Managing Projects with openSE

Part 3

Table of Content

Project Planning & Scheduling .................................................................................................................. 1
  Work Breakdown Structure ....................................................................................................................... 6
  RACI Matrix .............................................................................................................................................. 11
  Scheduling ............................................................................................................................................... 13
Project Costing .......................................................................................................................................... 13
  Cost Estimating ....................................................................................................................................... 14
  Budgeting ................................................................................................................................................ 20

Project Planning & Scheduling

Typology

2 types of project schedules

Master Schedule
  ~ Summary Schedule
  Masterplan
  Calendrier directeur

Coordination Schedule
  ~ “PERT”, Gantt chart
  Activity network
  Calendrier de coordination

Strategic level
  The whole project
  Intuitive approach

Tactical level
  One or a few phases
  Analytical approach

One page/slide
  Can be in the Project Roadmap

Several pages
  Can be in the PMP

This work is licensed under a Creative Commons Attribution – Share Alike 3.0 Switzerland License. Pierre Bonnal & Thijs Wijnands
### Master Schedule

When and which effort?

- **INITIALIZE**
- **STUDY**
- **DESIGN**
- **BUILD**
- **COMMISSION**
- **FINALIZE**

- **Master Schedule** preparation
- **Master Schedule** (re)validation
- **Master Schedule** update
- **Master Schedule** updates

### Coordination Schedule

When and which effort?

- **INITIALIZE**
- **STUDY**
- **DESIGN**
- **BUILD**
- **COMMISSION**
- **FINALIZE**

- **Study Coordination Schedule** preparation (if needed)
- **Project Coordination Schedule** preparation
- **Project Coordination Schedule** updates

* incl. PBS, WBS, LoA (list of activities), RBS, RACI matrix
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BRZ•KITE project launched</td>
<td>Perform Basic Design</td>
<td>CDR released</td>
<td>Perform Engineering Design</td>
<td>TDR released</td>
<td>Make &amp; Test Prototype</td>
<td>Set Supply Chain</td>
<td>Procure Equipment &amp; Tooling</td>
<td>Produce Equipment &amp; Tooling</td>
</tr>
<tr>
<td></td>
<td>Perform Detailed Design of Manufacturing Facility</td>
<td>Instal &amp; Commission Equipment &amp; Tooling</td>
<td>Ramp-up Production</td>
<td>1st batch of kites shipped</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Coordination Planning & Scheduling

A three-step process

1. Identifying the project **activities**
   - The Work Breakdown Structure (WBS)

2. Identifying the **resources** available, estimating the **resources** required
   - The RACI Matrix

3. Scheduling the **activities**
   - The Coordination Schedule

- a Gantt chart
- ProjectWizard, Merlin, Gantt chart
- Microsoft, Project, Gantt chart
Coordination Planning & Scheduling

Identifying the project activities

3 possible approaches:
- Intuitive approaches
- Analogical approaches
- Analytical approaches

Approach sold as systematic, but not that much!

Global lessons learned collected by the Project Management Institute
Coordination Planning & Scheduling

1. Identifying the project activities → analogical approaches

- Inspired from the Quintilian heptameter

  quis | quid | ubi | quibus auxiliis | cur | quomodo | quando
  who  | what | where | which means     | why | how     | when

- Describing the final deliverable(s)
  → The Product Breakdown Structure (PBS)

- Deriving the Work Breakdown Structure (WBS) from the PBS
  → The WBS top nodes, then the WBS-matrix

- Generating the list of activities from the WBS-matrix
  → The activity portfolio
Coordination Planning & Scheduling

Identifying the project activities → analytical approach

What is an activity?

- ≠ deliverable! a.k.a. work unit
- action verb (infinitive tense) + noun

An activity:
- consumes time
- consumes resources
- has start and end dates
- creates (a) deliverable(s)
- is measurable
- is assignable to one project participant

To avoid confusion, clever professional practices (e.g., MIL-HDBK-245B + appendix A) and several textbooks suggest to label activities as follows:
- consumes resources
- has start and end dates
- creates (a) deliverable(s)
- is measurable
- is assignable to one project participant

Some examples:
- Manage the project
- Prepare PM documents
- Perform detail design of wing surface
- Supply rope & straps
- CFT for moulded ABS parts

Coordination Planning & Scheduling

Identifying the project activities → analytical approach

What is an activity?

An activity:
- consumes time
- consumes resources
- has start and end dates
- creates (a) deliverable(s)
- is measurable
- is assignable to one project participant

And how many activities on a coordination schedule?
- No definitive answer!
- No more than 5% to 10% of the project duration
- No more than 13 weeks (long lead projects)
- One or up to 1% of level-of-effort activities

What is the maximum duration?
- No definitive answer!
- No more than 5% to 10% of the project duration
- No more than 13 weeks (long lead projects)
- One or up to 1% of level-of-effort activities

And how many activities on a coordination schedule?
- No definitive answer!
- But not more than 400 activities, otherwise difficult to manage
Coordination Planning & Scheduling

1. Identifying the project activities → analytical approach

What is a deliverable?

