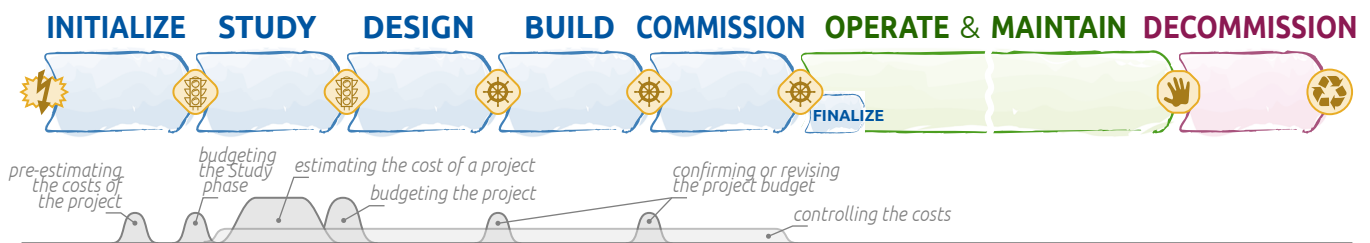


Costing the Project

Resource Estimating, Budgeting and Controlling

WHEN SHALL THE PROCESS(ES) BE IMPLEMENTED?



What it is about

Project cost management is a set of processes of crucial importance for an effective, responsible and pro-active control of any project. It comprises three processes:

- ▶ estimating the resources required to perform the project;
- ▶ budgeting the resources allocated to the project;
- ▶ controlling the resources that are spent as the project progresses.

Resource estimating is a process that can already be launched in the Initialize phase, because the foreseen Project Board members need such an information to decide to move into a Study phase or not. But most of this process is done in the Study phase itself.

Budgeting is a process that is performed over inter-phase decision points. It baselines the resources that will be preserved and provided to the Project Team to perform a phase or the remaining phases of the project. Budgets are set at the beginning of every phase, even if it is common to set the project budget for the Design, Build and Commission phases prior the launch of the Design phase. A budget can be allocated to the Study phase while the overall cost estimate of the project is not known.

Cost controlling is a continuous process that aims at comparing actuals to planned figures to verify that the project is not overrunning (nor underrunning) and to trigger whether resources shall be added, removed or reallocated to enhance the project value.

All project cost management processes are of prime importance because their outcomes are needed in most of the decision-making processes. Typically, they support many financial analyses.

Three approaches to implementing project cost management processes are proposed in the present brochure, corresponding to projects of different size and Project Teams of different project management maturity levels. For sake of effectiveness, the present brochure shall be read in conjunction with the document entitled *openSE Framework* (see [1]).

1 Simple approach

This simple approach is well suited to projects of a small size or to newcomers to project management.

1.1 Estimating the costs

Cost estimating is a process that aims at assessing the resources that are needed¹ to perform a project. The assessment is based on the information that is available at a given point of time. Necessarily, the accuracy of the estimates increases as the project moves from phase to phase.

A prerequisite to the estimating process is the setting up of a **Project Resource Currency** and of *exchange rates* in case estimates are obtained in various currencies. The Project Resource Currency can either be a monetary currency (e.g. EUR, GBP, USD, JPY, CHF, etc.) or a *workload currency* (person-hours, person-days, person-weeks, etc.) for those

¹In the spirit of systems engineering, 'needed' is preferred to 'required' because the latter also conveys the concept of commitment that is not necessarily part of the estimating process.

internal projects that only intend to spend manpower. It is common project management practice to display cost figures in a unique currency that is time-stamped: 10 kCHF of year 2000 are different from 10 kCHF of year 2010.

Costs to be considered are the quantification of all the resources deemed to be necessary to perform each of the project activities. In other words, these are all the resources *that will be charged* to the project if the decision to perform it is made.

Are included, but not limited to:

- ▶ human resources, whether they are internal to the organization (i.e. accounted in a *workload currency*) or involved with the project by means of commercial contracts (incl. temporary labour contracts) or collaboration agreements;
- ▶ materials and equipment (including information and communication technology means), services and facilities, work and storage spaces, energy and utilities, etc., procured through commercial orders and/or contracts, or provided as in-kind contributions by means of collaboration agreements.

Indirect costs, i.e., those costs that are likely to exist whether the project is performed or not, should not be considered in the cost estimate, as well as those costs that are difficult to quantify in one of the possible Project Resource Currencies. Provisions for price escalation or fluctuation due to causes such as inflation, foreign exchange rates, trends on the commodity market, oligopolistic business conditions, etc. should be considered, but be kept separated.

Inputs. The following documents are required to run this process:

- ▶ the Project Roadmap (see [2]);
- ▶ the Project Management Plan (see [3]);
- ▶ the Project Master Schedule (see [4]);
- ▶ the Work Breakdown Structure (WBS) (see [6]);
- ▶ the Project Risk Register (see [9]);
- ▶ published economical and business conditions.

