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Project Control and Follow-up

"Project triangle"

Verification vs. Validation

Project Requirements

Physical Progress (a.k.a. Earned Value)

tangible Deliverables

PERFORMANCE

QUALITY

COST

TIME

Actual Costs

vs. Budgeted Costs

Actual Dates

vs. Planned dates

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Project Control and Follow-up
When and which effort?

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

**PROGRESS REPORTS**

Periodicity?

**CLOSE-OUT REPORT**

*The preferred project control and follow-up approach shall be defined in the Project Management Plan*

---

**Project Control and Follow-up with openSE**

3 levels of implementation

1. **Simple** approach
2. **Intermediate** approach
3. **Advanced** approach

---

The preferred project control and follow-up approach shall be defined in the Project Management Plan
The ‘simple toolbox’

Project Control and Follow-up

The ‘basic toolbox’

1. Major achievements (as bullet points)
2. Problems encountered
3. Cost and schedule statuses
   3.1 Cost status
      Table (actuals vs. budgeted)
   3.2 Schedule status
      Milestone Trend Chart
         (gdpm Milestone Plan)
   3.3 Physical progress status
      Dashboard
4. Work laying ahead (as bullet points)
5. Risk Register update (limited to changes)

Project Costing

3 types of resources

Manpower
(project participants)
(workload currency)

Financial resources
(monetary cur.)

In-kind contributions
(various cur.)

planned

manpower budget

financial budget

agreement figures

actuals

time spent

expenses

(= planned)

data

timesheeting system

accounting books

Ø
At CERN
Project
Costing
3 types of resources
Manpower
(project participants)
[workload currency]
Financial
resources
[monetary cur.]
In-kind
ccontributions
[various cur.]
planned
manpower budget
financial budget
agreement figures
expenses
(= planned)
accounting books
Ø
actuals
(= planned)
data
Ø

Project Control and Follow-up

Cost Control Table

Project Control & Follow-up with openSE Part 5 Pierre Bonnal
Milestone Trend Chart

Project Control and Follow-up

Schedule status → Milestone Trend Chart

<table>
<thead>
<tr>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
</tr>
<tr>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
<tr>
<td>2017</td>
<td>2018</td>
<td></td>
</tr>
</tbody>
</table>

- CanNet Project launched
- CDR released
- PILOT PROJECT
- FULL IMPLEMENTATION PROJECT
- readines review
- project completion review
- Early 2017

Key milestones

Reporting dates

Reference (baseline) dates

45° line (isochrone)

Project Control & Follow-up with openSE --- Part 5 Pierre Bonnal
Milestone Plan

**Project Control and Follow-up**

**Milestone status**

**Milestone Plan**

<table>
<thead>
<tr>
<th>DATE</th>
<th>Project Board</th>
<th>Eng. Team</th>
<th>Proc. Team</th>
<th>Site Activities</th>
<th>MILESTONE DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.01</td>
<td>PPL</td>
<td>Eng</td>
<td></td>
<td></td>
<td>When the CanNet Pilot Project is formally launched by the Project Board</td>
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<tr>
<td>31.03</td>
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<td></td>
<td>When the engineering design tasks of the Pilot Project are completed</td>
</tr>
<tr>
<td>15.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>When the procurement contract is signed</td>
</tr>
<tr>
<td>30.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>When the installation and commissioning works for the three tanks are completed</td>
</tr>
<tr>
<td>15.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>When the CanNet Project Readiness Review is held</td>
</tr>
<tr>
<td>31.10</td>
<td></td>
<td>Eng2</td>
<td></td>
<td></td>
<td>When the engineering design tasks of the Full Implementation Project are completed</td>
</tr>
</tbody>
</table>
### Project Control and Follow-up