- ≠ activity!
- ≠ product!
- e.g., the brz-kite

noun + verb at past participle tense

≠ milestone!

Deliverable is a term used [...] to describe a tangible or intangible object produced as a result of the project that is intended to be delivered to a customer (either internal or external). A deliverable could be a report, a document [...] or any other building block of an overall project.

Deriving the Work Breakdown Structure (WBS) from the PBS

WBS top nodes

- Project management and system-level design activities
- Development activities associated with sub-systems and product components
- A slightly refurbished PBS
- System-level integration, validation, refinement and ramp-up activities

Managing Projects with openSE — Part 3 Pierre Bonnal & Thijs Wijnands
### Coordination Planning & Scheduling

1. Identifying the project activities → analytical approach
2. Generating the list of activities from the WBS-matrix

#### Generic activities

- Manage the project
- Prepare PM documents
- Perform basic design
- Prepare detailed design
- CFT and award contract
- Supply equipment
- Negotiate agreement
- Prepare construction
- Pour concrete
- Do secondary works
- Do finishing works
- Control, survey
- Transfer to owner

### Generating the List of Activities from the WBS-matrix

- For each cell of this matrix, count how many activities are required to manage the project efficiently

- **1** One activity shall be planned
- **n** A few activities shall be planned (cf. activity def.)

- **Sum < 400 act.**
Coordination Planning & Scheduling

1. Identifying the project activities → analytical approach
2. Generating the list of activities from the WBS-matrix
3. Generic activities suited to a NPD project

Managing Projects with openSE — Part 3
Pierre Bonnal & Thijs Wijnands
Coordination Planning & Scheduling
1. Identifying the project activities → analytical approach

- Work packages = level 1 of the Work Breakdown Structure
- Activities = the leaves of the WBS (from level 2 to level 6 max.)
- There is no requirement to have all activities at a same level!
Coordinating Planning & Scheduling

1. Identifying the resources available, estimating the resources required
2. Assigning resources to activities → RACI Matrix

2 types of resources:

- Renewable resources
- Non-renewable resources

- Identifying the resources that are available
  - The Resource Breakdown Structure (RBS)

- Estimating the resources that are required
  - See section dedicated to Project Costing

- Assigning resources to activities
  - The RACI Matrix

Managing Projects with openSE --- Part 3  Pierre Bonnal & Thijs Wijnands
### Coordination Planning & Scheduling

2. Identifying the **resources** available, estimating the **resources** required

3. Assigning **resources** to activities → **RACI Matrix**

<table>
<thead>
<tr>
<th>Executes</th>
<th>Is responsible</th>
<th>Participate to decisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>R</td>
<td>X</td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>I</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Is required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### RACI Matrix

- **R**: Is responsible
- **X**: Executes
- **F**: Follows up
- **I**: Is informed
- **H**: Provide help
- **Only one per row!**

---

The purpose of this RACI matrix is twofold:

1. Identifying the required resources ('X', 'R' and sometimes 'F' and 'H')
2. Organizing information circulation (mailing lists)

---

Managing Projects with openSE — Part 3

Pierre Bonnal & Thijs Wijnands
Coordination Planning & Scheduling

3. Scheduling the activities
   
   3.1 Estimating the duration of the activities
   
   3.2 Defining technical constraints between activities
   
   3.3 If required, getting rid of loops
      
      DSM (Design Structure Matrix)
   
   3.4 If required, defining temporal constraints
   
   3.5 Calculating earliest/latest start/finish dates, floats + critical path(s)
      
      PDM (Precedence Diagramming Method) + Gantt Chart
   
   3.6 If required, defining resource constraints
   
   3.7 Calculating (earliest) start/finish dates and floats
      
      RCPS (Resource-Constrained Project Scheduling) + Gantt Chart

Project Costing

Project Costing
A three-step process

1. Estimating the resources required to perform the project
   
   The (project) Cost Estimate

2. Budgeting the resources allocated to the project
   
   The (project) Budget Document
Project Costing

When and which effort?

INITIALIZE STUDY DESIGN BUILD COMMISSION FINALIZE

Preliminary Cost Estimate (study + project) preparation

Initial Budget Document (study + project) preparation

Cost Estimate (project) refinement/update

Budget Document (project) refinement/update

Cost Estimate + Budget Document updates

Budget Document (re)validation

Project Costing

Estimating the resources required to perform the project

4 families of cost estimating approaches

Intuitive approaches
rules-of-thumb

Global approaches
top-down analogical

Modular approaches
parametric (Cost Estimation Relationship)

Detailed approaches
bottom-up analytical

the project is analysed as a whole

estimates done for each activity

Managing Projects with openSE Part 3 Pierre Bonnal & Thijs Wijnands
Project Costing

Estimating the resources required to perform the project

Which costs (and incomes) to take into account?

