Managing Projects with openSE for Executives

CERN | EN ENGINEERING DEPARTMENT

Pierre Bonnal

version **1.0**

Project Management

What are we going to see together?

Inspired from Hermes

Lifecycle

openSE

Roles

Processes

- Launching a project
- Ensuring quality
- Defining requirements
- Planning & scheduling
- Costing
- Managing risks
- Reporting progress
- Handling issues
- Finalizing a project

Artefacts

0

Foundations

openSE

Managing Projects with openSE

i.e. studies and projects

Entrepreneurial activities

- Specific mandates, organizations and objectives
- Change-oriented
- Unique product
- Heterogeneous teams
- A start and an end

Operations activities

- Permanent mandates, organizations and objectives
- Status quo-oriented
- Standard product
- Homogeneous teams
- No temporal limitation

Intrusiveness

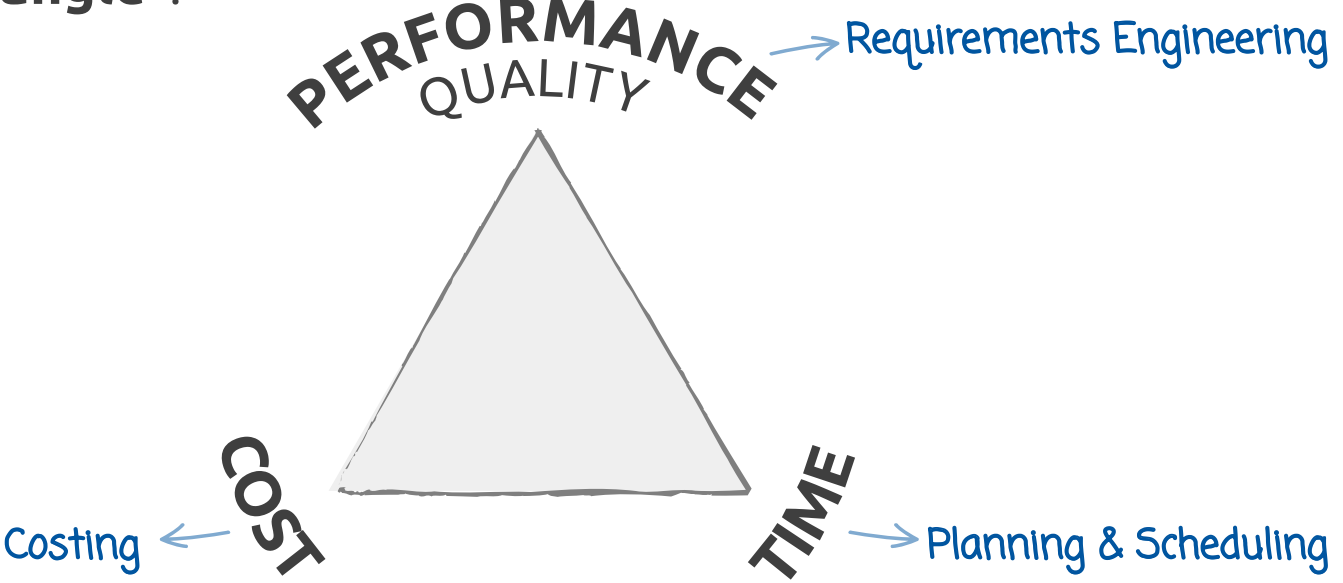
6. **New projects**
5. **Upgrade projects**/activities
4. **Consolidation projects**/activities
3. **Corrective maintenance activities**
2. **Preventive maintenance activities**
1. **Inspection activities**

Managing Projects with openSE

A unique set of processes consisting of coordinated and controlled activities with start and end dates, performed to achieve project objectives.

ISO 21500:2012

"**Project triangle**":



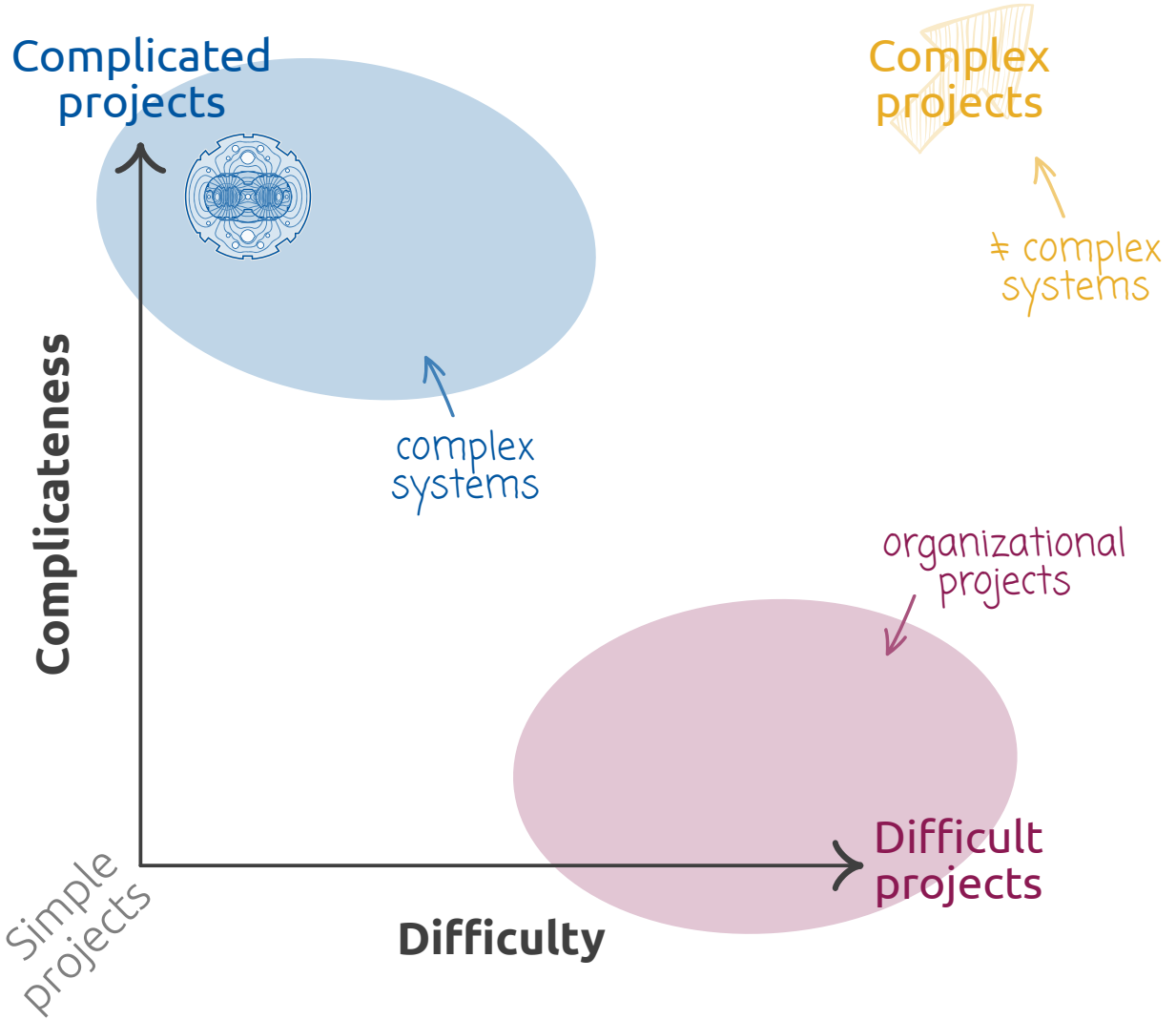
Managing Projects with openSE

PROJECTS

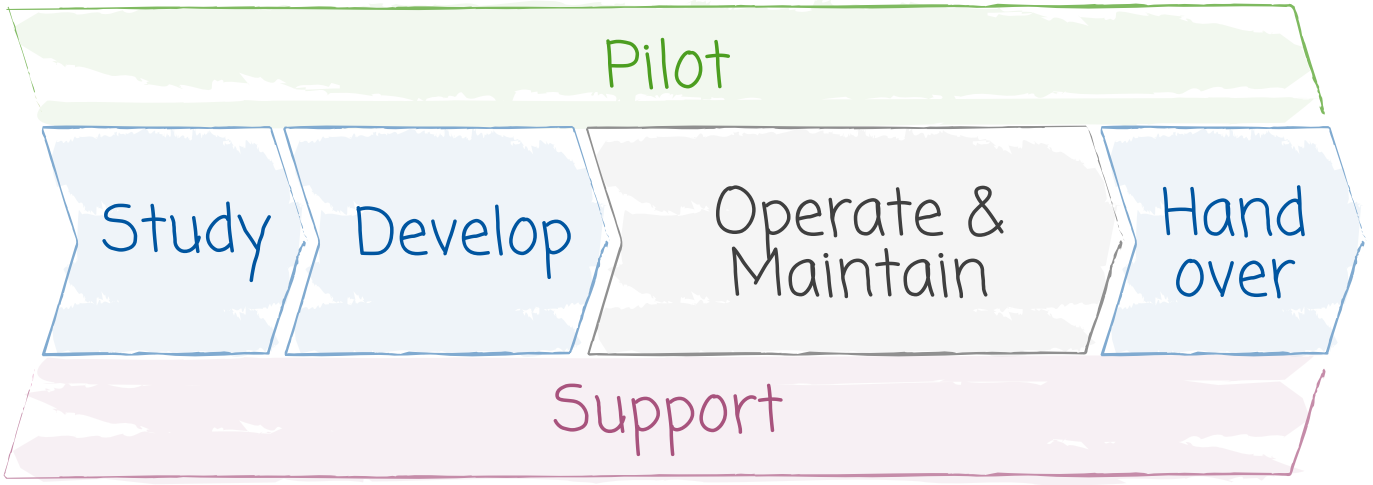
- Computing / Software
- Construction

- Industrial Plants
- Complex Systems
- New Products
- Organizational
- Personal Development
- Events
- New Services

Managing Projects with openSE

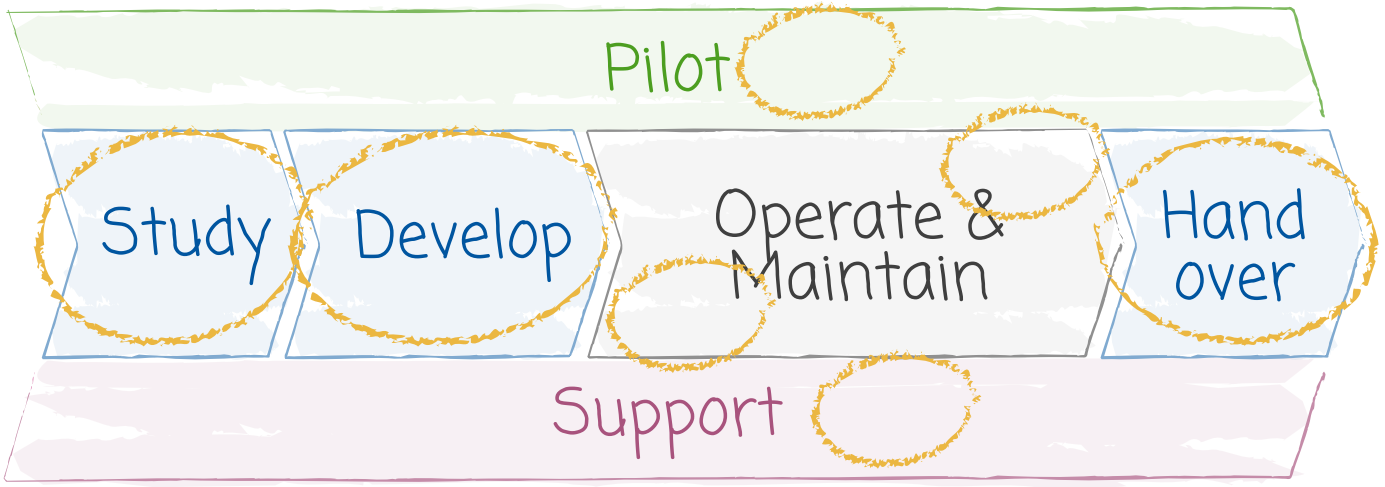


Managing Projects with openSE



Managing Projects with openSE

Projects can be found everywhere!



Managing Projects with openSE

Project = { project activities }

⚠ ∃ activities ≠ project activities

Program = { projects, non project activities }

focused on a common goal

Portfolio = { projects, non project activities }

not necessarily focused on a common goal

At **CERN** (in the A&T Sector)
Typology of projects
Regimented by EDMS 1398374

- **Beam-facility-related** (large-scale) programs and projects
  LHC Project, LIU Project*, HL-LHC Project*, HIE-ISOLDE Project, AWAKE Project, etc.
- **Non beam-facility-related** programs and projects
  SM18 Refurbishing Project, Building 107 Project, Building 311 Project, etc.
- **Equipment-** and **systems-related** projects
  Consolidation and renewal of the demineralised water production plant of building 378
  Renovation of the Meyrin site electrical safety network
- **Facility-related** sub-projects (work package of a facility-related project)
  Development of the RF cryomodules for HIE-ISOLDE
  Development of the cryolink in IR3 of the LHC
  Development of the crab cavities for HL-LHC
  Development of beam diagnostic boxes for HIE-ISOLDE
  Installation of the cooling and ventilation system of the Linac 4 building
  Upgrade of the HVAC system of the CERN computer centre (building 513)
  Development of teleoperated shielding doors for MEDICIS

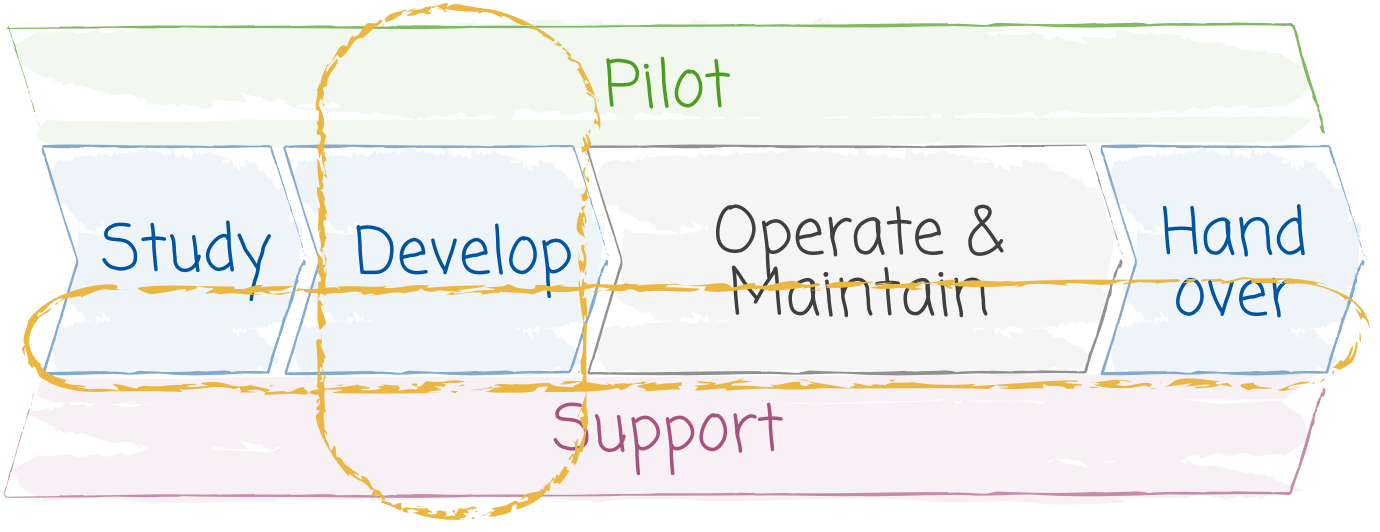
At **CERN** (in the A&T Sector)
Typology of projects
Regimented by EDMS 1398374

- **Large-scale studies** managed as programs or projects
  CLIC Study, FCC Study, etc.
- **Organisational** or **IT-related** programs and projects
  CAD'20 Replacement Program, EDMS Portal Refurbishing Project, etc.

Facility-related projects → multi-trade projects

Several equipment groups involved

Programs are more transverse!



Managing Projects with openSE

The application of **methods**, **tools**, **techniques** and **competencies** to a project

ISO 21500:2012

PMI PMBoK

ISO 10006:2003

openSE

IPMA ICB

Hermes HERMES 5.1

ANSI #748

CCPM

NASA Systems Engineering Handbook NASA/SP-2007-6105 Rev1

INCOSE SEBoK

Ecss EUROPEAN COORDINATION FOR SPACE STANDARDISATION

RUP RATIONAL UNIFIED PROCESS

PRINCE2

gdpm

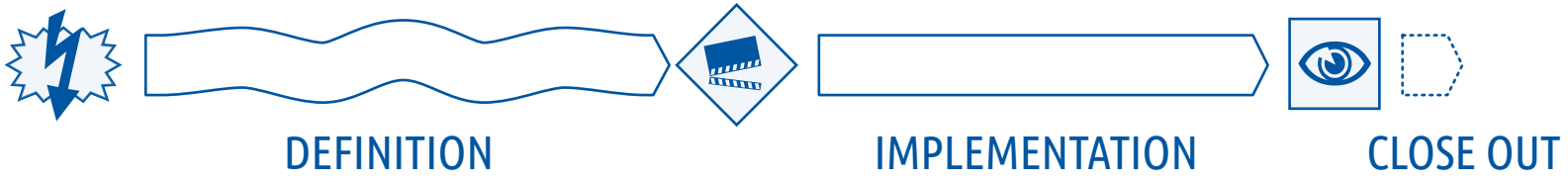
SCRUM +KANBAN

XP EXTREME PROGRAMMING

ISO 21500:2012

Managing Projects with openSE

Concept of **lifecycle**



Creativity
is required

some clumsiness
can be beneficial !

collaboration

Rigour
is required

a disciplined approach
is essential !