#### Milestone Plan

<table>
<thead>
<tr>
<th>DATE</th>
<th>Board</th>
<th>Eng. Team</th>
<th>Proc. Team</th>
<th>Site Activities</th>
<th>MILESTONE DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.01</td>
<td></td>
<td>Eng</td>
<td></td>
<td>When the CanNet Project is formally launched</td>
<td>Planned</td>
</tr>
<tr>
<td>31.03</td>
<td></td>
<td></td>
<td>Proc</td>
<td>When the engineering design tasks of the Pilot Project are completed</td>
<td>On-going</td>
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<tr>
<td>15.05</td>
<td></td>
<td></td>
<td></td>
<td>When the procurement contract is signed</td>
<td>Completed</td>
</tr>
<tr>
<td>30.06</td>
<td></td>
<td></td>
<td>Inst</td>
<td>When the installation and commissioning works for the three tanks are completed</td>
<td>Late</td>
</tr>
<tr>
<td>15.07</td>
<td>PPR</td>
<td>Eng2</td>
<td></td>
<td>When the CanNet Project Readiness Review is held</td>
<td>Critical</td>
</tr>
<tr>
<td>31.10</td>
<td></td>
<td></td>
<td></td>
<td>When the engineering design tasks of the Full Implementation Project are completed</td>
<td></td>
</tr>
</tbody>
</table>

#### Project Control and Follow-up

**3 Simple approach**

### Progress Dashboard

**Project Control and Follow-up**

**3 Physical progress status → Dashboard**

```
<table>
<thead>
<tr>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
</tr>
<tr>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
</tr>
<tr>
<td>CanNet Project launched</td>
<td>CDR released</td>
<td>3 tanks</td>
</tr>
<tr>
<td>Early April 2017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>
```
CanNet Project launched
CDR released

STUDY
PILOT PROJECT
FULL IMPLEMENTATION PROJECT
readiness review
project completion review

Early April 2017
Eng. design
Procurement
Installation
Eng. design
Procurement
Installation

3 tanks 22 tanks

SIMPLE approach

Project Control and Follow-up
The 'basic toolbox'

Close-out Report

1. Rationale
2. Major Achievements
3. Risks and Issues
4. Cost and Schedule
   4.1 Cost status
   4.2 Schedule status
   4.3 Physical progress status
5. Lessons Learned

INTERMEDIATE approach
ADVANCED approach
The ‘intermediate toolbox’

Project Control and Follow-up

The ‘intermediate toolbox’

Progress Presentations

Progress Reports

Gantt Chart (coord. sched.)

EVM Data

Progress Reviews

Project Board

Gantt Chart Reporting

Project Control and Follow-up

Intermediate approach

Schedule status
Gantt Chart Reporting

Project Control & Follow-up with openSE --- Part 5

Pierre Bonnal
Project Control and Follow-up

**Gantt Chart Reporting**

INTERMEDIATE approach

During the schedule construction:
- Start Date
- Finish Date
- Planned Dates

After the baseline is set:
- Actual Start Date
- Expected Finish Date
- Status Date

On-going task:
- Actual Start Date
- Actual Finish Date
- Status Date

Completed task:
- Status Date

Meaning of the **status line** (isochrone line*):
- On schedule
- Behind schedule
- Ahead of schedule

* A line drawn on a Gantt chart connecting points (tasks) at which something occurs or arrives at the same time.
At a given status date, the focus is given on tasks that either are on-going or that should be on-going.

As a driving principle, duration of planned tasks is not re-evaluated with each schedule status report.

Earned Value Management

Earned Value Management
Earned Value Analysis

Practice Standard for Earned Value Management

American Military Standard C/SCSC
Cost/Schedule Control System Criteria

32 criteria/guidelines to consider

American National Standard Institute
Electronic Industries Alliance
NDIA
National Defense Industrial Association

PMI
Practice Standard for Earned Value Management

1969
1996
2005

1969
1996
2005
**Earned Value Management**

When and which effort?

**INTERMEDIATE approach**

When and which effort?