Incomes

Expenses

Project Costing

Estimating the resources required to perform the project

Which costs to take into account?
Project Costing

1. Estimating the resources required to perform the project

Which costs (and incomes) to take into account?

- Only chargeable costs shall be considered!
- Cash flows that are distorted (i.e. suppressed or modified)
- Cash flows that are generated by the project

Cash flows of the project = Cash flows of the organisation with the project − Cash flows of the organisation without the project

- Past or irrecoverable costs: no! These costs will exist whatever the decision
- Renunciation costs: yes! E.g. the consequence of stopping a project that is already on-going
- Unquantifiable costs: no! Benefits sometimes replace incomes

Project Costing

1. Estimating the resources required to perform the project

Estimating with global approaches

Global approaches

- Linear regressions
- Chilton law
- Freiman principle
- Distance weighing

Cost = \( a \cdot b^k \cdot \text{Size} \to (\text{Size}_\text{ref}) \to 1 - 1/k \)

\( 1 \leq k \leq 10 \)

\( k \in [0.3 \cdots 0.7] \)
Project Costing

Estimating the resources required to perform the project

Dealing with price escalation

\[ \text{Cost}_{\text{now}} = \text{Cost}_{\text{past}} \cdot \left( \sum_{i=1}^{n} \frac{\omega_i}{\text{El}_i \text{past}} \right) \]

where

- \( \omega_i \rightarrow \) weighing coefficients so that: \( \sum_{i=1}^{n} \omega_i = 1 \)
- \( \text{El}_i \rightarrow \) appropriate economical indices

Project Costing

Estimating the resources required to perform the project

Estimating with modular approaches

Project cost as a function of several sizing parameters:

\[ \text{Cost} = f(p_1, p_2, \ldots, p_n) \]

where \( p_i \) are the sizing parameters

Software:

- TruePlanning® [PRICE System] (www.pricesystems.com)
- Cost+ [3f] (www.3f-fr.com)
- COCOMO for IT projects (csse.usc.edu)

Handbook:

- ISPA (International Society of Parametric Analysts)
  - Parametric Estimating Handbook (www.ispa-cost.org)
Project Costing

**Estimating** the resources required to perform the project

- **Initial Project Estimation**
  - Importance of Engineering Cost Estimates
  - Project Control System

**Estimating with detailed approaches**

1. **Initialize**
2. **Study**
3. **Design**
4. **Build**
5. **Commission**
6. **Operate & Maintain**
7. **Decommission**

**Opportunity Study**
- Global: ±30%
- Modular: ±20%
- Detailed: ±10%
- Conceptual Study: ±30%
- Detailed: ±10%

**Feasibility Study**
- Basic Design: Detailed ±10%
- System Design: Detailed ±5%

**Application**
- Process industry projects
- New product development projects

**Incomes vs. Expenses**
- Development costs
- Operations and maintenance costs
- Dismantlement costs
- Past and irrecoverable costs

**Imprecision ≠ Uncertainty**

- Deterministic nature
- Probabilistic nature
Project Costing

**Estimating** the resources required to perform the project

How to deal with **interest rates** and future **price escalation**?

⚠️ cost of money ≠ price escalation!

- Interest rates (financial concept)
- Inflation (economical concept)

**All CF's shall be set as if they were paid now!**

In Cost Estimate and Budget, all figures in CHF\(_{\text{now}}\)

Cost Estimate

Editorial Process

- **Authoring:** Study (or Project) Manager + a few Key Study (or Project) Participants
- **Verification:** Some other Key Study (or Project) Participants + some experts in the fields
- **Validation:** Study (or Project) Manager

Typical Content

- The approach used (global, modular, detailed)
- The assumptions (incl. sourcing of economical rates and indices)
- The figures and their accuracy

A comprehensive cost breakdown is appreciated!
**Project Costing**

**Budgeting** the resources allocated to the project

which becomes

**Cost Estimate**

- \pm \text{kCHF}
- \pm \text{p·yr}

**Budget Document**

- \text{kCHF}
- \text{p·yr}

**Microsoft Excel®**

'®' Total Allocated Budget

Logically: \[ \text{kCHF} \leq \text{p·yr} \]

---

**Project Costing**

**Budgeting** the resources allocated to the project

WBS

CBS Cost Breakdown Structure

or

BAC Budget at Completion

PMR Project Management Reserve

**Managing Projects with openSE**

Part 3

Pierre Bonnal & Thijs Wijnands
Budget Document
Editorial Process

**Authoring:** Study (or Project) Manager + a few Key Study (or Project) Participants

**Verification:** Some other Key Study (or Project) participants + some experts in the field

**Validation:**
- Study Manager
- Project Manager

- Project Board

  at Work Package level

  at Cost Center level