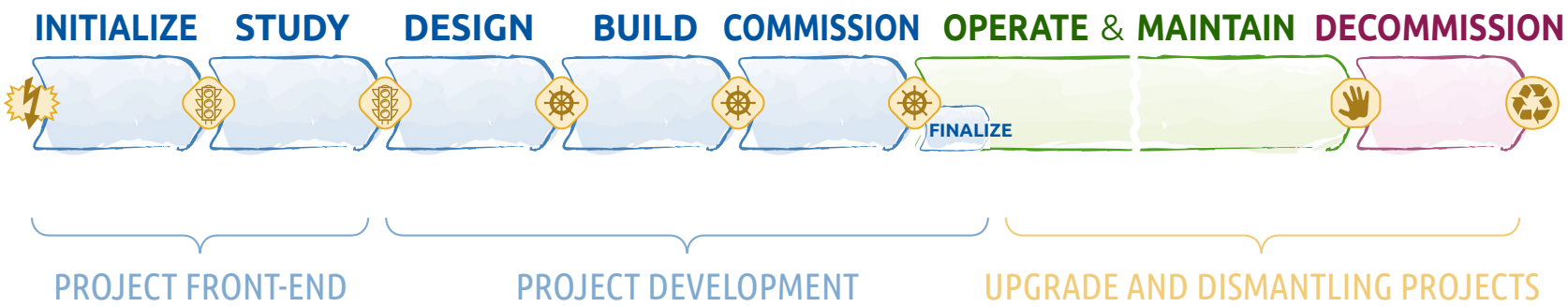
co-operation

some iterations

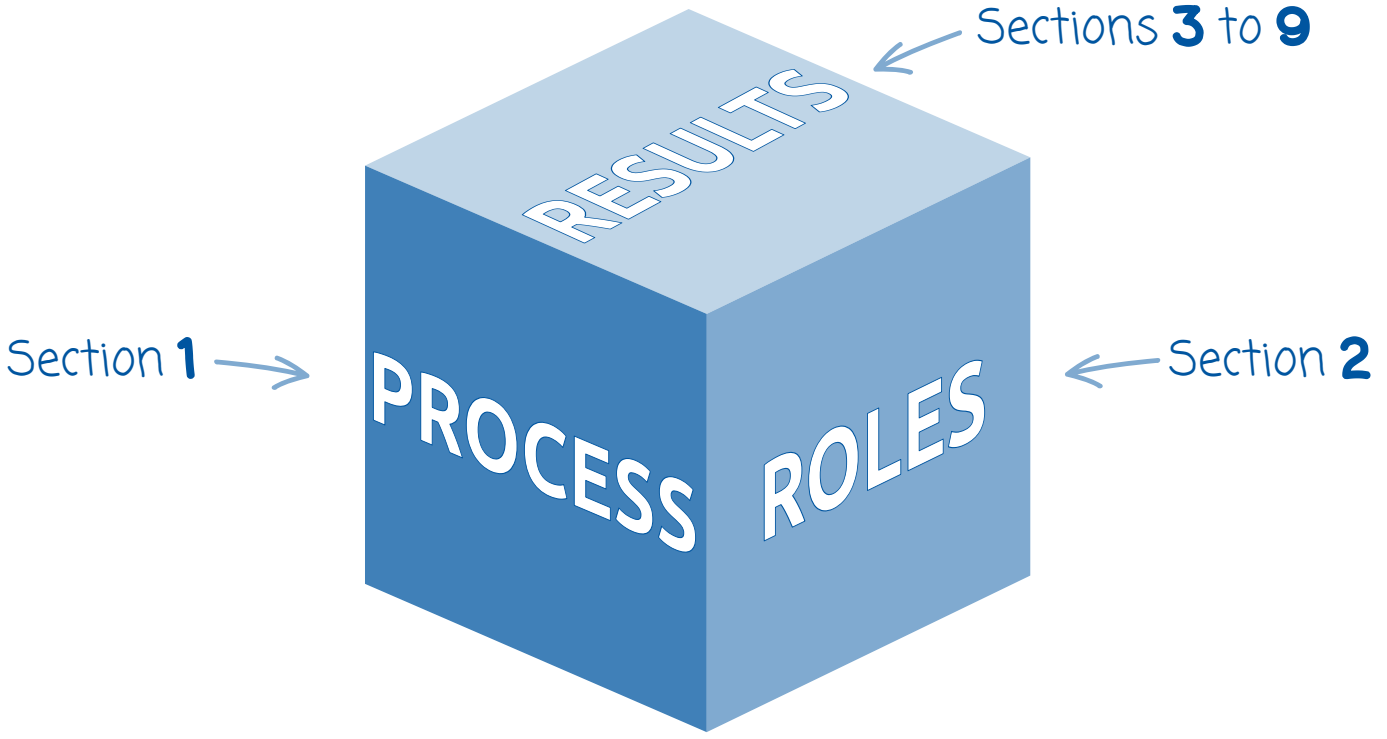
some iterations

t

Managing Projects with openSE

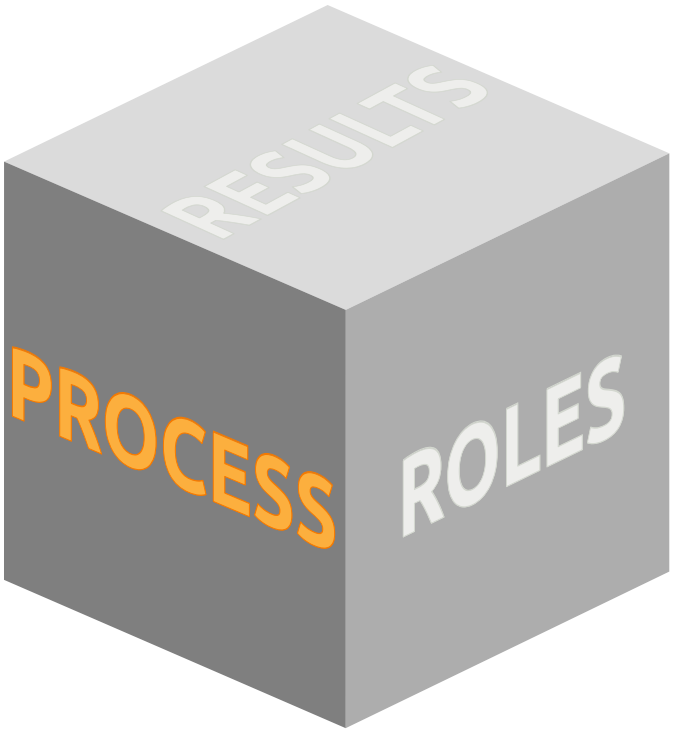


Managing Projects with openSE



Inspired from Hermes

1



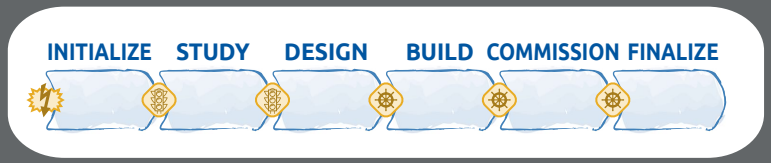
openSE

Project Management

What are we going to see together?

openSE

Lifecycle



Inspired from Hermes

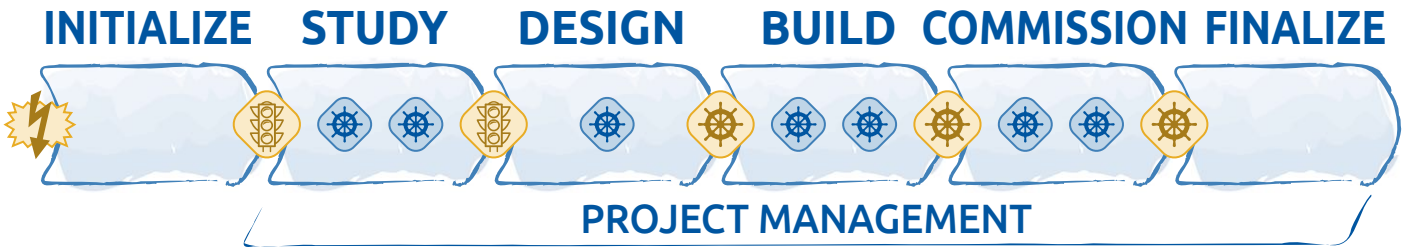
Roles

Processes

- Launching a project
- Ensuring quality
- Defining requirements
- Costing
- Planning & scheduling
- Managing risks
- Reporting progress
- Handling issues
- Finalizing a project

Artefacts

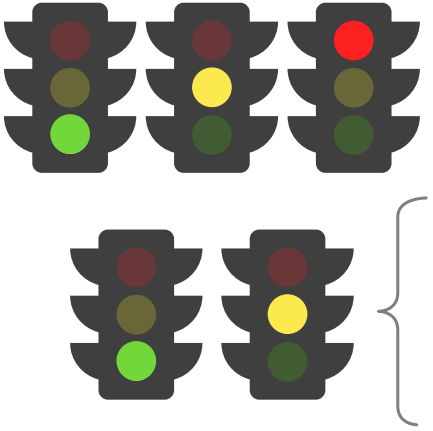
Phases and Decision Points



Phase

Support process

Emerging need or problem



Gonogo decision point

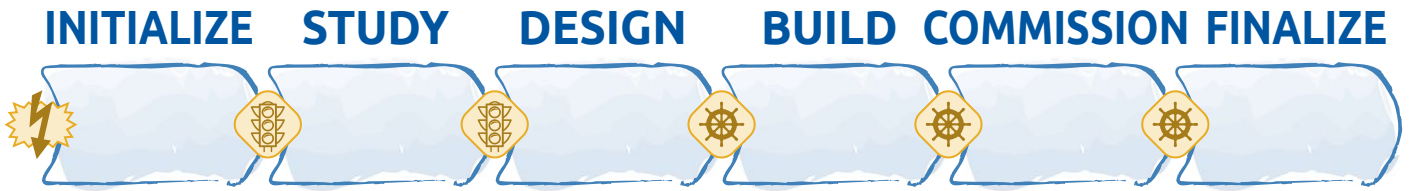
Inter-phase decision points

Drift decision point

Intra-phase decision point

Inspired from Hermes

Phases and Decision Points



Project boundary **defined**

Preferred solution **identified**

Reference solution **designed**

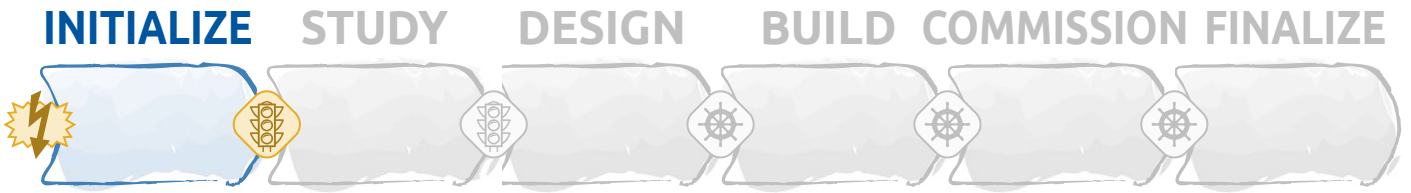
Reference solution **developed**

Reference solution **in-use**

Lessons learned **capitalized**

Inspired from Hermes

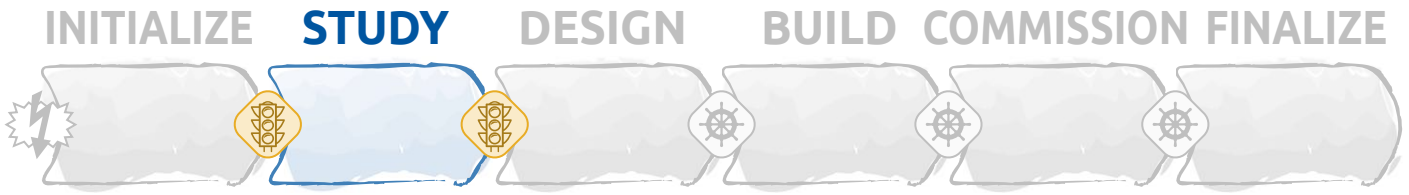
Initialize



- Formalize the **decision** to perform the project
- Analyse the **current situation**; define the **problem**
- Propose some **possible solutions**

Inspired from Hermes

Study



- Define more precisely the **scientific/user requirements**
- Convert the gathered UR's into **product/systems requirements**
- Identify straightforwardly all possible solutions
- Propose one solution and demonstrate its **feasibility**
- If required, develop **prototypes**, mock-ups…

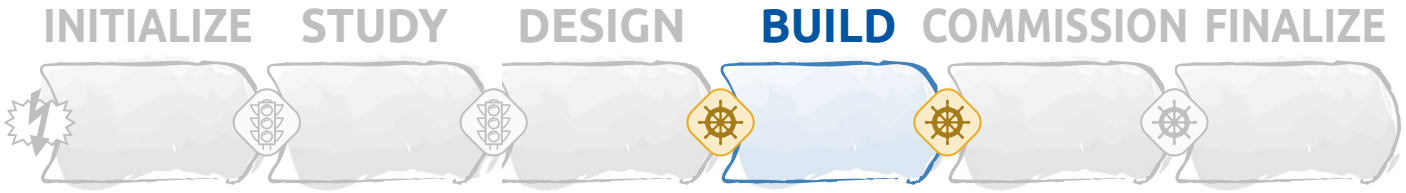
Inspired from Hermes

Design

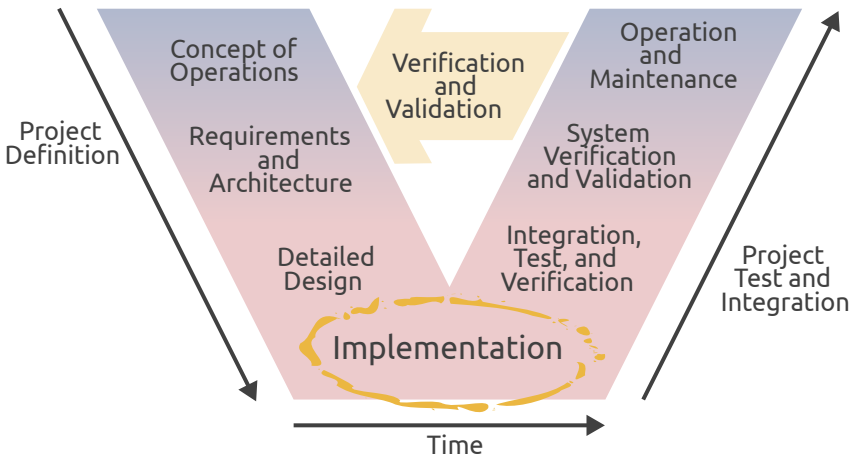
- Finalise the definition of the **scientific/user requirements**
- Finalise the **product/systems requirements** accordingly
- Design the solution (design and engineering tasks)
- Plan the **BUILD** and **COMMISSION** phases
- If required, develop further prototypes, mock-ups…

Inspired from Hermes

Build

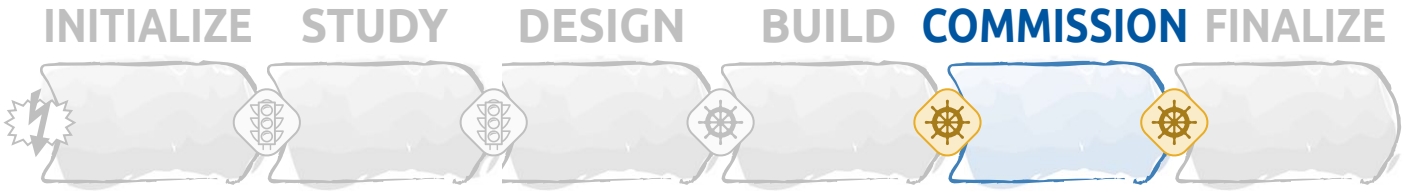


- Perform the **detailed design**
- **Materialize**, i.e. procure, manufacture, assemble…
- **Verify** and **validate** at components and subsystems levels



Inspired from Hermes

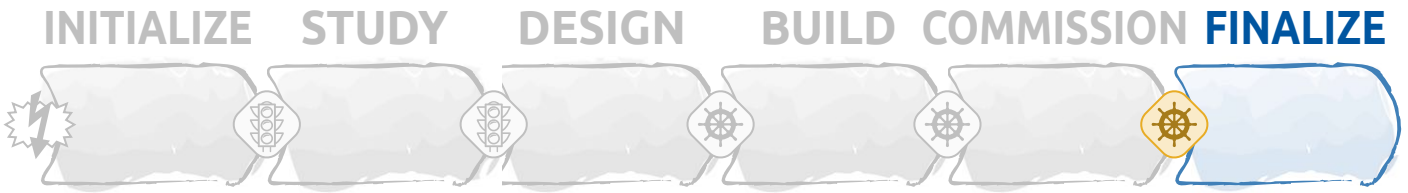
Commission



- Further **validate** (i.e. commission) at systems level
- Refine and ramp-up
- **Train** of the users
- Adapt to the evolving context

Inspired from Hermes

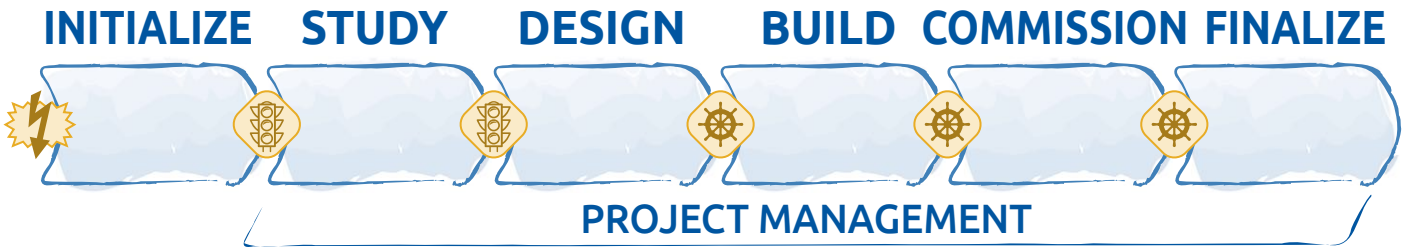
Finalize



- **Capitalize** of the lessons learned

Inspired from Hermes

Support Processes



Launching a project

Ensuring quality

Defining requirements

Costing

Planning & scheduling

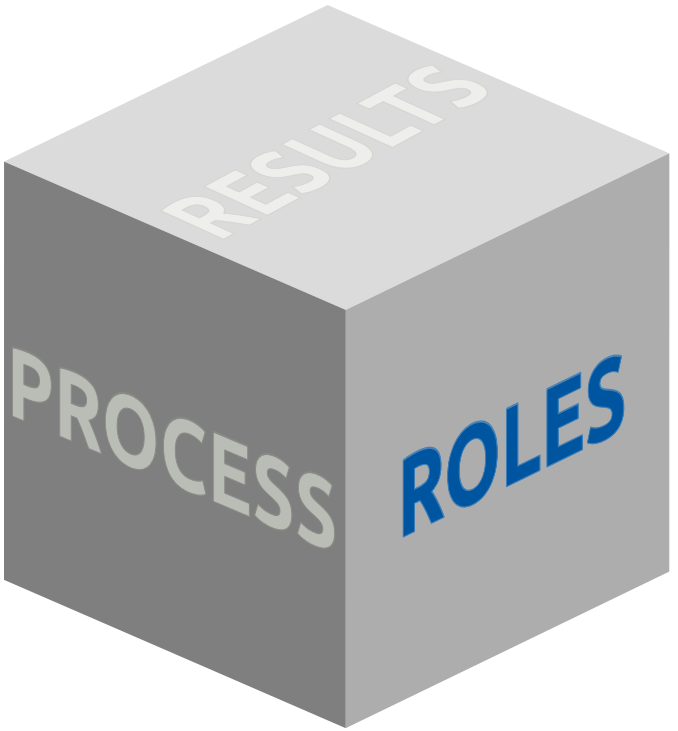
Managing risks

Reporting progress

Handling issues

Finalizing a project

2



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Project Management

What are we going to see together?