**INITIALIZE**

**STUDY**

**DESIGN**

**BUILD**

**COMMISSION**

**FINALIZE**

Quite useless except for large and long lead studies

At the early stage of the project, set the PV curve(s)

Periodically, collect EVs and ACs, then calculate the various indices: SVs, CVs, EACs

**EVM Basics**

\[ PV(t) = \text{?} \]
EVM Basics

PV(t) for the whole project

activity 01
EVM Basics → PV, Planned Value

$ PV(t > \text{project finish date}) = \text{BAC} $

$ PV(t < \text{project start date}) = 0 $
EVM Basics → AC, Actual Costs

$PV(t > \text{project finish date}) = BAC$

$PV(t) \text{ of the whole project}$

$PV(t < \text{project start date}) = 0$

$AC(t)$

$EV(t) = BAC \times \% \text{physical progress}(t_R)$

EVM Basics → EV, Earned Value

$PV(t > \text{project finish date}) = BAC$

$PV(t) \text{ of the whole project}$

$PV(t < \text{project start date}) = 0$

$AC(t)$

$EV(t) = BAC \times \% \text{physical progress}(t_R)$
EVM Basics

<table>
<thead>
<tr>
<th>AFITEP</th>
<th>C/SCSC</th>
<th>ANSI #748</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBTP</td>
<td>Coût budgété du travail prévu</td>
<td>BCWS</td>
</tr>
<tr>
<td>CRTE</td>
<td>Coût réel du travail effectué</td>
<td>ACWP</td>
</tr>
<tr>
<td>CBTE</td>
<td>Coût budgété du travail effectué</td>
<td>BCWP</td>
</tr>
<tr>
<td>CTB</td>
<td>Coût total budgété</td>
<td>BAC</td>
</tr>
</tbody>
</table>

EVM Basics → SV, Schedule Variance

$ PV(t > \text{project finish date}) = BAC$

$ PV(t) \text{ of the whole project}$

$ AC(t)$

$ SV(t_R) = EV(t_R) - PV(t_R)$

$ PV(t < \text{project start date}) = 0$
EVM Basics → CV, Cost Variance

$PV(t > \text{project finish date}) = BAC$

$PV(t < \text{project start date}) = 0$

$EV(t_R) = \text{EV}(t_R) - AC(t_R)$

$\phi(t_R) = \phi(t_R) = CR(t_R) = SPI(t_R) \times CPI(t_R)$

<table>
<thead>
<tr>
<th>Schedule Variance</th>
<th>Cost Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$SV(t_R) = EV(t_R) - PV(t_R)$</td>
<td>$CV(t_R) = EV(t_R) - AC(t_R)$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Schedule Performance Index</th>
<th>Cost Performance Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>$SPI(t_R) = \frac{EV(t_R)}{PV(t_R)}$</td>
<td>$CPI(t_R) = \frac{EV(t_R)}{AC(t_R)}$</td>
</tr>
<tr>
<td>$SPI(t_R) &gt; 1 \bigcirc$</td>
<td>$CPI(t_R) &gt; 1 \bigcirc$</td>
</tr>
<tr>
<td>$SPI(t_R) &lt; 1 \bigtimes$</td>
<td>$CPI(t_R) &lt; 1 \bigtimes$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Critical Ratio</th>
<th>Physical Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>$CR(t_R) = SPI(t_R) \times CPI(t_R)$</td>
<td>$\varphi(t_R) = \frac{EV(t_R)}{BAC}$</td>
</tr>
</tbody>
</table>
EVM Basics

EVM Basics

Project Control & Follow-up with openSE --- Part 5  Pierre Bonnal
EVM Basics → EAC, Estimate at Completion

\[ EAC(t_R) = AC(t_R) + RTC(t_R) \]

EVM Basics → EAC, Estimate at Completion

\[ EAC(t_R) = \frac{BAC}{CPI(t_R)} \]
\[ EAC(t_R) = AC(t_R) + \frac{BAC - EV(t_R)}{CPI(t_R)} \times SPI(t_R) \]
EVM Basics → TAB, Total Allocated Budget

$m$ $BAC$ $EAC$ $PROJECT MANAGEMENT RESERVE$ $EAC$

$PV(t)$

Project Control & Follow-up with Pierre Bonnal
Project Control & Follow-up with openSE --- Part 5

Pierre Bonnal
EVM → EAC, Estimation à l’achèvement,
Estimate At Completion.
EVM → EAC, Estimation à l’achèvement, Estimate At Completion.
EVM → TAB, Budget total alloué, Total Allocated Budget.

