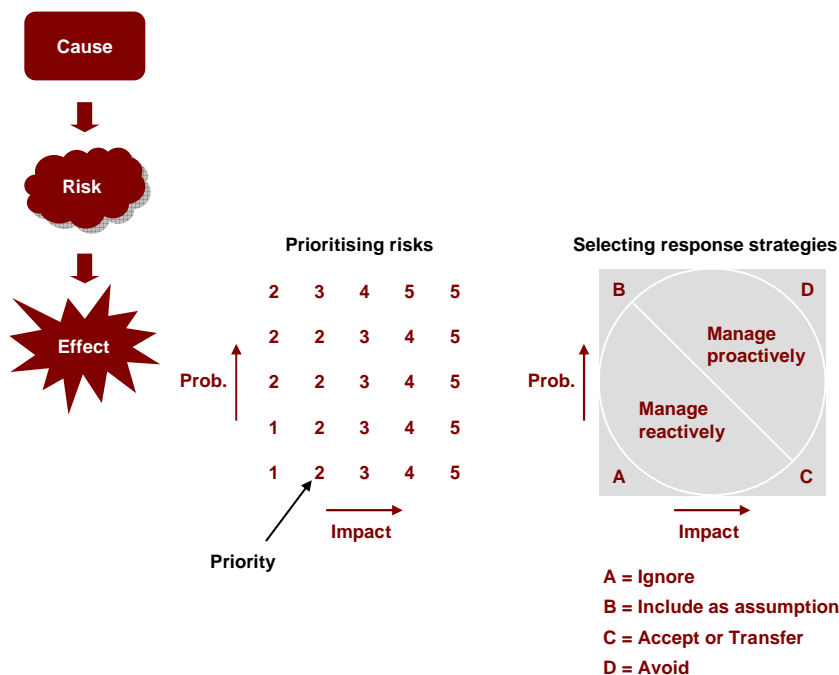
Analyse & prioritise risks

Step 4.3

Plan risk management actions

Risk analysis and response planning

Describing and analysing risks



Primary outputs

- Risk descriptions/models
- Qualitative/quantitative risk analysis
- Risk management actions
- Cost-benefit analysis
- Assumptions

Supplementary outputs

- Probability-Impact Diagrams
- Probabilistic schedule/cost risk analysis
- Sensitivity analysis
- Decision trees
- Influence diagrams

Key criteria

- Have all the assumptions made during planning been reviewed for potential risks?
- Are the causes and effects of each risk understood?
- Is the plan risk-efficient?
- Is the risk exposure commensurate with the appetite?
- Have risk owners been specified?
- Have all mitigation activities been included and budgeted for in the plan?
- Have budgets been set aside for contingency plans and dealing with emergent risks?

Hints and tips

- Assumptions made during planning are an important source of risk information (e.g., assumptions made about external dependencies or interfaces, or the availability and performance of resources).
- Remember that most risk management actions do not come for free, but usually incur some form of time and cost penalty. Don't forget to include them in the plan.
- Since it is not usually feasible to identify every possible risk during the planning process, it is important to keep a look out for emergent risks during the project control cycle, and target analysis and responses accordingly.

Objectives

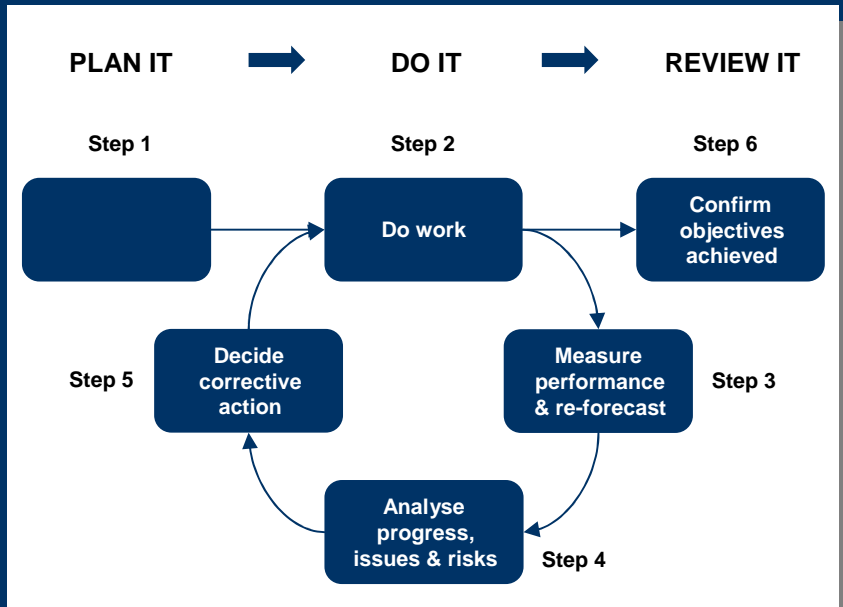
- To inform decision-making processes at all levels in the project organisation, and to take any corrective action needed to ensure that objectives are achieved.
- To identify problems and emergent risks early enough while there is still time to do something about them.
- To communicate regular progress to the project team and other stakeholders in order that confidence and commitment towards the project is maintained.