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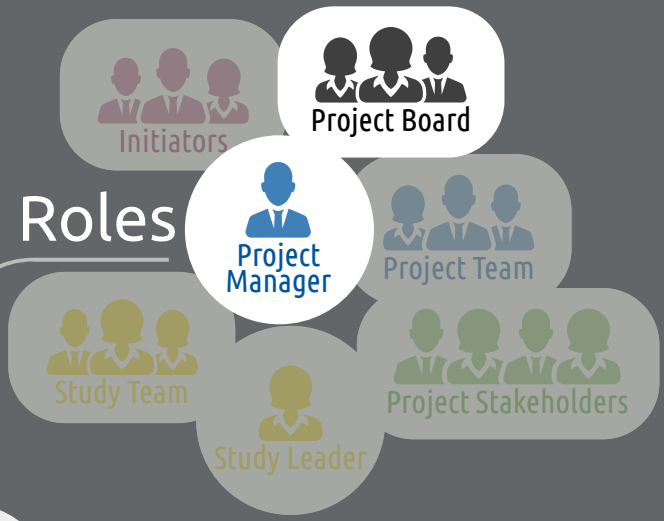
Lifecycle

Inspired from Hermes

Roles



Processes

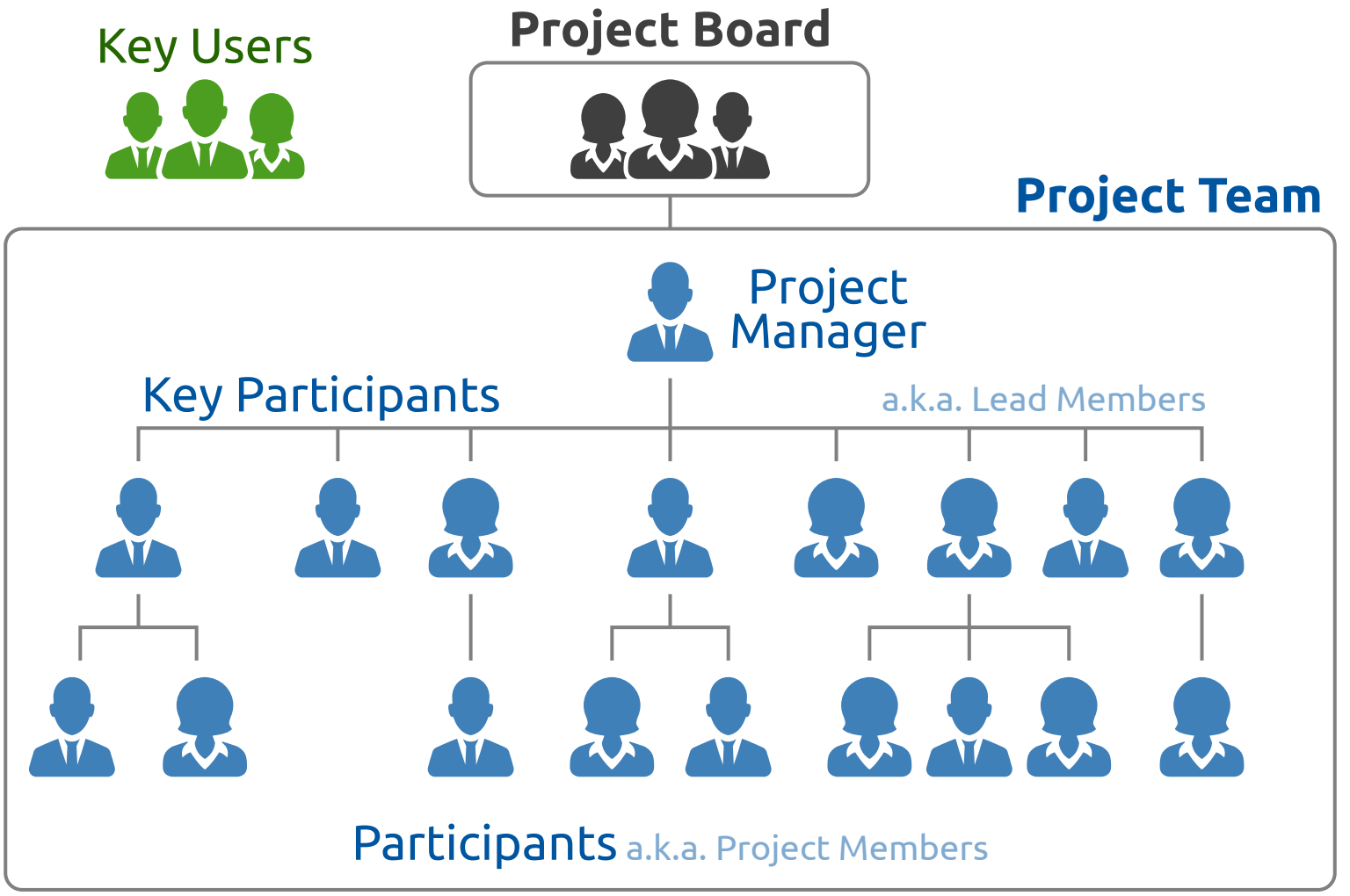
- Launching a project
- Ensuring quality
- Defining requirements
- Costing
- Planning & scheduling
- Managing risks
- Reporting progress
- Handling issues
- Finalizing a project

Artefacts

- Project Proposal
- Project Roadmap
- Project Mngt Plan
- Project PBS & WBS
- Project Schedule
- Project Budget
- Reqts. Register
- Risk Register
- Progress Report(s)

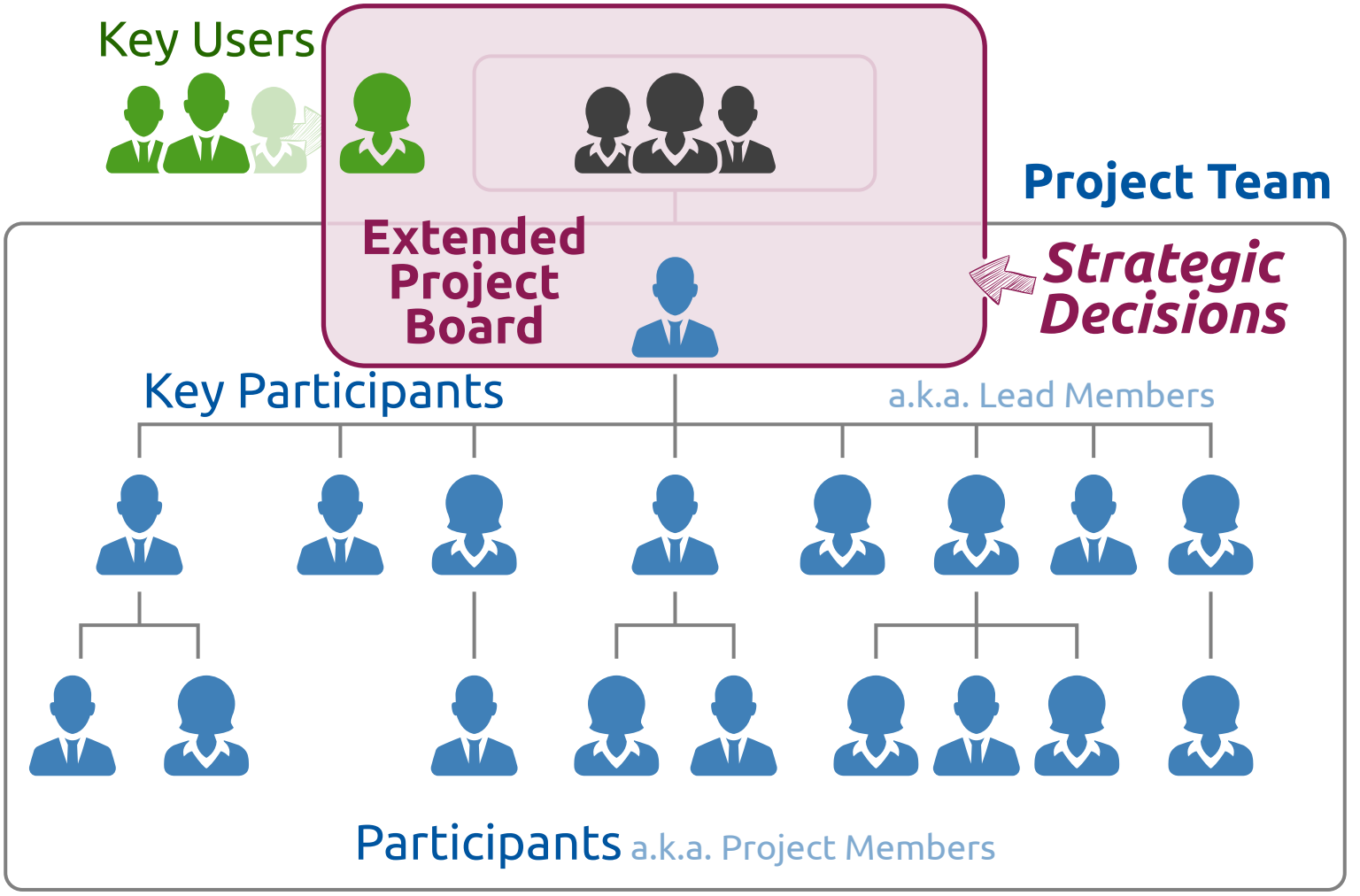
Roles

Core roles



Roles

Core roles



Roles

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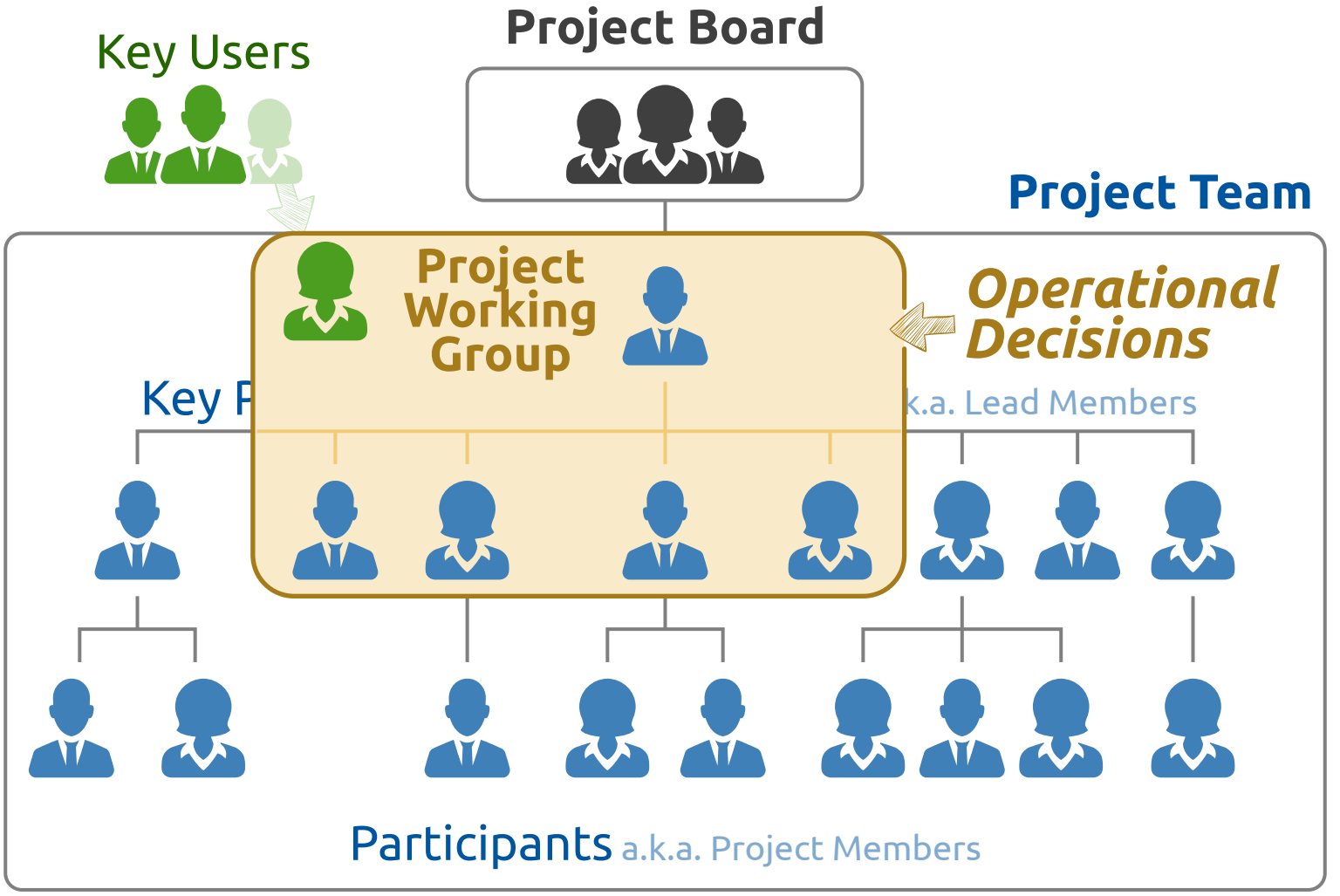
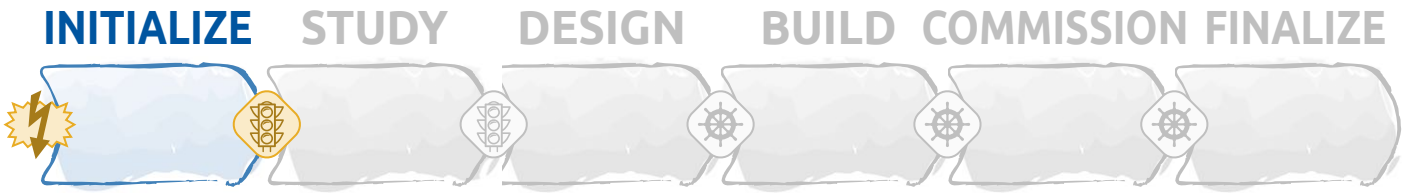
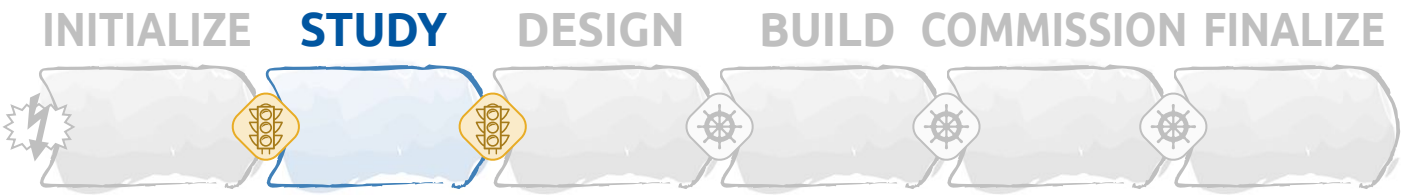


Roles

Core roles



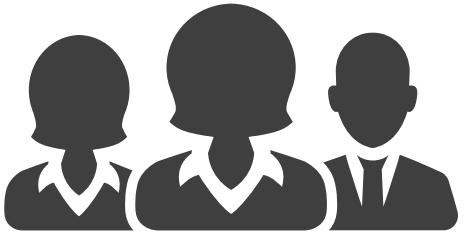
Project Initiators



Study Team

Roles

Responsibilities



Project Board (PB)

Strategic/Steering Board/Committee,
Project Owner, Product/Systems Owner,
Comité de projet (CoP),
Comité de pilotage (COPIL),
Donneur d'ordre,
Maître d'ouvrage (MOU),
Projektausschuss,
Comitato di progetto...

- Ensure the **strategic management** of the project
- Is ultimately responsible w.r.t. successfull completion of the project
- Guarantee the acquisition and availability of resources
- Validate transitions between phases (and intra phases also)
- In case if conflict or disagreement within the project team, arbitrate

Roles

Responsibilities

Project Manager (PM)

Project Leader (PL), Project Coordinator, Coordinator,
Chef de projet (CP), Maître d'œuvre (MŒU),
Projektleiter (PL), capoprogetto (CP)...