Processes. The analogy-based (or global) and the analytical (detailed) approaches are both complementary and suited for this simple approach to estimating.

Analogy-based estimating approach. It consists of identifying already performed projects of similar characteristics, analyzing which aspects are similar (identical or scalable) or different, then deriving the overall project estimate by analogy with the final actuals of these projects.

Analytical estimating approach. It consists of estimating the costs of every single activity of the WBS, then aggregating these costs to derive that of the project.

Variations around these two approaches can also be considered, for instance involving expert judgements for fine tuning the analogy-based estimates, or considering the project final deliverable, also called Product Breakdown Structure as a baseline for estimating elementary costs instead of the WBS.

Output. The output of the cost estimating process is documented in a **Project Cost Estimate**. This document consists of a quantitative assessment of the costs required to complete the project and of the supporting documentation to provide a clear and complete understanding of how the cost estimate was derived.

Prior to its release, the Project Cost Estimate shall be submitted to a verification/validation process within the Project Team (see [10]). The document is also *reviewable*: it shall be regularly updated to take into account evolutions, whether they are of an economical nature or of a programmatic one (evolution of the project scope and of the deliverable definition).

1.2 Budgeting the project

While the Project Cost Estimate, released by the Project Team, does not commit anyone, the **Project Budget** is a document that is jointly prepared by the Project Board and the Project Team (or at least drafted by the Project Manager and the Key Project Participants and validated by the Project Board) and that binds the Project Team to perform the project and deliver its outcome within a given cost.

Good project management practices [12] suggest that the Project Budget (also called the Total Allocated Budget, TAB) is at least made of two components:

- ▶ the **Budget at Completion** (BAC) allocated to clearly identified activities or aggregated sets of activities (sometimes called **Work Packages** or **Work Units**);
- ▶ a **Project Management Reserve** (PMR) intended to accommodate unexpected events for which the Project Team should be knowledgeable and by the way accountable, typically technical and programmatic risks (see [9]).

As a general principle, risks for which the Project Team has little control, for instance external risks such as acts of God (earthquakes, floods, etc.) or economical or business conditions, should not be owned by the Project Team and therefore are not aimed to be covered by the PMR.

The PMR should be made up of between 5 % for small projects that are not perceived as risky, and up to 30 % for rather complex, long-lead and speculative projects that comprise an important part of uncertainty. In the civil engineering domain for instance, this percentage is quite often set to 15 %.

Inputs. The following documents are required to draft, verify then baseline a Project Budget:

- ▶ the Project Roadmap (see [2]);
- ▶ the Project Management Plan (see [3]);
- ▶ the Project Master Schedule (see [4]);
- ▶ the Work Breakdown Structure (WBS) (see [6]);
- ▶ the Project Cost Estimate;
- ▶ the Project Risk Register (see [9]).

Processes. The Project Budget typically results from something like a negotiation between the Project Board (and sometimes additional stakeholders such as funds providers) on the one hand, and the Project Manager and some Key Project Participants on the other hand. Particular attention shall be paid to the sizing of the PMR and the risks that are covered by the PMR.

Output. The output of the budgeting process is the **Project Budget**. This key project management document is necessarily validated or confirmed by the Project Board after an inter-phase decision point is reached.

1.3 Controlling the costs

The Project Team shall implement some mechanisms to record **actuals**, whether these are time spent by project participants or financial expenditures.

Inputs. The following documents are required to control the costs of a project:

- ▶ the Project Budget;
- ▶ periodic Time Sheets and/or invoices.

Process. The cost control process consists of comparing planned figures to actual ones and to derive trends.

Output. Actual vs. planned and trends, for the whole project, for phases and for sets of activities are typically progress components that shall be featured in periodic **Progress Reports**.

1.4 On the periodicity of reporting

Reporting periodicity is always an issue. While too few progress reports may undermine the mutual trust between the Project Team and the project stakeholders, editing too many reports may be perceived as a waste of time. It seems that around ten to twelve periodic Progress Reports is considered appropriate. Some project management experts suggest reducing the timespan between reports as the project progresses (see [11]).

2 Intermediate approach

This intermediate approach is suited to rather challenging projects or to Project Teams that are already somehow experienced.

The concepts are essentially the same as those described in the previous section, but enhanced processes should be implemented.

2.1 Estimating the costs

Inputs. In addition to the already listed input documents (see section 1.1), the following ones may be useful:

- ▶ the Project Coordination Schedule(s) (see [8]);
- ▶ the RACI Matrix (see [7]).

Processes. Expert judgements, by means of the Delphi method, can be used to obtain more accurate global estimates for the project. Analytical estimates should also rely on a knowledge base that is populated with data and ratios extracted from Project Close-out Reports.

Output. The Project Cost Estimate is still the output of this process. Because of the enhanced approaches that should be implemented, the accuracy of the estimates should also be increased.