Fundamental principles

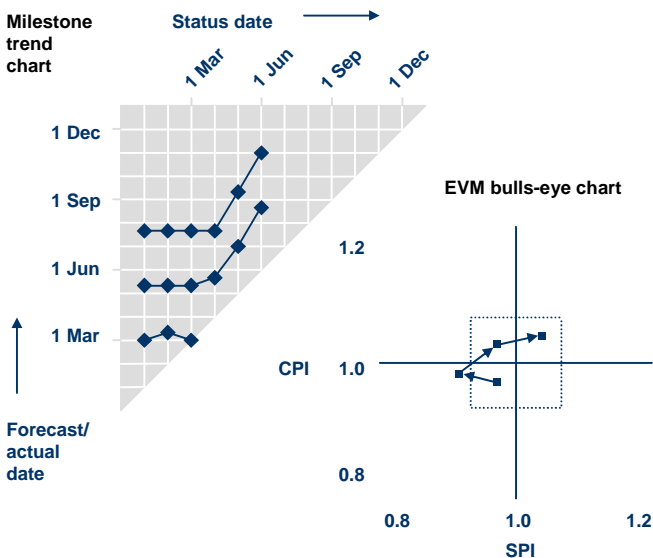
- Apply the principles of closed-loop control to monitor performance against the plan at regular intervals, and take any corrective action needed to achieve the objectives.
- Monitor trends in performance over a period of time as well as the "spot" performance with respect to a baseline. This allows us to distinguish between assignable and common causes of variation.

Project control cycle

- Identify the objectives and constraints, and develop a plan. Review and baseline the plan. Obtain authorisation to proceed.
- Do some work.
- Measure performance and update the original estimates and forecasts. Update the schedule and budget forecasts to take account of the latest information.
- Investigate the causes of any significant variations with respect to the baseline. Review the associated risks and assumptions. If necessary, develop options for taking corrective action.
- Agree on any corrective action that is required and update the plans (via Change Control if the baseline is changed).
- Confirm that the objectives have been achieved and that the required products have been delivered. Obtain formal sign-off if appropriate.



Tools for visualizing performance trends



Performance monitoring techniques

- Schedule analysis – Monitor variations in the forecast schedule with respect to the baseline, as well as changes to the critical path(s) and remaining float of activities.
- Budget analysis – Monitor variations in the forecast budget with respect to the baseline.
- Milestone trend charts – Monitor the forecast dates and actual dates of key milestones as a function of time.
- Earned Value Management (EVM) – Monitor "earned value" and actual cost against planned value/cost (see Earned Value Project Management).
- Risk analysis – Monitor confidence values or probability distributions associated with key elements of the schedule or budget, as a function of time.
- Buffer management "fever charts" – Monitor the consumption of schedule and budget contingency buffers as a function of time (see Critical Chain Project Management).
- Burn-down charts – Monitor the work remaining as a function of time (assuming it is possible to quantify the work using an output-based metric).

Key criteria

- Have the plans been baselined?
- Is performance being monitored on a frequent enough basis so that corrective action can be taken in a timely and effective manner?
- Are output-based metrics being used to measure performance (i.e., what does "percent complete" mean in reality)?
- Are the schedule and budget forecasts updated to take account of progress and revised estimates?
- Are changes to the project scope subject to formal Change Control procedures?