\[ \text{PV}(t) \]

\[ \text{EVM} \]

\[ \text{AC}(t_R) = 4.5 \text{ p-m} \]

\[ \text{EV}(t_R) = 3.5 \text{ p-m} \]

\[ \text{EAC}(t_R) = ? \]

\[ \text{TAB} = \text{BAC} + \text{PMR} \]
32 Guidelines of ANSI/EIA-748-C

Group 1 → Five organization criteria

Guideline #

01 Define the work scope → WBS
02 Define the project organization → OBS (and RACI matrix)
03 Integrate the project control processes to those of the organization
04 Organize overhead management → indirect costs
05 Integrate (i.e. matrix) the WBS and OBS → control accounts (CBS)
32 Guidelines of ANSI/EIA-748-C

Group 2 → Planning, scheduling and budgeting criteria

**INTERMEDIATE approach**

06 Schedule tasks with network logic → Coord. Schedule
07 Set progress measurement indicators (i.e. deliverables, results)
08 Set time-phased detail budgets for authorised work (i.e. at task level)
09 Set budgets by cost elements (i.e. manpower, material, etc.)
10 Create work packages (WP)s and planning packages (PP)s*
11 Sum detail budgets to control accounts (CBS)
12 Set level-of-effort* (LoE) budgets (direct costs)
13 Set overhead budgets (i.e. indirect costs)
14 Set the project management reserve (PMR)*
   Set undistributed budgets (UBs)*
15 Reconcile to total allocated budget (TAB)*

**Level-of-Efforts (LoE) Budgets**

- Efforts that commence at project start and end at project finish
- No measurable performance basis
  \[ EV(t) = PV(t) \]
  \[ SV(t) = 0 \] always!
- LoE value < 10% BAC
- LoE tasks distort overall performance measurement
- Quarantine LoE outside the Performance Management Baseline
Budget Element Hierarchy

Total Allocated Budget

Performance Management Baseline

Total Allocated Budget

Performance
Management
Baseline

BAC

PMR

Project Management Reserve

PMB

ундistruted

BAC

PMR

TAB

INTERMEDIATE approach

32 Guidelines of ANSI/EIA-748-C

Group 3 → Accounting consideration criteria

16 Record direct costs from the accounting system → ACs
17 Summarize direct costs by WBS element
18 Summarize direct costs by OBS element
19 Record/allocate indirect costs
20 Identify unit costs or lot costs
21 Track and report material costs and quantities → EVs

Entreprise Accounting System

ACs & ACs

WBS

OBS

EVs / PVs

INTERMEDIATE approach
32 Guidelines of ANSI/EIA-748-C
Group 4 → Analysis and management reports criteria

22 Calculate (at least monthly) EVM indicators → SV, CV, SPI, CPI, EAC, etc.
23 Explain significant variances
24 Identify and explain indirect cost variances
25 Summarize EVM information for the project board
26 Implement managerial actions as result of guideline 25
27 Revise estimates at completion → EACs

32 Guidelines of ANSI/EIA-748-C
Group 5 → Revision and data maintenance criteria

28 Incorporate changes in a timely manner
29 Reconcile current budgets with prior budgets
30 Control retroactive adjustments (commercial and economical fluctuations)
31 Prevent all but authorized budget changes
32 Document changes to the performance measurement baseline
The ‘advanced toolbox’

Project Control and Follow-up
The ‘advanced toolbox’

Progress
Presentations

Progress
Reports

Progress
Reviews

EVM-based
Planning and
Control System

At CERN
Beam-facility related projects
or large infrastructure projects

APT
Contact
Benoit Daudin
FAP-AIS-PM

Project Control & Follow-up with openSE --- Part 5 --- Pierre Bonnal
Project Control and Follow-up
The 'advanced features'

- **Deliverable**-oriented earned value management approach
- Dealing with **price escalation, inflation**, the **economical context**
- Augmenting earned value with **earned schedule**
- **Buffer**-based schedule progress monitoring
- Using stochastic models, vector machines, machine learning, etc. to derive **more accurate estimates at completion**