- Ensure the **operational management** of the project
- Is responsible for the **organisation** of the project and for its coordination

Most of **project management**
is about setting this organisation

3

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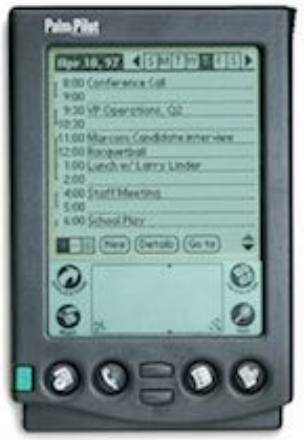
Tangible Results



Prototype(s)

End product

i.e. the final **design** or **item**
+ a few preseries products

Manufacturing plant

incl. the **supply chain**

Key Results

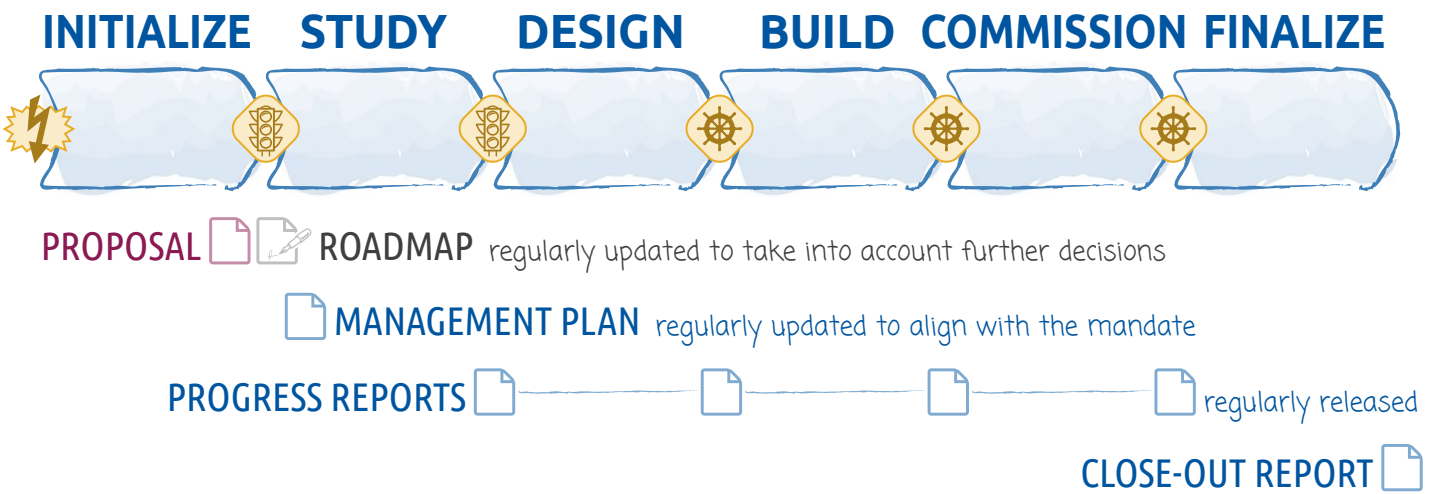
"Lean Project Management"

Proposal **Roadmap** **PM Plan** 5 **Reports**

8 documents!

Key Results

Project Management Documents



3.1

Project Roadmap

openSE

Project Management

What are we going to see together?

Inspired from Hermes

Lifecycle

openSE

Roles

- Initiators
- Project Board
- Project Manager
- Project Team
- Study Team
- Study Leader
- Project Stakeholders

Artefacts

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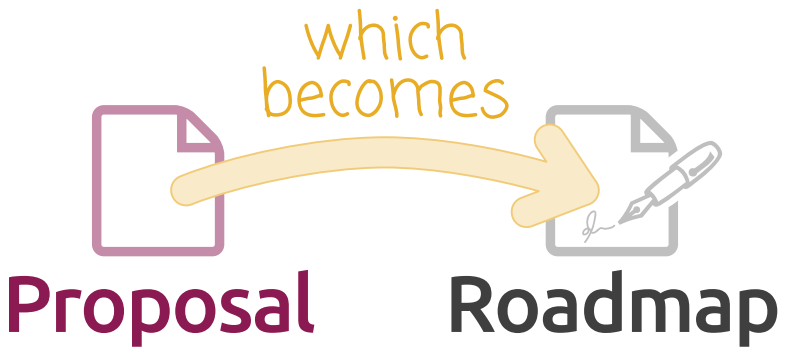
Project Roadmap

It is a document that summarizes the direction to be followed by the project team (for the **STUDY**, **DESIGN**, **BUILD** and **COMMISSIONING** phases)

Other names for this document:

- (Project) Charter
- (Project) Mandate (e.g. GDPM)
- (Project) Mission Statement
- (Project) Brief
- Concept of Operations (systems eng.)



Project Proposal

Typical Table of Contents

Project Proposal

Editorial Process

Authoring: Project Initiators 

Verification: Some experts in the field
The foreseen Project Manager
A few possible Key Project Participants

Validation: ∅

Project Roadmap

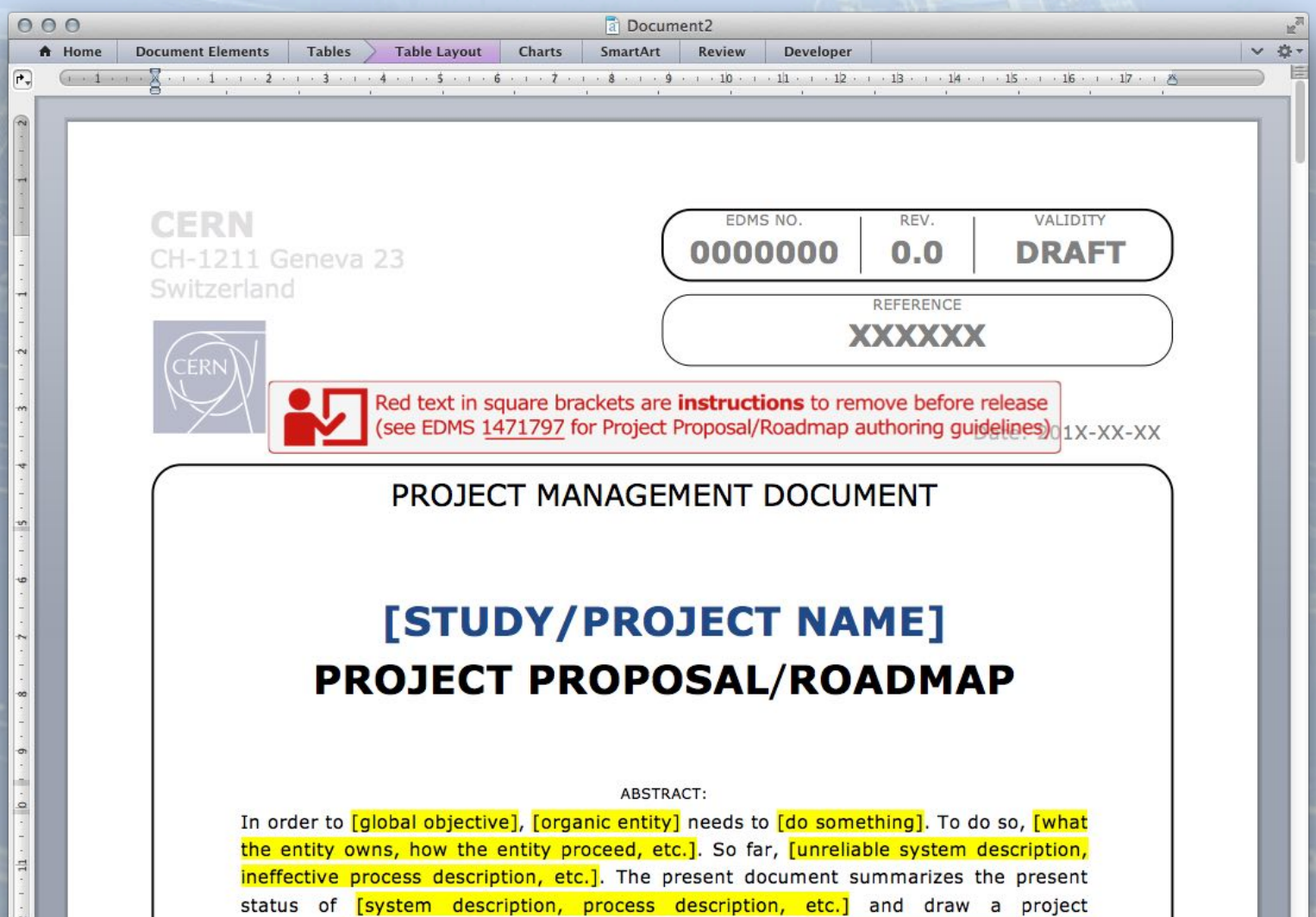
Typical Table of Contents

Project Roadmap

Editorial Process

- **Authoring:** Project Initiators 
- **Verification:** Some experts in the field
  The foreseen Project Manager
  A few possible Key Project Participants
- **Validation:** **Project Board** 

At **CERN** (in the A&T Sector)
Project Proposal/Roadmap
Template and authoring guidelines → EDMS 1471797



Document2

Home | Document Elements | Tables | Table Layout | Charts | SmartArt | Review | Developer

CERN
CH-1211 Geneva 23
Switzerland

EDMS NO.	REV.	VALIDITY
0000000	0.0	DRAFT

REFERENCE
XXXXXX

Red text in square brackets are **instructions** to remove before release (see EDMS 1471797 for Project Proposal/Roadmap authoring guidelines)

Date: 201X-XX-XX

PROJECT MANAGEMENT DOCUMENT

[STUDY/PROJECT NAME]
PROJECT PROPOSAL/ROADMAP

ABSTRACT:

In order to [global objective], [organic entity] needs to [do something]. To do so, [what the entity owns, how the entity proceed, etc.]. So far, [unreliable system description, ineffective process description, etc.]. The present document summarizes the present status of [system description, process description, etc.] and draw a project

4

Project Quality Management

Project Management

What are we going to see together?

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Lifecycle

Inspired from Hermes

Roles

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- Project Stakeholders

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Quality

At a glance

Quality Planning

Quality Assurance

I say what I will do

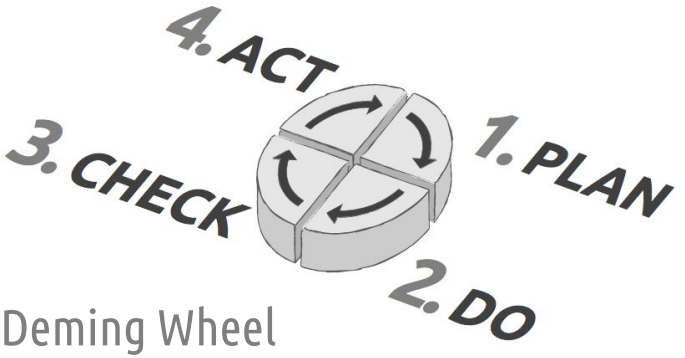
Someone checks that it is appropriate

I do what I have said

I provide evidence of compliance

Quality Control

I also identify defects in the processes and seize the opportunity to improve them



Deming Wheel

4.1

3.2
important
results

Project Management Plan

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Project Management Plan

- The "**entry point**"  to project information
- The aim of the PMP is twofold:
  - Ensuring that the project participants agree upon and share a common framework for organizing their project
  - Giving the project board the assurance that the project expectations are well understood and that everything is done to ensure the operational success of the project
- A few possible approaches depending on the project participants maturity level w.r.t. project management processes

See openSE brochure #1000 "Setting up a Project Management System"

Project Management Plan

Typical Table of Contents
Simple Approach

1 **Project Overview** PMP Scope + Reformulation of the Project Roadmap

2 **Project Organization** Project Board, Project Team, roles, OBS

3 **Project Management Processes**

- 3.1 **Scope Management** WBS, Work Packages, Work Units, Activities
- 3.2 **Time Management** Master and Coordination Schedules
- 3.3 **Resource and Cost Management** Manpower, budgeting, EVM
- 3.4 **Quality Management** Document management, V&V, configuration management, issue and non conformity handling
- 3.5 **Communication Management** Meetings, reporting periodicity
- 3.6 **Risk Management** Project Risk Register, Project Continuity Plans
- 3.7 **Procurement and Contribution Management** Ordering, contracting

A **Applicable Standards**

Project Management Plan

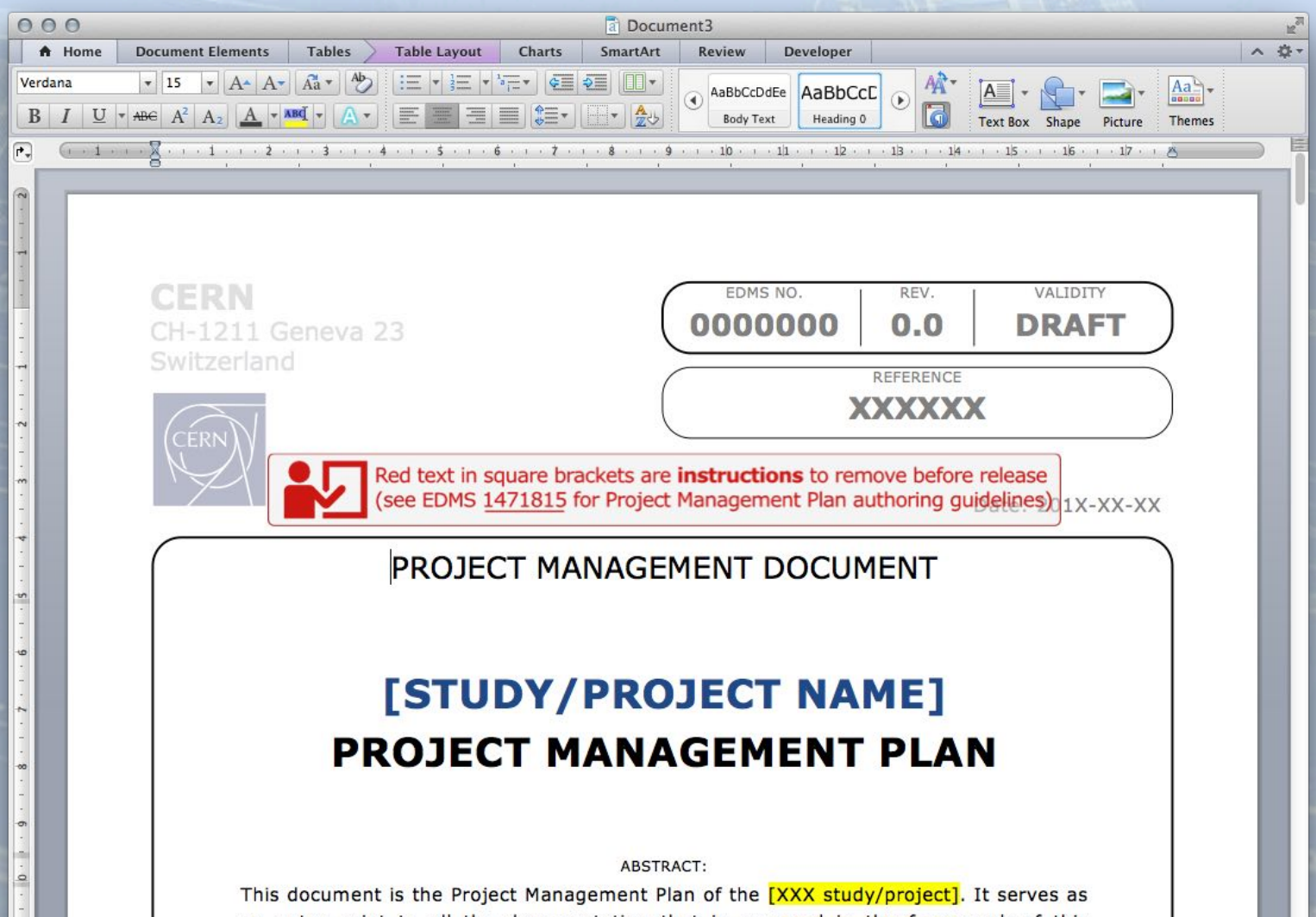
Editorial Process

Authoring: Project Manager 
+ a few Key Project Participants

Verification: Some other Key Project Participants + some Project Management Experts (e.g. members of the PMO)

Validation: **Project Manager** 

At **CERN** (in the A&T Sector)
Project Management Plan
Template and authoring guidelines → EDMS 1471815



4.2

Document Management System

openSE

Project Document Register

Unique ID	Document title	Ver.	Date	Authored by	Verified by	Validated by
100	Project Roadmap					
		0.1	2014-01-13	Alberte		
		0.2	2014-01-20	—	Ursule, Yvone	
		1.0	2014-01-22	—	—	Xavier, Zélie
101	Project Management Plan					
		0.1	2014-02-05	Alberte, Barnabé		
102	Project Work Breakdown Structure					
103	Project Cost Estimate					
104	Project Budget					
105	Project Master Schedule					
		0.1	2014-02-07	Alberte, Cyprien		
106	Project Coordination Schedule					
107	Project RACI Matrix					
108	Project Risk Register					

At **CERN** (in the A&T Sector)
Project Document Registers

- **EDMS** → 100% engineering and PM documents
- **EDMS/CDD** → 2D drawings
- **CATIA/SmarTeam** → 3D models
- **CDS** → Scientific publications (reports, notes)
- **Indico** → Presentations
- **SharePoint** or **Drupal** → General project information
- **DFS** → Nothing! Very bad practice
- **CFU/CDS** → Released procurement documents

No project-wide document register!

Project Document Template

Unique ID	Version	Status	Date
101	**0.3**	**DRAFT**	2014-02-22

the whatever project

PROJECT MANAGEMENT PLAN

Authored by:	Verified by:	To be validated by:
Alberte Barnabé	Cyprien Denise	Ernest

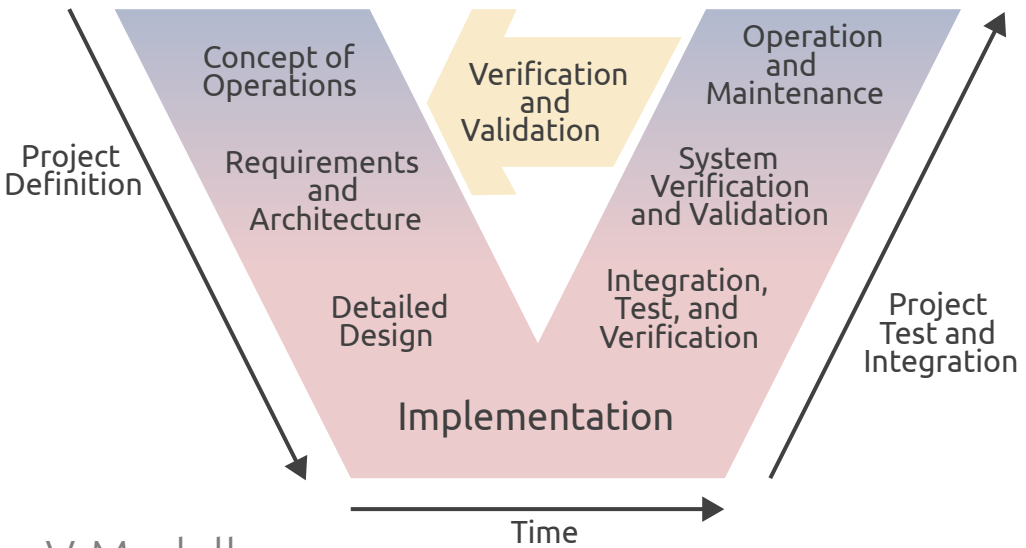
This document is uncontrolled when printed.
Check the Project Document Register to verify
that this is the correct version before use

Verification vs. Validation

Check vs. Approval

From Software Engineering but also widely applied to document lifecycle

Concept introduced by **Barry W. Boehm** (1981)



V-Modell

Verification:
Are we building the product right?
Are we solving the equation right?