Hints and tips

- The performance indicators associated with the schedule and budget are not the only ones you will usually need to track to ensure you meet the project success criteria.
- Don't forget to involve the project team in the monitoring and control process as well as the initial planning process.
- Remember that the purpose of control is not to hold meetings and talk about progress. The purpose is to monitor progress, to compare progress to the plan, and to take the necessary action to achieve the project's objectives.

Techniques for planning larger projects

- Staged planning – The project is split into a number of discrete stages. An outline plan is developed for the project as a whole, together with more detailed plans for each stage. The plans for each stage are usually developed towards the end of the preceding stage. This approach is a useful way of limiting risk exposure when there is uncertainty about the requirements, the work to be performed, the available resources, or the project environment.
- Hierarchical planning – Planning and control is carried out in a hierarchical fashion so that lower level plans and their associated control systems are nested within elements of the higher-level plans.
- Rolling Wave planning – Only the near-term work packages are planned in detail, while the far-term work packages (sometimes called Planning Packages) are planned in outline only.

Principles of effective planning and control

- Divide-and-conquer – Manage complexity by breaking down the various elements of the plan in a structured way. But don't forget to keep track of the dependencies between elements as you go.
- Integrated approach – Don't plan and control the various project functions in isolation (e.g., scope, quality, cost, time, risk), as they are all interdependent. Instead, adopt a more integrated approach by bringing them together at key control points on the WBS (e.g., work packages or control accounts).
- Keep it simple, systematically – Only add more detail to the plan where the cost of doing so and the increased complexity it brings with it is justified by the amount of information it provides.
- Team collaboration – Don't forget that the plan represents the team's vision for achieving the objectives. So make sure they are involved in its development and any subsequent changes during the monitoring and control process.

Terminology

- Activity – A task, operation, or process consuming time and possibly other resources.
- Baseline – A snapshot of a plan (or element of a plan) that is used as a point of reference.
- Budget – The agreed cost or quantification of resources needed to complete an activity by a set time.
- Critical Path – A sequence of activities through an activity network where each activity in the sequence has zero or negative total float.
- Duration – The estimated or actual time required to complete an activity.
- Milestone – A key event selected for its importance in the project.
- Product – The measurable output of an activity.
- Resource – Anything other than time that is necessary for carrying out an activity.

- Risk – An uncertainty that, if it occurs, could affect one or more project objectives.
- Schedule – A timetable showing when activities and milestones are planned to occur over a period of time.
- Scope – The work content and products of an activity (i.e., what is in and what is out).
- Total Float – The total amount of time that an activity can be delayed without delaying the project finish date, or violating a schedule constraint.
- Work Breakdown Structure – A hierarchical decomposition of the project scope (i.e., the project work and products) into work packages.
- Work Package – A discrete element of project scope at the lowest level of each branch of the work breakdown structure. Collectively, the work packages specify all of the work and products included in the project.

Recommended reading

- Advanced Project Management: A Structured Approach 4/e, F. Harrison, D. Lock, Gower Publishing, 2004.
- Critical Chain Project Management 2/e, L. Leach, Artech House, 2004.
- Earned Value Project Management 3/e, Q. Fleming, J. Koppelman, Project Management Institute, 2006.
- Effective Opportunity Management for Projects, D. Hillson, Marcel Dekker, 2003.
- Effective Work Breakdown Structures, G. Haugan, Management Concepts Inc., 2002.
- Managing Successful Projects with PRINCE2 5/e, Office of Government Commerce, TSO Books, 2005.
- Practical Project Management: Tips, Tactics and Tools, H. Levine, John Wiley & Sons, 2002.
- Practice Standard for Work Breakdown Structures 2/e, Project Management Institute, 2006.
- Project Management 8/e, D. Lock, Gower Publishing, 2003.
- Project Management and Project Planning 7/e, J. Gordon, K. Lockyer, FT Prentice Hall, 2005.
- Project Management: Planning and Control Techniques 4/e, R. Burke, John Wiley & Sons, 2003.
- Project Planning and Control 4/e, A. Lester, Elsevier Butterworth-Heinemann, 2003.
- The Handbook of Project-Based Management 2/e, R. Turner, McGraw-Hill, 1998.