2.2 Budgeting the project

Inputs. In addition to the already listed input documents (see section 1.2), the following ones may be useful:

- ▶ the Project Coordination Schedule(s) (see [8]);
- ▶ Work Package/Unit Description Datasheets (see [6]);
- ▶ the RACI Matrix (see [7]).

Processes. The budgeting process still relies on a fair negotiation.

Output. In addition to the Project Budget, a set of **Planned Value Curves** can be prepared so that the Earned Value Management (EVM) methodology can be used to follow-up the progress of the project (see [11]).

2.3 Controlling the costs

Inputs. In addition to the already listed input documents (see section 1.3), the following ones may be useful:

- ▶ the Planned Value Curves (see [11])
- ▶ the Progress Reports of the previous periods.

Processes. Experiences have shown that EVM-based project reporting is much more efficient than simply comparing actual figures to planned ones. To implement this project follow-up approach, Earned Value (EV) figures shall be collected prior to comparing them to Planned Value (PV) ones in order to get Schedule Variances (SV), and to Actual Costs (AC) in order to obtain Cost Variances. Estimates at Completion (EAC) can be derived from all of these figures (see [11]).

Outputs. Periodic Progress Reports are still the outputs of this process.

3 Advanced approach

This approach is suited to complex projects of a substantial size. It can only be implemented by more experienced project management professionals.

3.1 Estimating the costs

Inputs. Basically the same input documents as those listed in sections 1.1 and 2.1 are necessary.

Processes. In addition to the global and detailed estimating approaches, **parametric estimating approaches** should be seriously considered (see [13]). If the project deliverable is a mechatronics product, software dedicated to product costing² should also be considered.

Output. The Project Cost Estimate is still the output of this process.

3.2 Budgeting the project

Essentially, the inputs, process and outputs as those listed in § 1.2 and § 2.2 are still the components of the budgeting process in an advanced approach.

3.3 Controlling the costs

An advanced approach to controlling the project costs shall necessarily rely on a **deliverable-oriented Earned Value Management** methodology. By doing so, the Progress Reports are assembled in a reliable way from actuals and progress figures collected by means of collaborative tools.

References

- [1] The openSE editorial community (2014) *openSE Framework*, Geneva, Switzerland.
- [2] — (2014) *Initiating a Complex Systems Project. Drafting and Releasing a Project Proposal/Roadmap*, Geneva, Switzerland. [openSE Guidelines no. 1009](#).
- [3] — (2014) *Setting up a Project Management System. Drafting and Releasing a Project Management Plan*, Geneva, Switzerland. [openSE Guidelines no. 1000](#).
- [4] — (2014) *Planning and Scheduling the Overall Project. Drafting and Releasing the Master Schedule*, Geneva, Switzerland. [openSE Guidelines no. 1010](#).
- [5] — (2014) *Costing the Project. Resource Estimating, Budgeting and Controlling*, Geneva, Switzerland. [openSE Guidelines no. 1001](#).

- [6] — (2014) *Constructing the Project Work Breakdown Structure*, Geneva, Switzerland. [openSE Guidelines no. 1012](#).
- [7] — (2014) *Constructing the Project RACI*, Geneva, Switzerland. [openSE Guidelines no. 1005](#).
- [8] — (2014) *Planning and Scheduling at Coordination Level*, Geneva, Switzerland. [openSE Guidelines no. 1006](#).
- [9] — (2014) *Managing Project Risks, Opportunities and Uncertainties*, Geneva, Switzerland. [openSE Guidelines no. 1011](#).
- [10] — (2014) *Coding and Versioning Project Documents*, Geneva, Switzerland. [openSE Guidelines no. 1008](#).
- [11] — (2014) *Controlling and Reporting the Progress of the Project*, Geneva, Switzerland. [openSE Guidelines no. 1007](#).
- [12] NDIA PMSC ANSI/EIA-748-A (2005) *Standard for Earned Value Management Systems Intent Guide*. Arlington, VA, USA: National Defense Industrial Association. 90 p.
- [13] P. Foussier (2006) *From Product Description to Cost. A Practical Approach. Vol. 1 The Parametric Approach. Vol. 2. Building a Specific Model*. Springer, London UK. 316 p. ISBN 1849969825 and 368 p. ISBN 1846280427.
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- [15] K. K. Humphreys, P. Wellman (2011) *Basic Cost Engineering*. 3rd ed. Marcel Dekker, New York, NY, USA. 338 p. ISBN 0824796705.
- [16] PMI Standard Committee (2008) *A guide to the project management body of knowledge*. 4th ed. Newton Square, PA: Project Management Institute. 403 p. ISBN 1933890517.

All openSE documents are freely downloadable from cern.ch/openSE.

Authoring information

This brochure was authored and cross-verified by Zhaklina Kamcheva and Pierre Bonnal. It is an outcome of the PURES SAFE project: a FP7 Marie Curie Actions Initial Training Network, supported by the European Commission under grant agreement no. 264336.

²DFMA from Boothroyd Dewhurst, Inc. (www.dfma.com) for instance.