Validation:
Are we building the right product?
Are we solving the right equation?

5

Requirements Engineering

openSE

Project Management

What are we going to see together?

Inspired from Hermes

Lifecycle

openSE

Roles

- Initiators
- Project Board
- Project Manager
- Project Team
- Study Team
- Study Leader
- Project Stakeholders

Artefacts

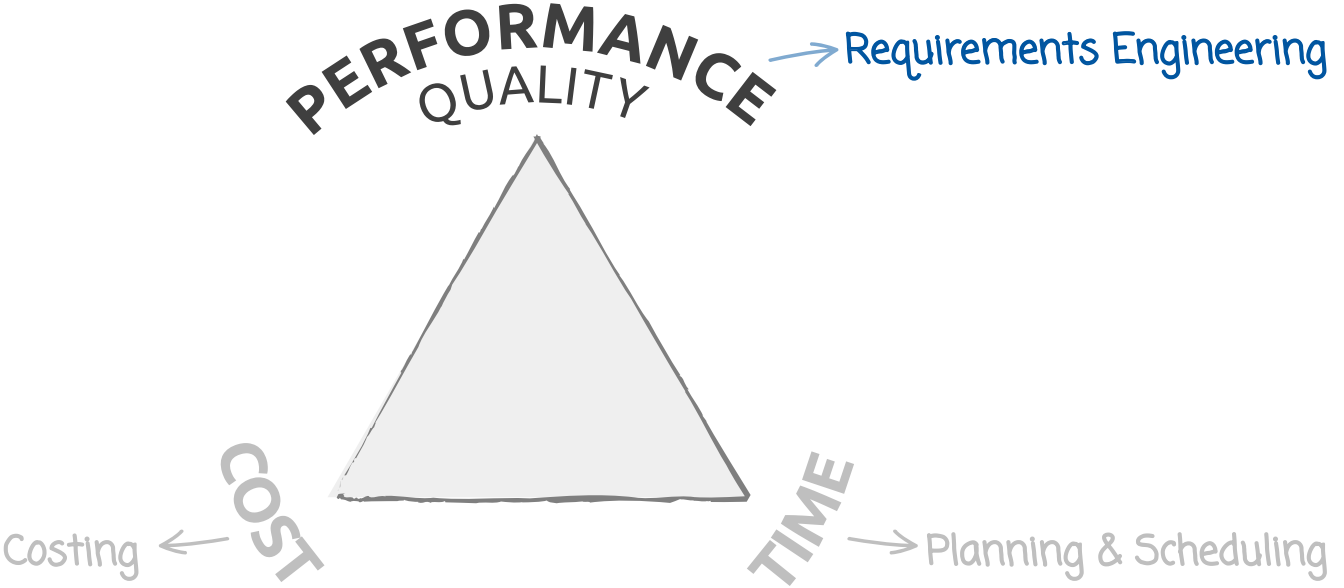
- Project Proposal
- Project Roadmap
- Project Mngt Plan
- Project PBS & WBS
- Project Schedule
- Project Budget
- Reqts. Register
- Risk Register
- Progress Report(s)

Processes

- Launching a project
- Ensuring quality
- Defining requirements
- Costing
- Planning & scheduling
- Managing risks
- Reporting progress
- Handling issues
- Finalizing a project

Requirement(s) Engineering

"Project triangle"



Requirement(s) Engineering

The process of documenting, analyzing, tracing, prioritizing and agreeing on requirements and then controlling change and communicating to relevant stakeholders

en.Wikipedia.org

- Procurement and Purchasing → **technical specification** writting
- Quality Management → **QFD** (Quality Function Deployment) and the ***House of Quality*** ← 60's-70's in Japan
- New Product Development → gathering **customers needs** and translating them into **specifications** or specification items ← 80's
- Software Engineering → capturing **users requirements** ← 90's
- Systems Engineering → identifying **users** vs. **functional** vs. **non-functional requirements** ← ca. 2005

Typology

Requirements

Business & User Requirements*

~ **Customer Needs***
or Customer Attributes**
or Stakeholder Intentions*
or sometimes just Expectations

Problem Domain

System(s) or Product or Service or Organization Requirements

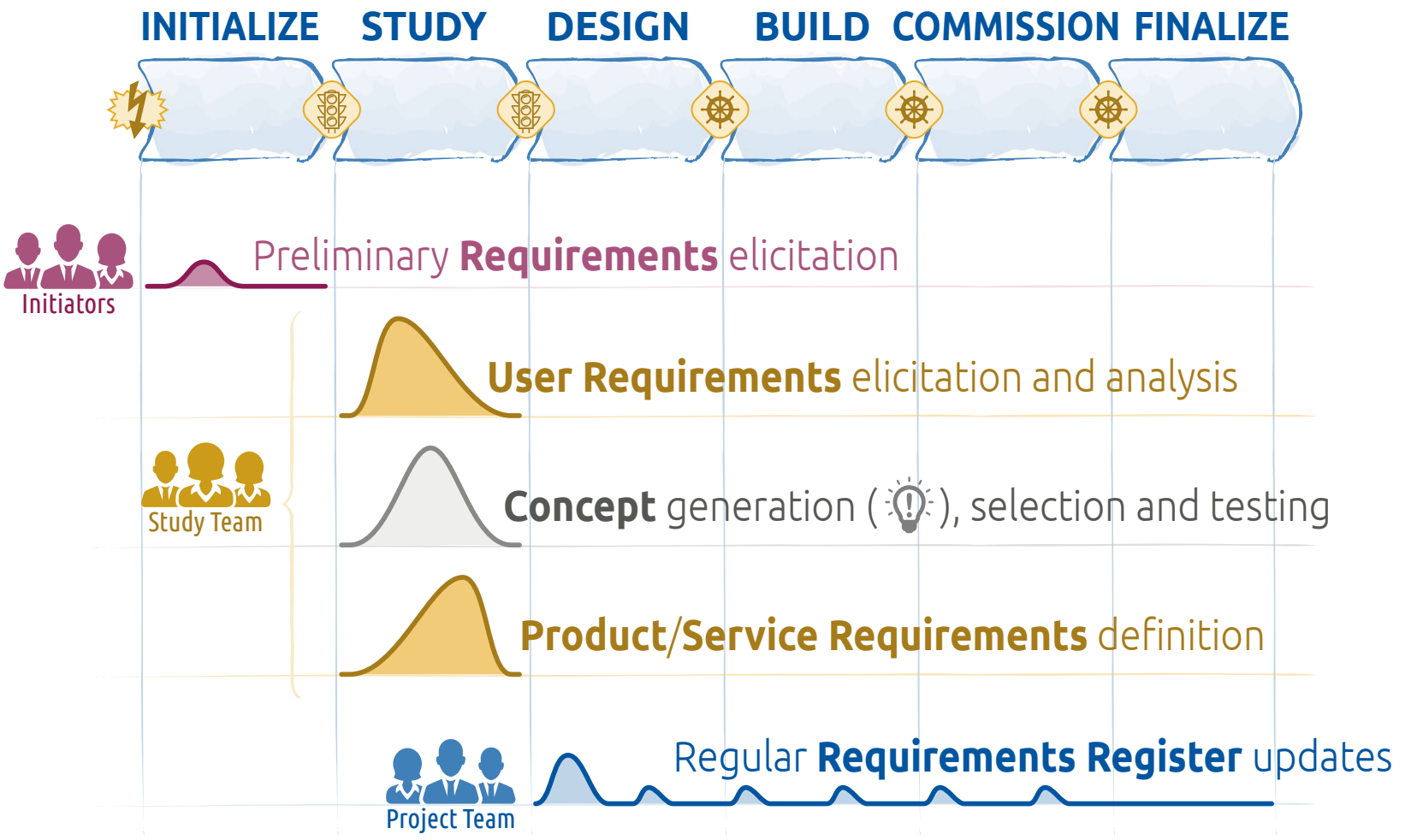
~ **Product/Service Specification**
Functional Requirements*
or Product/Service Characteristics

Solution Domain

- *ISO/IEC/IEEE 29148:2011 Requirements Engineering
- *Karl Ulrich, Steve Eppinger (2011) Product Design and Development. McGraw-Hill/Irwin
- *Nam-pyo Suh (1990) Principles of Design. Oxford University Press
- *John Hauser, Don Clausing (1988) The House of Quality. HBR

Requirements Engineering

When and which effort?



5.1

User Requirements

openSE

User Requirements

1. Identifying the **stakeholders** (end users, key users, customers, etc.)
2. Elicitating the **user requirements**
   - 2.1 Gathering **raw needs**

When and why do you (or will you) **use** this product/service?
Walk us through a **typical usage** of it
What do you **like** (👍) about the (existing) product/service?
What do you **dislike** (👎) about the (existing) product/service?
What issues do/will you consider when using it?
What **improvements** would you make to it?

   - 2.2 Translating raw data into **interpreted user requirements**
   - 2.3 Organizing the IUR's into a list → prelim. **Requirements Register***

*Stakeholder Requirements Specification (StRS) or preliminary Systems Requirements Specification (SyRS)

User Requirements

2.2 Translating raw data into **interpreted user requirements**

- Raw needs → *"in any vernacular spoken by the users"*
- Requirements → in a formal language*, a.k.a. *"shall-statements"* or "**deontic statements**"

  this applies to all types of requirements

  - "**Shall**" indicates **mandatory** or **binding** requirements strictly to be followed in order to conform and from which no deviation is permitted
    ("shall" equals "is required to")
  - "**Should**" indicates that among several possibilities one is **recommended** as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required
    ("should" equals "is recommended that")

*ISO/IEC/IEEE 29148:2011 Requirements Engineering → § 5.2.4 Requirements Constructs

User Requirements

2.2 Translating raw data into **interpreted user requirements**

- "**May**" is used to indicate a course of **action permissible**, of **allowance** or **suggestion** ("may" equals "is permited to")
- "**Can**" is used for statements of **possibility** and **capability**, whether material, physical, or causal ("can" equals "is able to")
- "shall" or "should" or "may" or "can"

Mandatory — Desirable — Optional — Possible (future enhancement)

- ~~"must"~~

"It is best to avoid using the term 'must' due to potential misunderstanding as a requirement"*

- "**Will**" is used for **statement of fact**, **futurity**, or **declaration of purpose**

*ISO/IEC/IEEE 29148:2011 Requirements Engineering → p. 10

User Requirements

2.3 Organizing the IUR's into a list → prelim. **requirements register**

- Merging all interpreted user requirements in a list
- From a few dozens to several hundred IUR's
- Eliminating redundant “shall-statements”
- Flagging them: **M**andatory, **D**esirable, **O**ptional, **P**ossible
- Grouping them according to the similarities of the needs they express

⚠ UR's (and IUR's) can be contradictory! → "the product shall be red"
"the product shall be blue"

- Requirements breakdown into more focused requirements

5.2

Solutions / Concepts

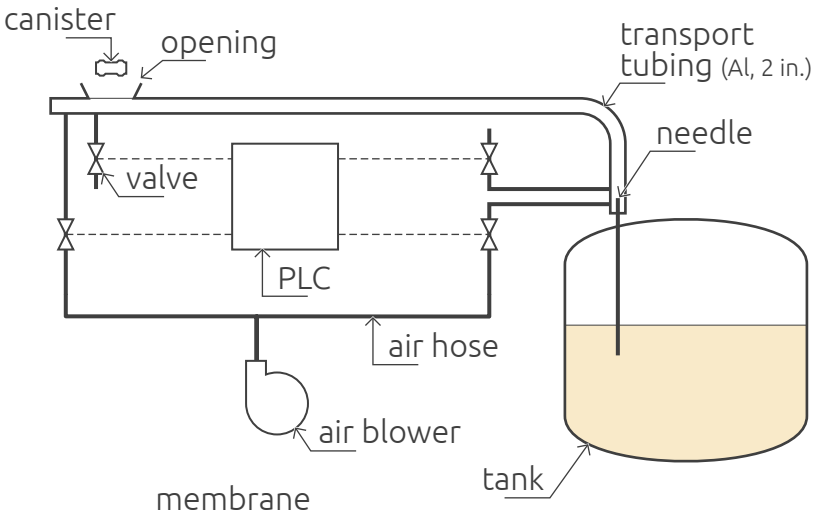
openSE

Requirements Engineering

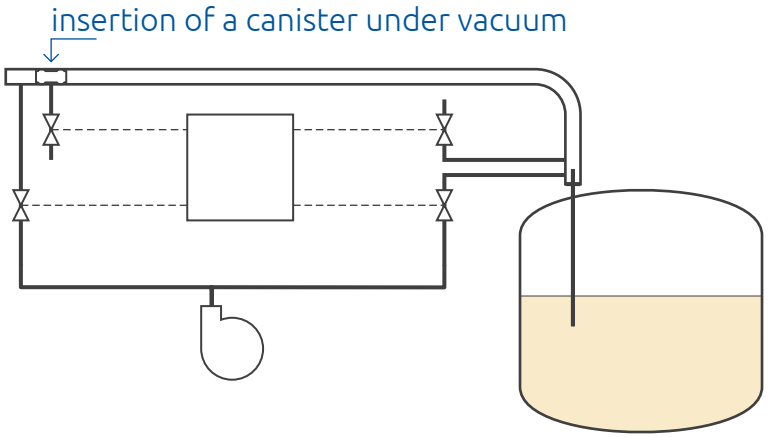
A nine-step process ➔ **incremental** innovations / **market-pull** services

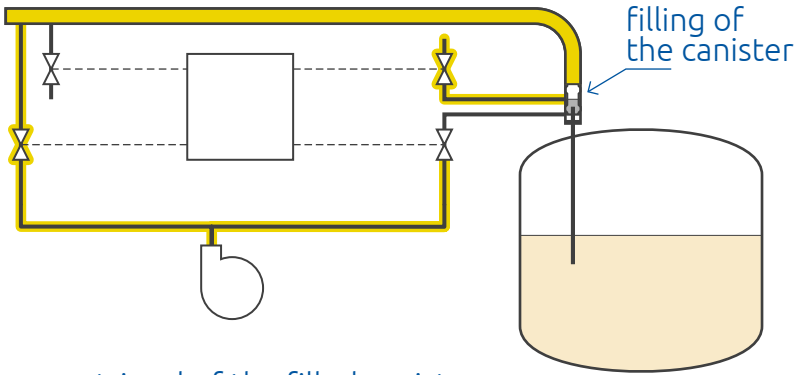
1. Identifying the **stakeholders** (end users, key users, customers, etc.)
2. Collecting the **user requirements** (~ needs gathering)
3. Searching for **solutions** (~ concept generation)
4. Translating the **user requirements** into **target requirements** (~ target specifications setting)
5. Benchmarking the **solutions** (~ concept selection and testing)
6. Setting the **final requirements** (~ final specifications setting)
7. Developing the **solution**, the **system**, **product**, **service** or **organization** (i.e. going through the **DESIGN** and **BUILD** phases)
8. Verifying the deliverable w.r.t. the **service requirements**
9. Validating the end deliverable w.r.t. the **user requirements**

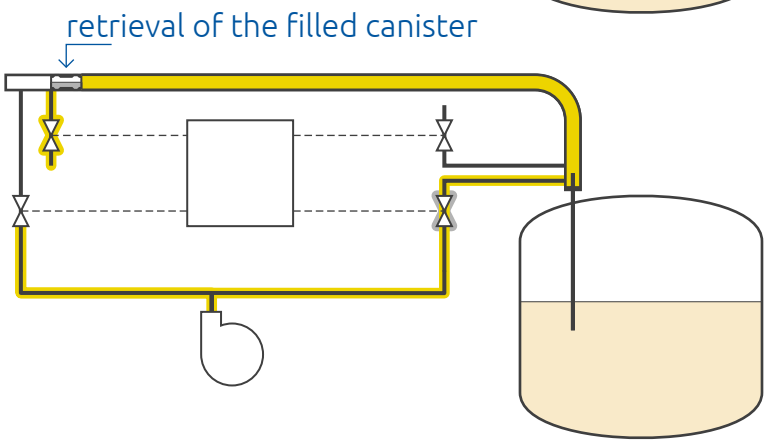
The process


canister
opening
transport
tubing (Al, 2 in.)
needle
valve
PLC
air hose
air blower
tank

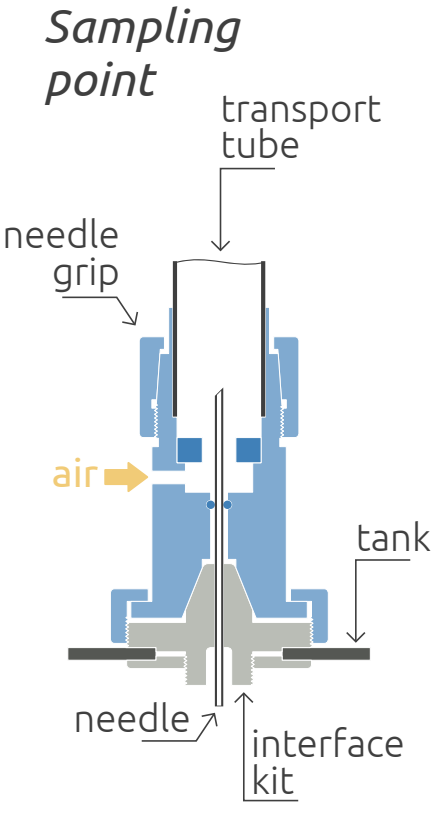

membrane

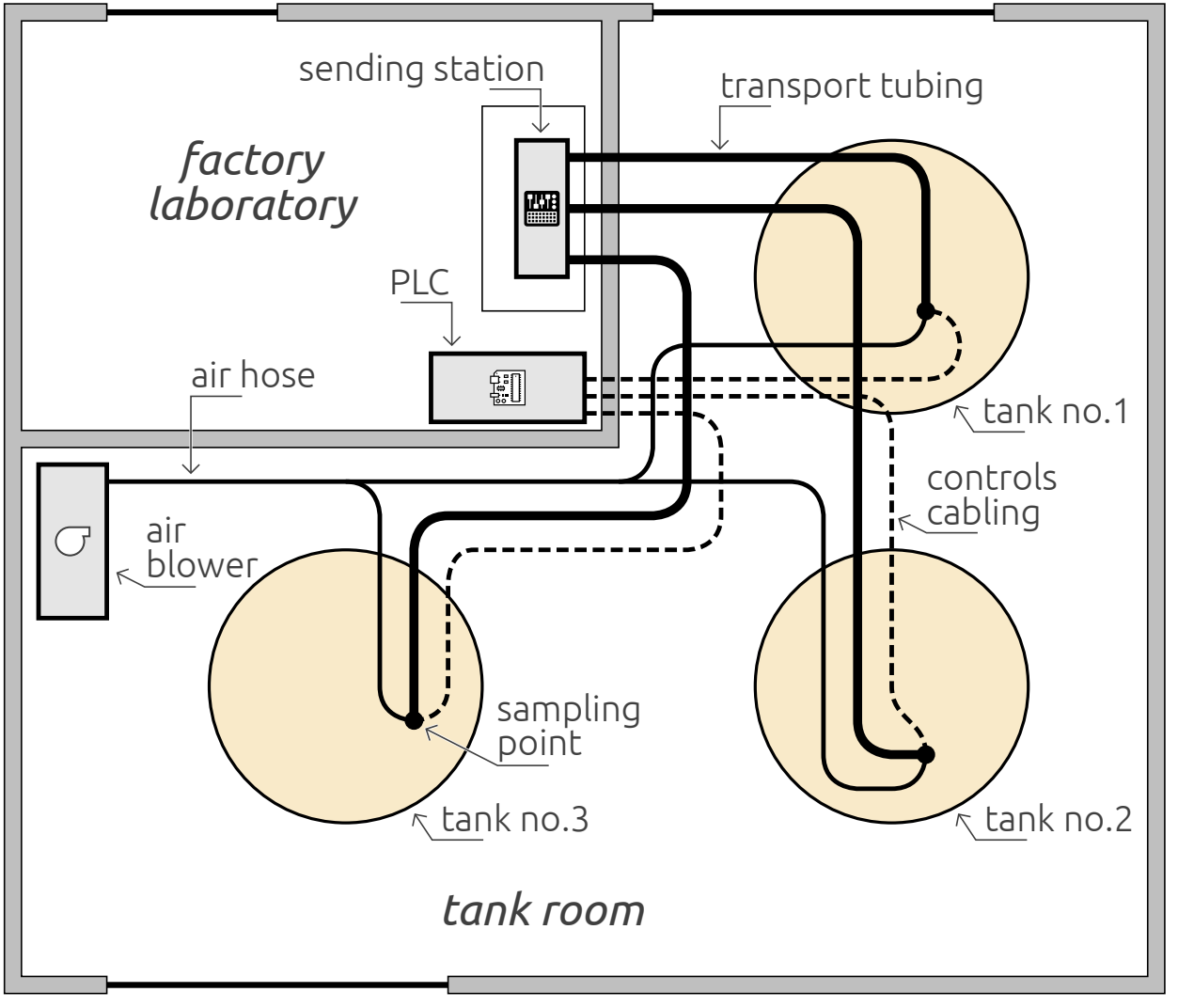

insertion of a canister under vacuum


filling of
the canister

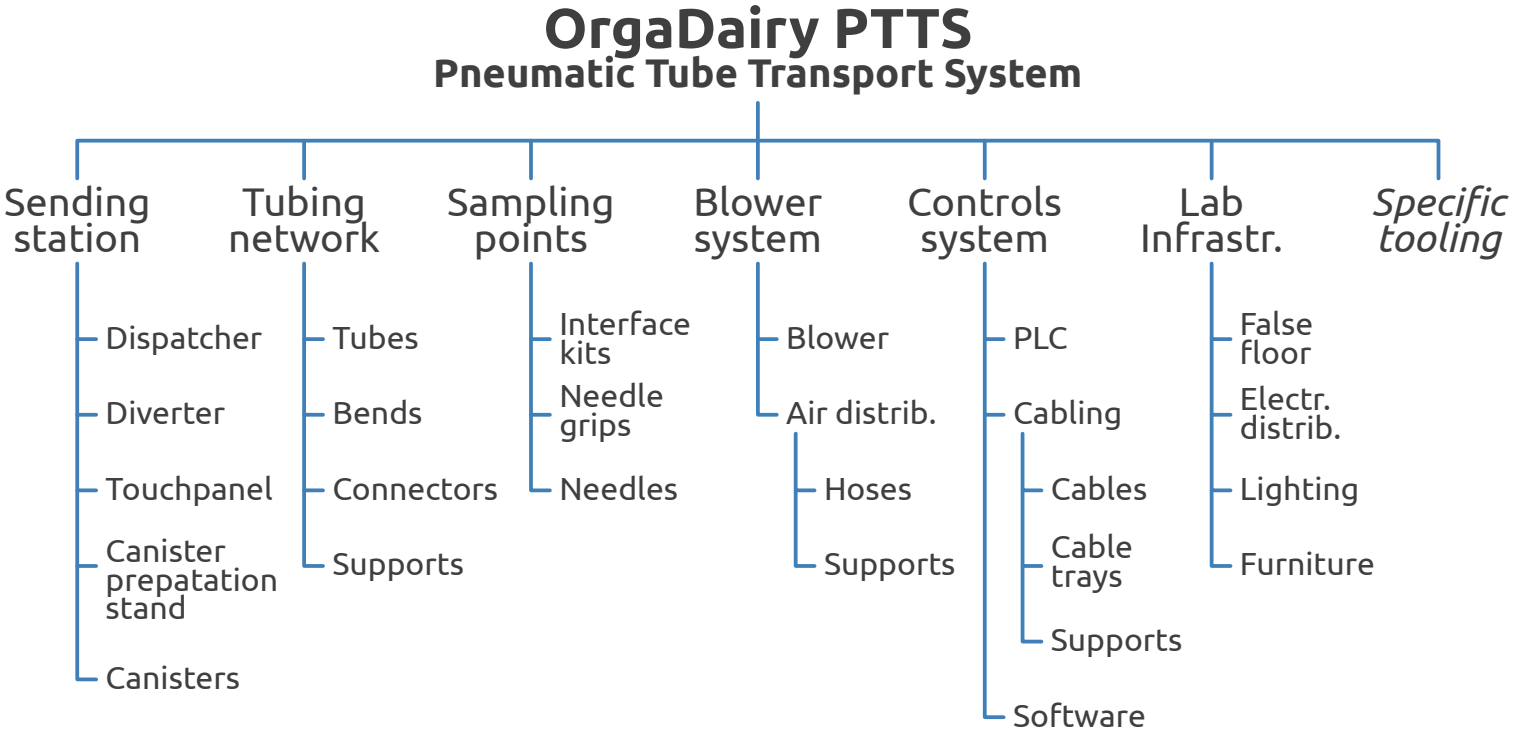

retrieval of the filled canister

The layout


Sampling point
transport tube
needle grip
air
tank
needle
interface kit


sending station
transport tubing
factory laboratory
PLC
air hose
tank no.1
controls cabling
air blower
sampling point
tank no.3
tank no.2
tank room

*Product Breakdown Structure (**PBS**)*



velib'


velib'
MAIRIE DE PARIS
La ville est plus belle à vélo
www.velib-paris.fr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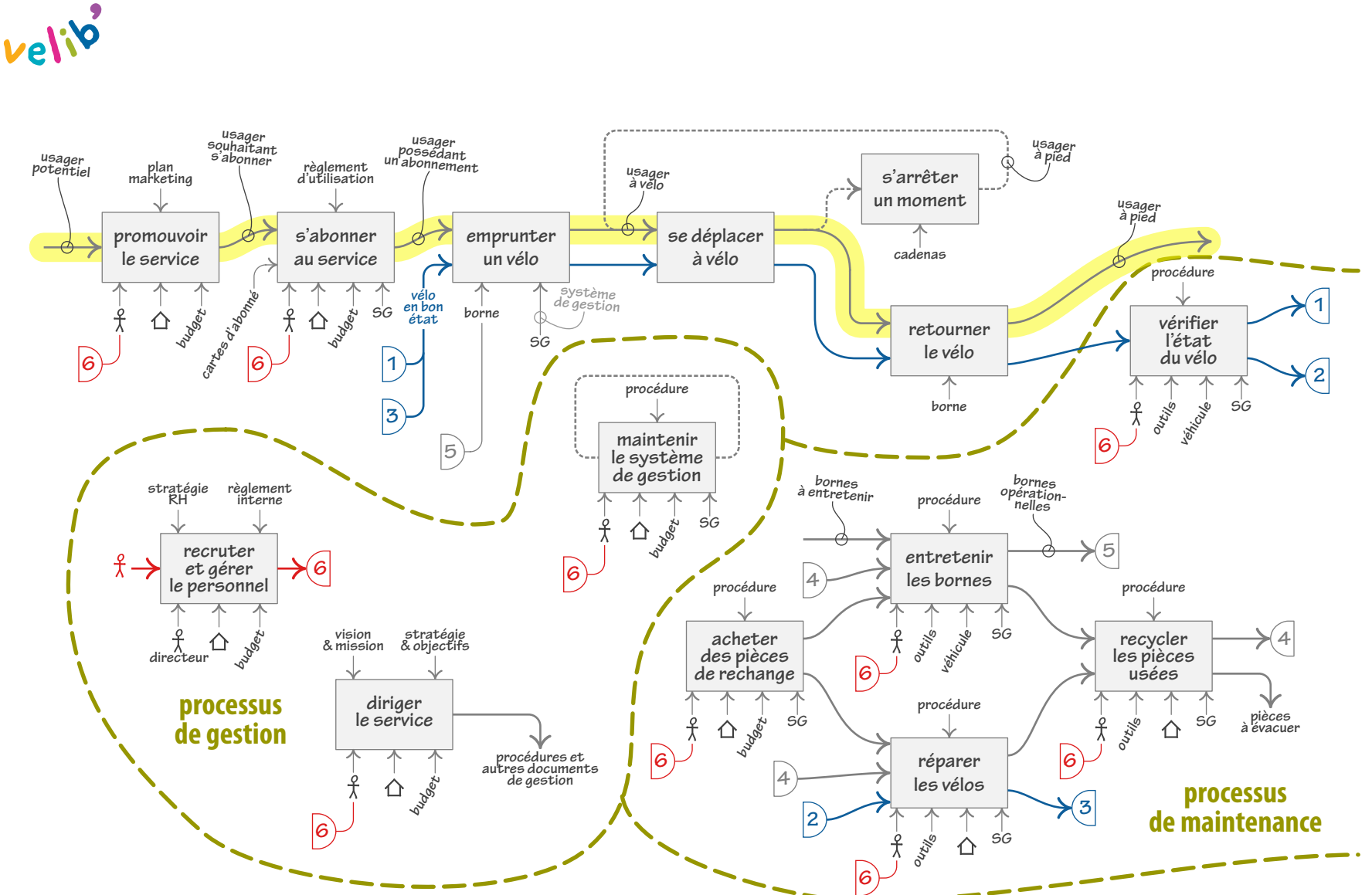
MAIRIE DE PARIS
velib.paris.fr


velib'
RÉCÉPISSÉ
CARTE BANCAIRE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usager potentiel
plan marketing
usager souhaitant s'abonner
règlement d'utilisation
usager possédant un abonnement
usager à vélo
usager à pied
promouvoir le service
s'abonner au service
emprunter un vélo
se déplacer à vélo
s'arrêter un moment
cadenas
retourner le vélo
borne
vérifier l'état du vélo
procédure
outils
véhicule
SG
budget
cartes d'abonné
vélo en bon état
système de gestion
maintenir le système de gestion
stratégie RH
règlement interne
recruter et gérer le personnel
directeur
processus de gestion
vision & mission
stratégie & objectifs
diriger le service
procédures et autres documents de gestion
bornes à entretenir
bornes opération-nelles
entretenir les bornes
acheter des pièces de rechange
réparer les vélos
recycler les pièces usées
pièces à évacuer
processus de maintenance

5.3

Product/Service Requirements

Product/Service Requirements

- User requirements are expressed in the language of the user
- Too much space is left for subjective interpretation
- The achievement of product/service requirements shall be measurable
- Product/service requirements are expressed in engineer's language

4 Translating the **user requirements** into **target requirements**
(~ target specifications setting)

- **4.1** Based on the IUR's, preparing a list of **metrics** → one to one mapping (House of Quality, **QFD**)
- **4.2** Collecting **competitive benchmarking** information
- **4.3** Setting ideal and marginally acceptable **target values**
- **4.4** Translate target values into **target requirement** statements

→ "formal shall-statements"

Service Requirements

4.3 Setting ideal and marginally acceptable **target values**

- Five ways to express values in metrics:
  at least *X*, at most *X*, between *X* and *Y*, exactly *X*, discrete values

Metric #1:
Attenuation from drop out to handlebar at 10 Hz > 13 dB

Metric #2:
Spring preload > 700 N

Metric #3:
Number of travel requests processed per day > 10

Metric #4:
ERP - Travel-IT DB synchronization < 10 min

4.4 Translate target values into **target requirement** statements

- In the form of a formal *"shall-statement"*:
  "the product/service [shall | should | can | may] do, be, etc..."

Product Reqt. #1:
The fork shall have an attenuation from drop out to handlebar at 10 Hz that is at least 13 dB

Product Reqt. #2:
The fork should have a spring preload of at least 700 N

Service Reqt. #3:
The travel arrangers shall process at least 10 travel requests per day

Service Reqt. #4:
The Travel-IT DB shall be synchonized with the central ERP at most every 10 minutes

5.4

Requirements Register

Requirements Register

ProR eclipse
consentor
IBM DOORS
Innoslate

It is a structured list of requirements

Microsoft Excel spreadsheet

- Rqt. **ID** and a short description
- So-called "***shall-statement***"
- Category or **type**, e.g. raw need/IUR or P/S Reqts and **subtype**
- **Compliance** to solutions, and for each solution:
  - Compliant (C)
  - Partialy compliant (PC)
  - Not compliant (¬C or NC)
  - Compliance not applicable (NA)
  - Compliance to be defined (TBD)
- **Deviation** request(s) and decision(s)

Requirements Register (cont'd)

- **Relationships** between requirements:
  - **Containement** Split of a composite reqt.
  - **Derivation** Reqt. of lower level in hierarchy
  - **Refinement**

- **Qualification** method:
  - **Tests** (T), destructive on samples or not destructive
  - **Analyses** (A), calculations, etc.
  - **Inspections** (I), incl. visual inspections
  - **Reviews** (R), design reviews, etc.
- **Qualification** procedure(s), report(s) and status
- **Nonconformance** report(s) and decision(s)
- Editorial quality control: comments, traceability information, requirement status (draft, V&V, etc.)

Verification for P/SRs
Validation for IURs

but also **theatralization** for service devt. projects

for reqt. statements

6

Project Planning & Scheduling

Project Management

What are we going to see together?

Inspired from Hermes

Lifecycle

openSE

Roles

- Initiators
- Project Board
- Project Manager
- Project Team
- Study Team
- Study Leader
- Project Stakeholders

Artefacts

- Project Proposal
- Project Roadmap
- Project Mngt Plan
- Project PBS & WBS
- Project Schedule
- Project Budget
- Reqts. Register
- Risk Register
- Progress Report(s)

Processes

- Launching a project
- Ensuring quality
- Defining requirements
- Planning & scheduling
- Costing
- Managing risks
- Reporting progress
- Handling issues
- Finalizing a project

Typology

2 types of **project schedules**

Master Schedule

~ Summary Schedule
Masterplan
Calendrier directeur

Strategic level
The whole project
Intuitive approach

One page/slide
Can be in the **Project Roadmap**

Coordination Schedule

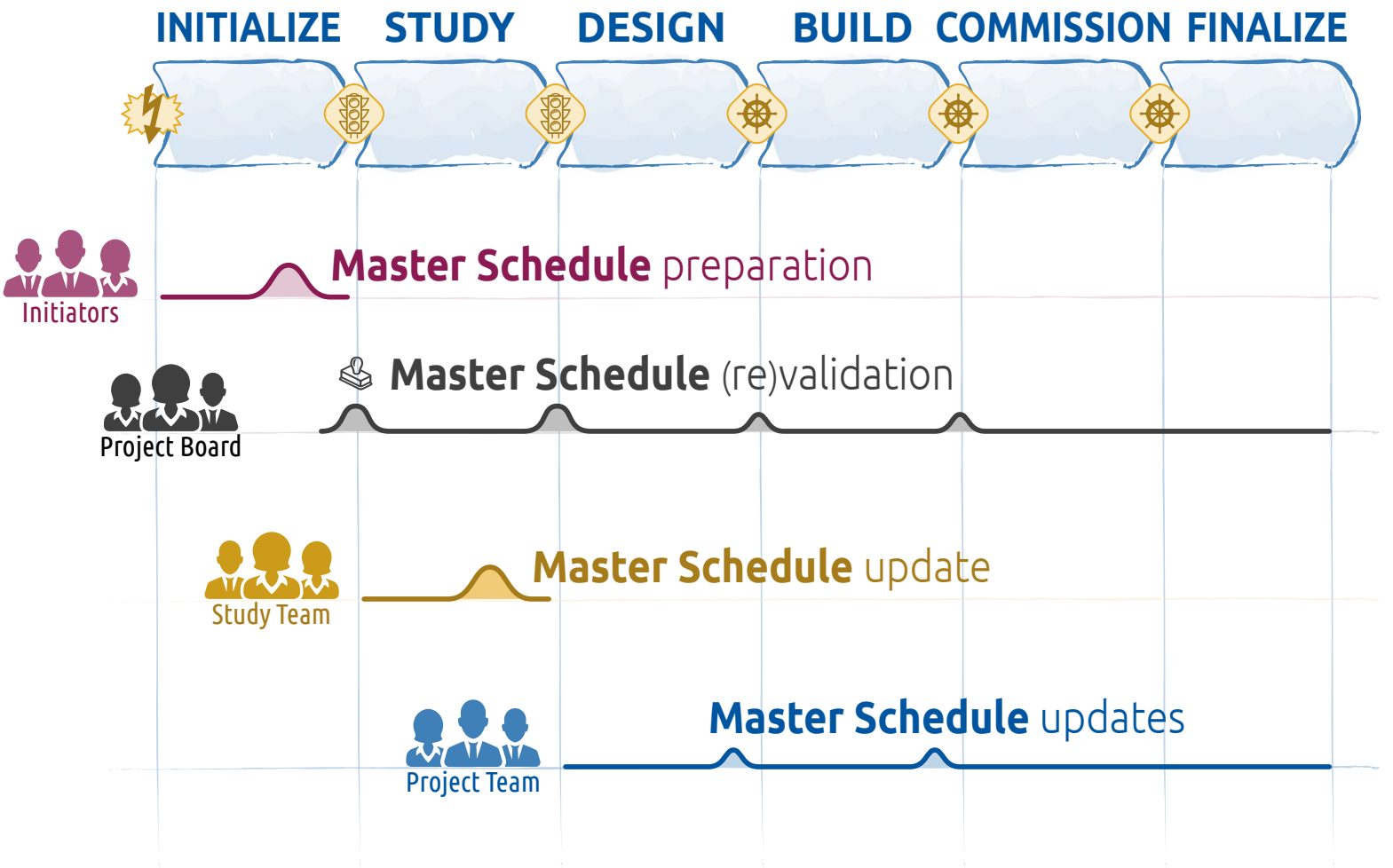
~ ~~"PERT"~~, Gantt chart
Activity network
Calendrier de coordination

Tactical level
One or a few phases
Analytical approach

Several pages
Can be in the **PMP**

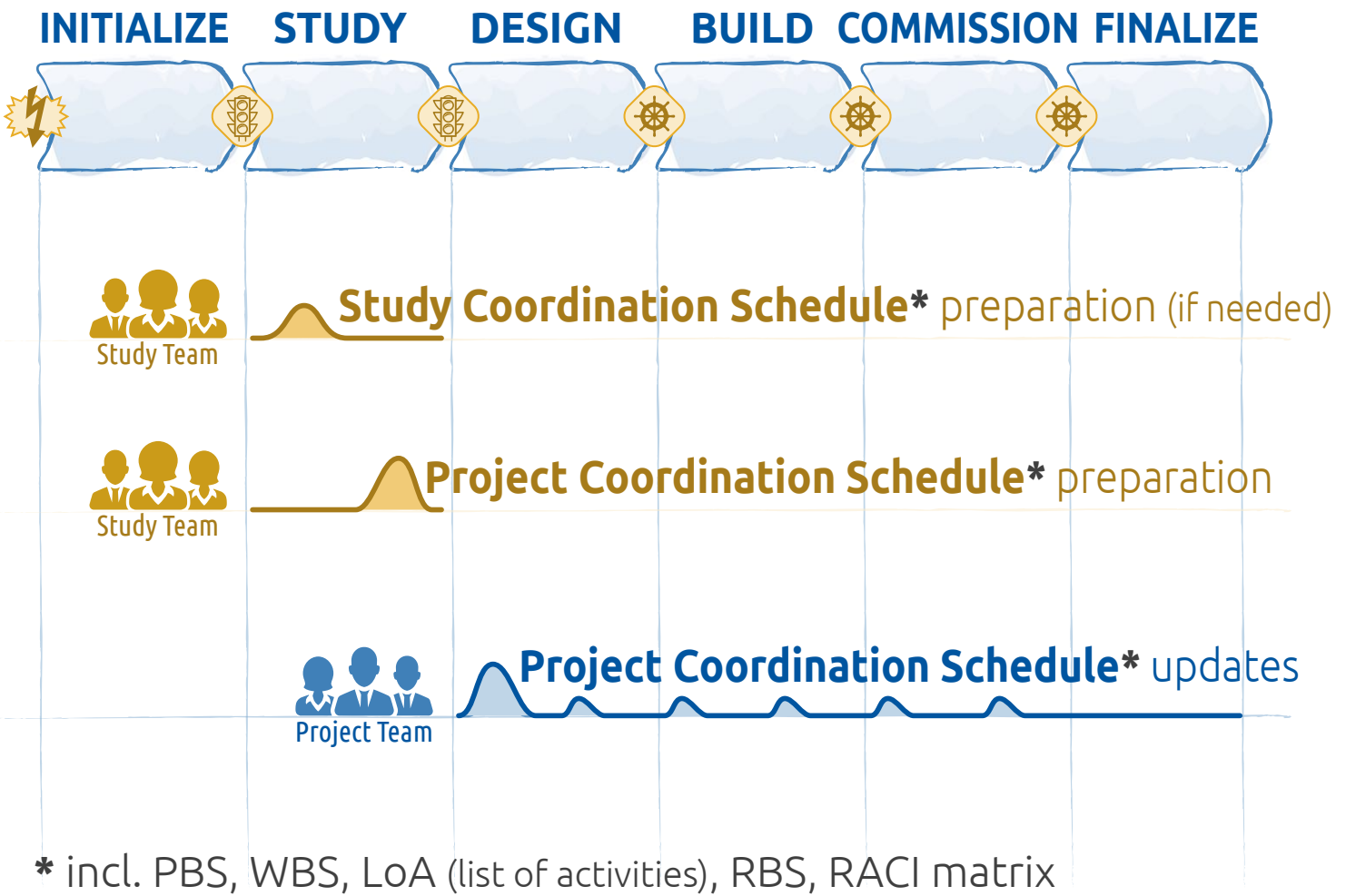
Master Schedule

When and which effort?



Coordination Schedule

When and which effort?



* incl. PBS, WBS, LoA (list of activities), RBS, RACI matrix

6.1

Master Schedule

openSE

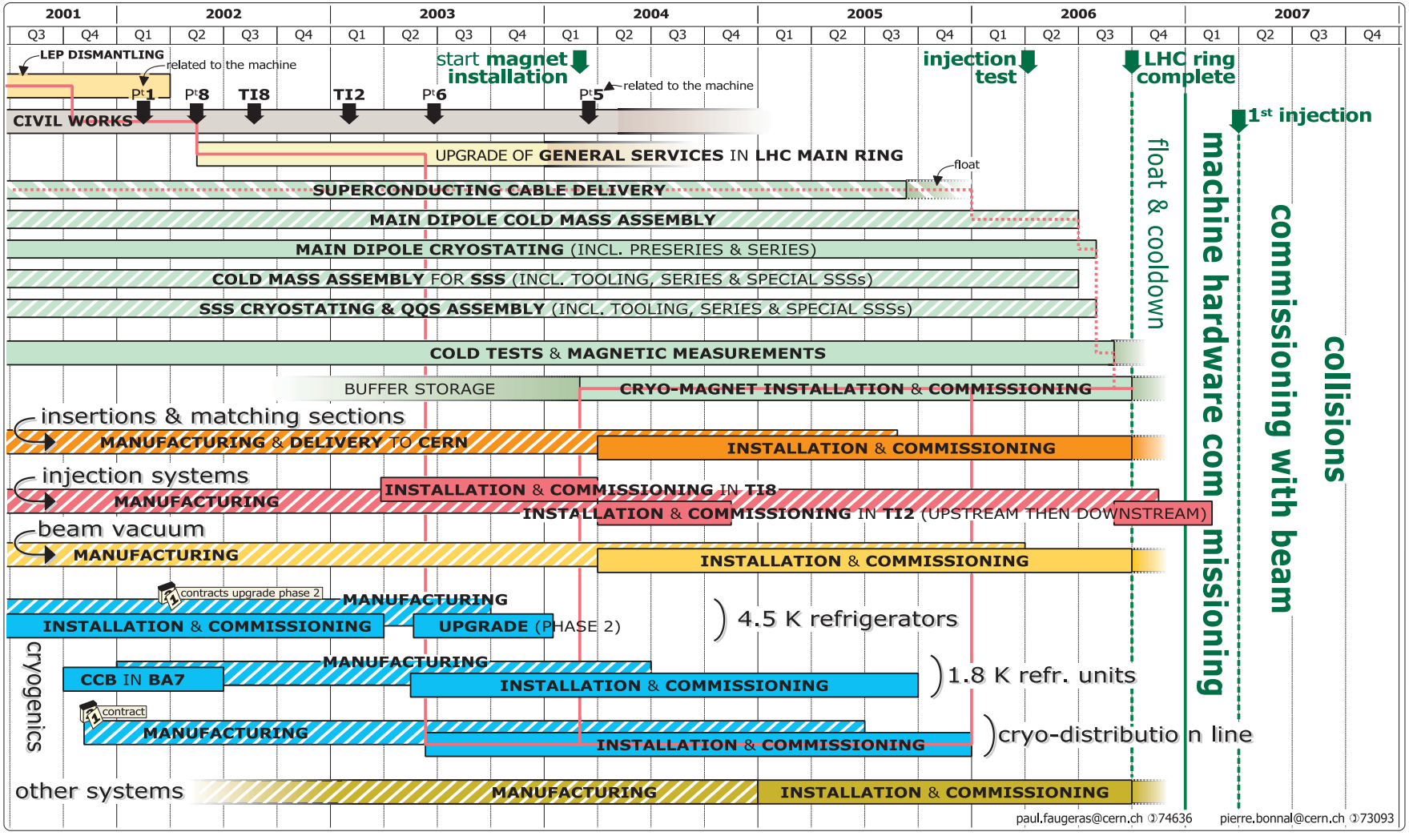
CERN
CH-1211 Geneva 23
Switzerland

the **Large Hadron Collider** project

LHC Project
Working Summary Schedule

LHC Project Document No.
LHC-PM-MS-0001 rev. **4.0**
CERN Div./Group or Supplier/Contractor Document No.
AC/TCP
EDMS Document No.
90193

Date : 2002-03-07



paul.faugeras@cern.ch 74636 pierre.bonnal@cern.ch 73093

6.2

Coordination Planning & Scheduling

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**

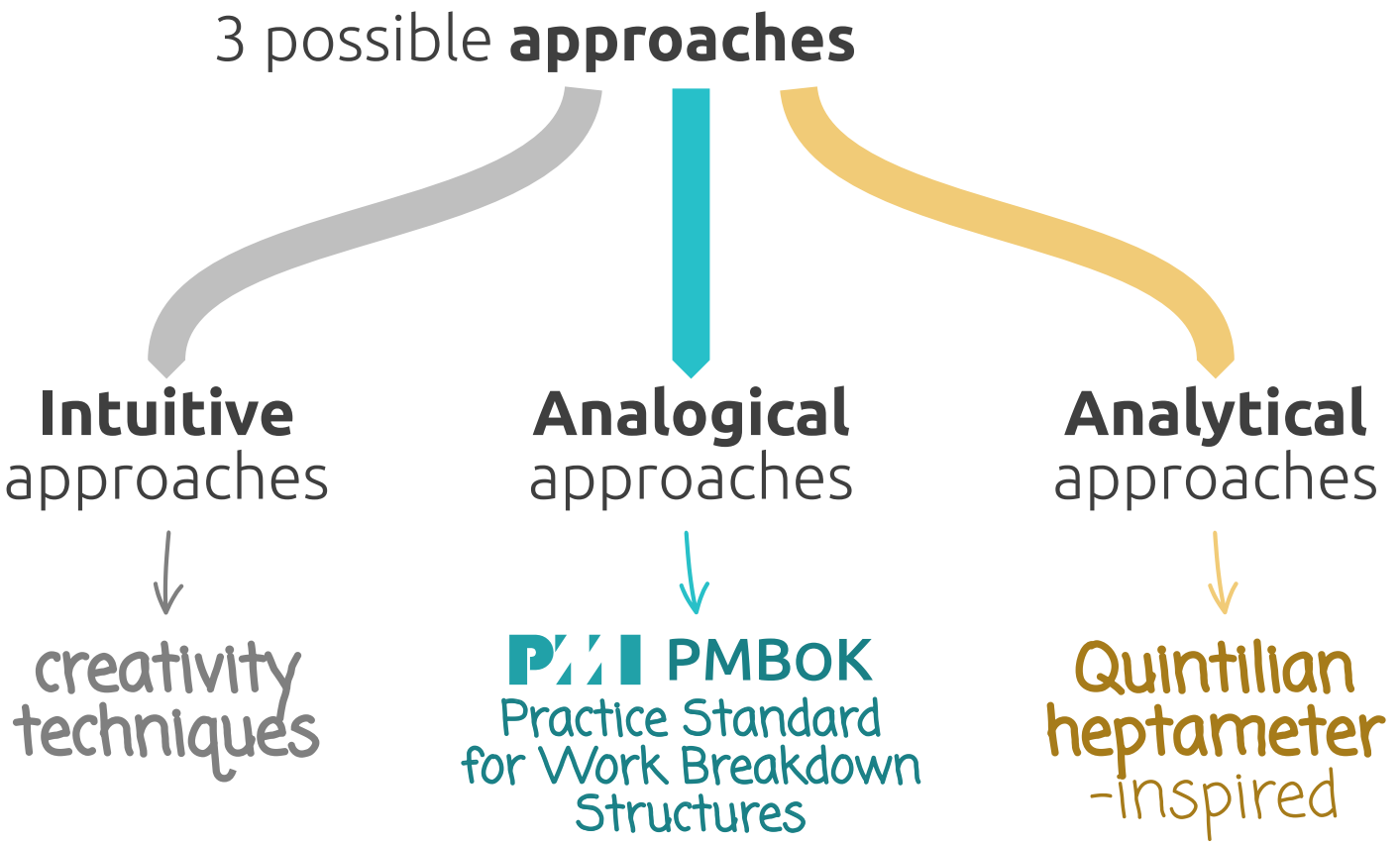
a **Gantt chart**

ProjectWizard® Merlin® Gantt chart

Microsoft® Project® Gantt chart

Coordination Planning & Scheduling

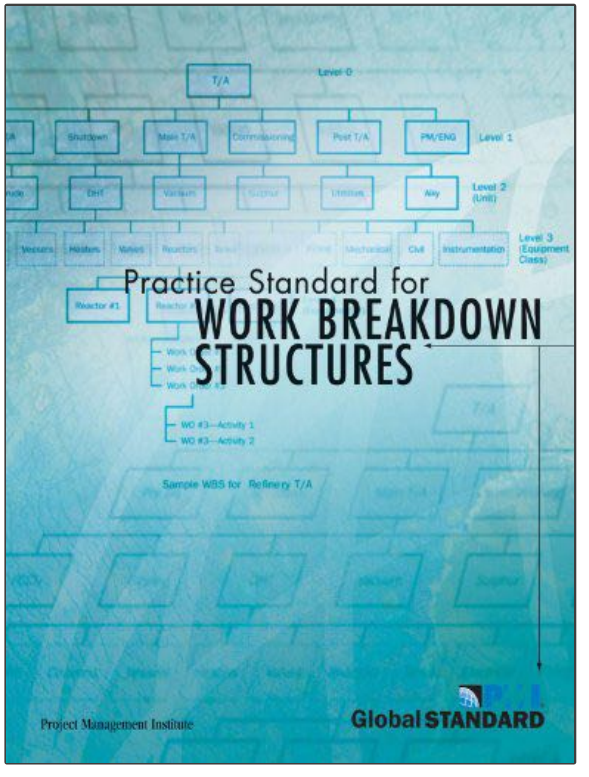
1 Identifying the project **activities**



Coordination Planning & Scheduling

1. Identifying the project **activities** → analogical approaches

- Approach sold as *systematic*, but not that much!
- Global lessons learned collected by the Project Management Institute



- Project Management Institute's Practice Standard to Work Breakdown Structures
- NASA's Work Breakdown Structure Handbook (NASA/SP-2010-3404)

Coordination Planning & Scheduling

1 Identifying the project **activities** → analogical approaches

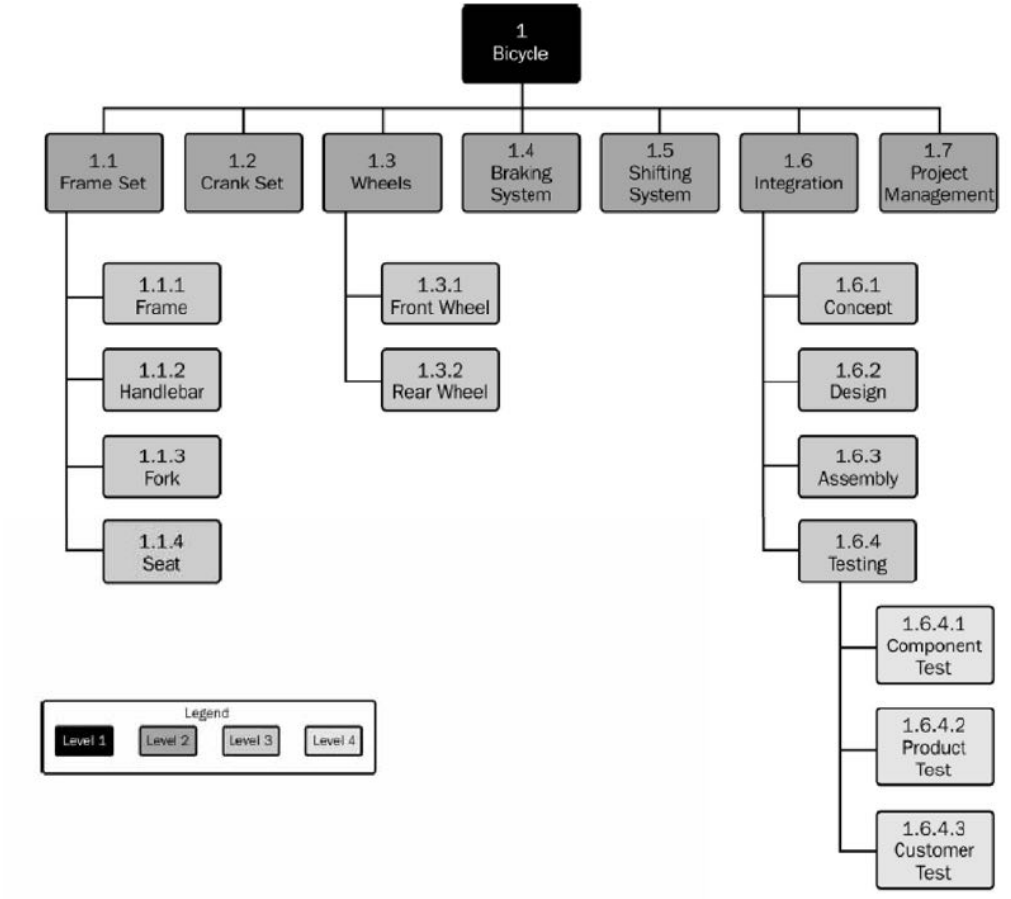


Figure 2-1. WBS Bicycle Example

Level	WBS Code	Element Name
1	1	Bicycle WBS
2	1.1	Frame Set
3	1.1.1	Frame
3	1.1.2	Handlebar
3	1.1.3	Fork
3	1.1.4	Seat
2	1.2	Crank Set
2	1.3	Wheels
3	1.3.1	Front Wheel
3	1.3.2	Rear Wheel
2	1.4	Braking System
2	1.5	Shifting System
2	1.6	Integration
3	1.6.1	Concept
3	1.6.2	Design
3	1.6.3	Assembly
3	1.6.4	Testing
4	1.6.4.1	Component Test
4	1.6.4.2	Product Test
4	1.6.4.3	Customer Test
2	1.7	Project Management

Coordination Planning & Scheduling

1 Identifying the project **activities** → analytical approach

Inspired from the **Quintilian heptameter**

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

Marcus Fabius Quintilianus
(c. 35 – c. 100 CE) was a Roman rhetorician from Hispania, widely referred to in medieval schools of rhetoric and in Renaissance writing

1.1 Describing the final **deliverable**(**s**)

→ The **Product Breakdown Structure** (**PBS**)

1.2 Deriving the **Work Breakdown Structure** (**WBS**) from the PBS

→ The **WBS *top nodes***, then the **WBS-matrix**

1.3 Generating the list of **activities** from the **WBS-matrix**

→ The **activity portfolio**

6.2.1

Product Breakdown Structure

6.2.2

Work Breakdown Structure

openSE

Coordination Planning & Scheduling

1. Identifying the project **activities** → analytical approach

? What is an **activity**?

- ≠ deliverable!

a.k.a. **work unit**

To avoid confusion, clever professional practices (e.g. MIL-HDBK-245B + appendix A) and several textbooks suggest to label activities as follow:

- **action verb** (infinitive tense) + **noun**

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

An **activity**:

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

and only one!

Coordination Planning & Scheduling

1. Identifying the project **activities** → analytical approach

? What is an **activity**?

An **activity**:

- consumes **time** ⚠ Yes, but within certain limits!

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

activities vs. planned activities ANSI #748

Coordination Planning & Scheduling

1. Identifying the project **activities** → analytical approach

   ? What is a **deliverable**?

   a.k.a. **result**

   - ≠ activity!
   - ≠ product! → e.g. the brz-kite
   - **noun** + **verb** at past participle tense

     Some examples:
     bzh-kite designed
     bzh-kite specified
     bzh-kite prototype tested
     bzh-kite manuf. facility commissioned
   - ≠ 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.

en.Wikipedia.org

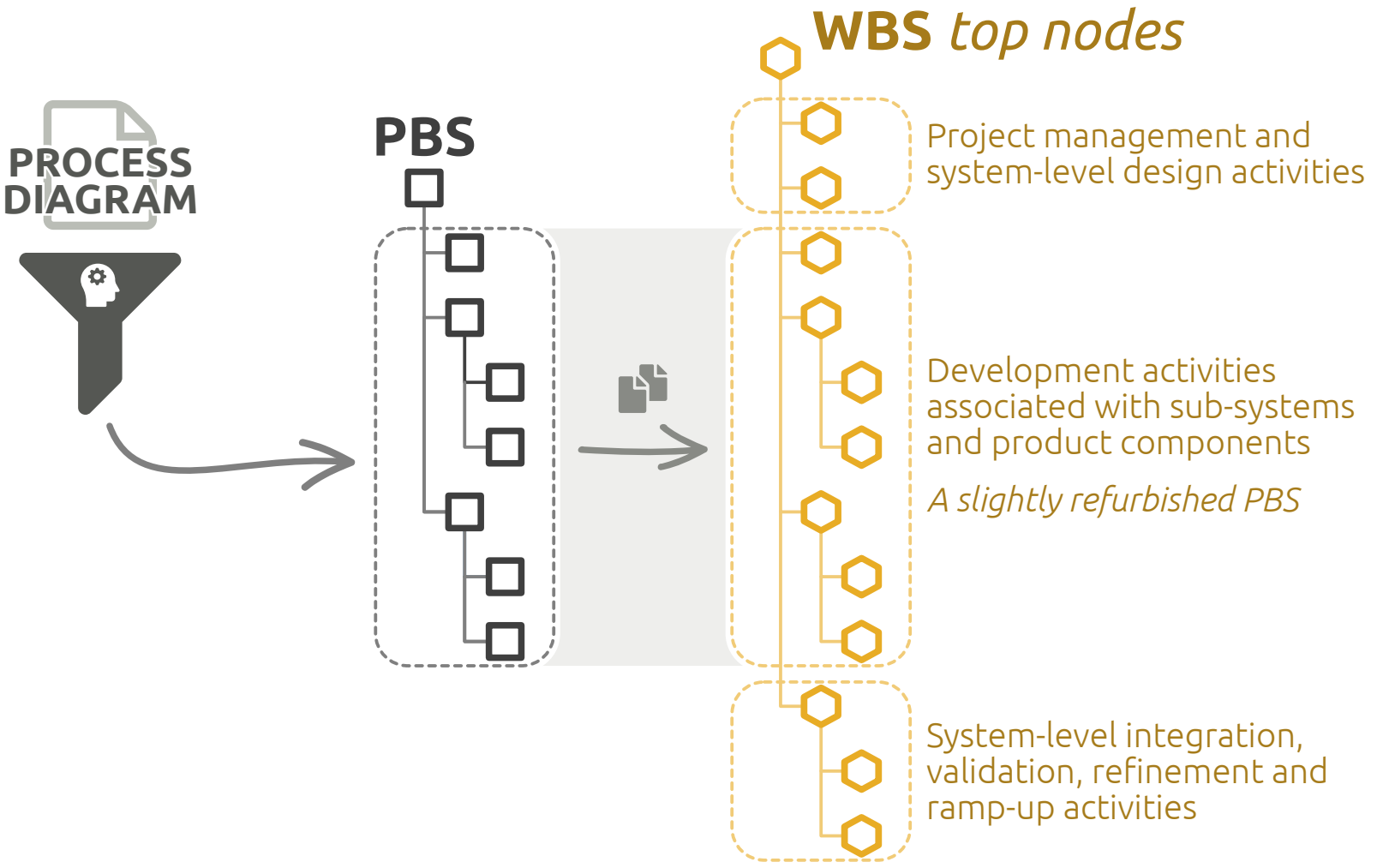
6.2.2.1

WBS *Top Nodes*

Coordination Planning & Scheduling

1 Identifying the project **activities** → analytical approach

1.2 Deriving the **Work Breakdown Structure** (**WBS**) from the PBS



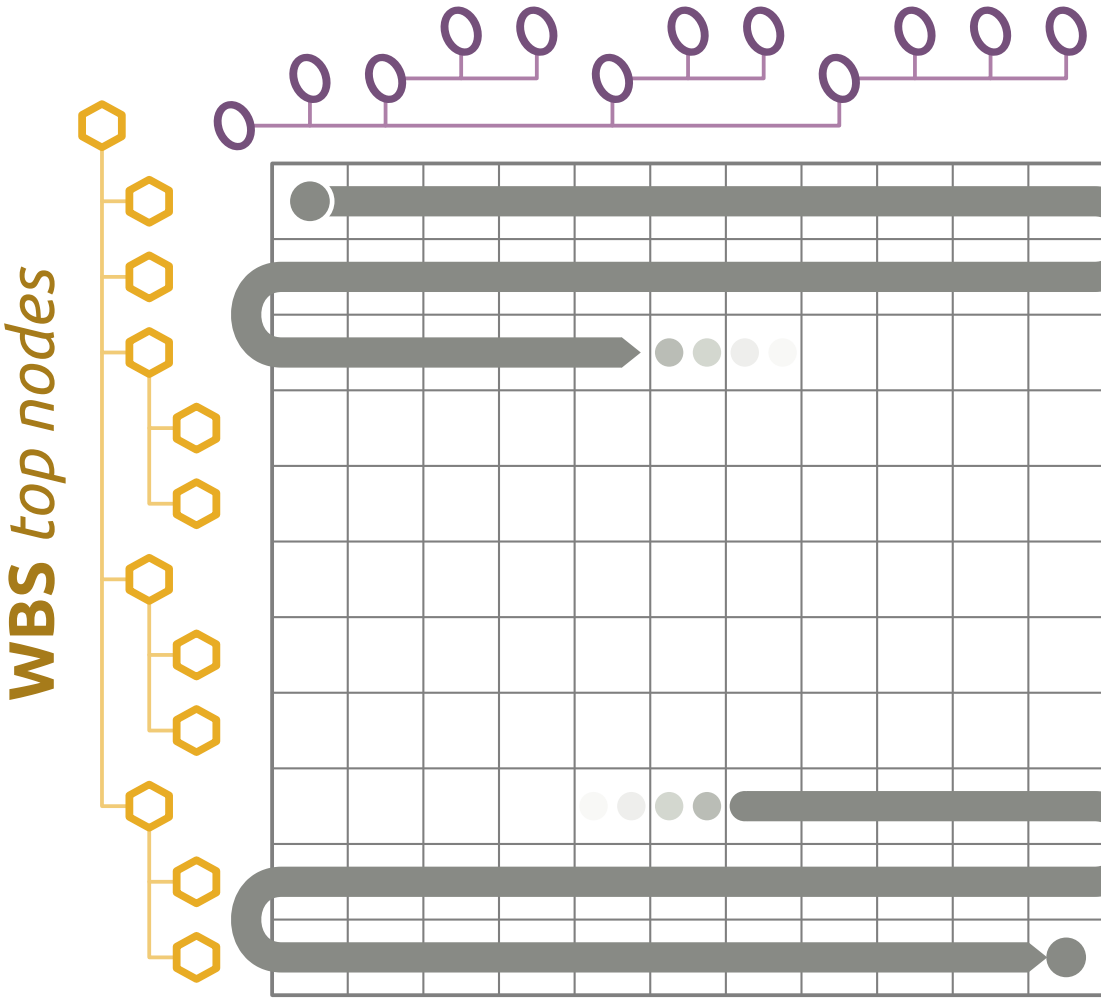
6.2.2.2

WBS-Matrix

Coordination Planning & Scheduling

1 Identifying the project **activities** → analytical approach

1.3 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

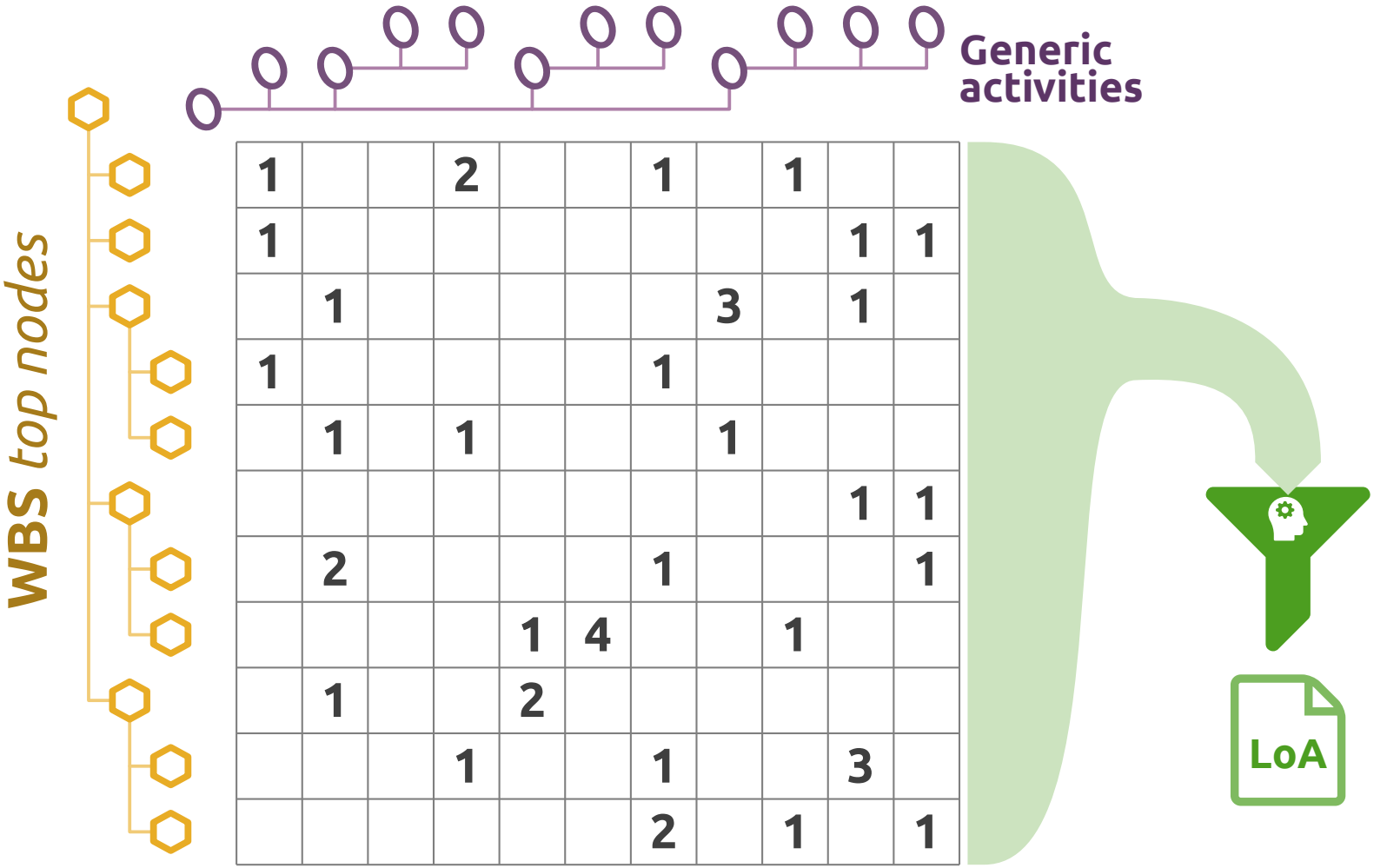
1.3 Generating the list of **activities** from the **WBS-matrix**

ⓘ Generic activities suited to a **new service development project**

Coordination Planning & Scheduling

1 Identifying the project **activities** → analytical approach

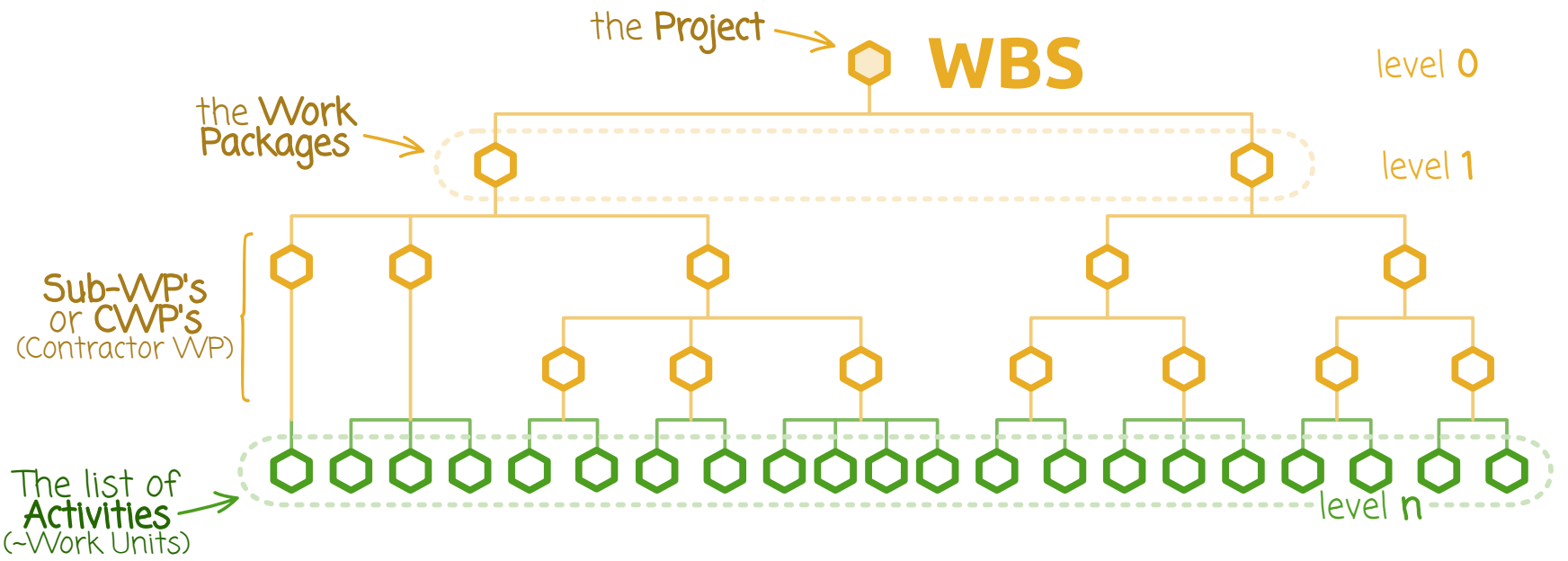
1.3 Generating the list of **activities** from the **WBS-matrix**



1			2			1		1		
1									1	1
	1						3		1	
1						1				
	1		1				1			
									1	1
	2					1				1
				1	4			1		
	1			2						
			1			1			3	
						2		1		1

Coordination Planning & Scheduling

1 Identifying the project **activities** → analytical approach

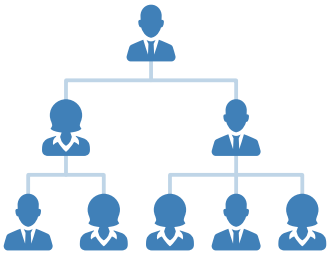


- **Work packages** = level 1 of the Work Breakdown Structure
- **Activities** = the *leaves* (🍃) of the WBS (from level 2 to level 6 max.)
- There is no requirement to have all activities at a same level!

Coordination Planning & Scheduling

1 Identifying the project **activities** → analytical approach

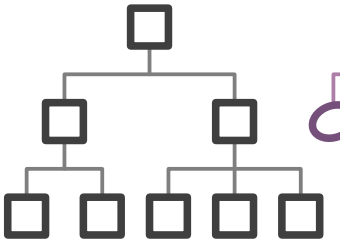
OBS



Organisational Breakdown Structure

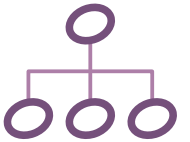
Bill of Materials

PBS

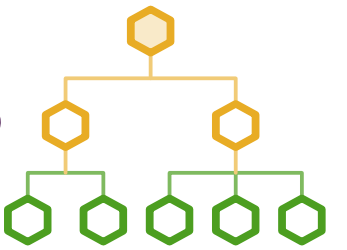


Product Breakdown Structure

Generic Activities



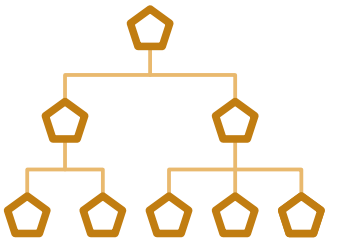
WBS



Work Breakdown Structure

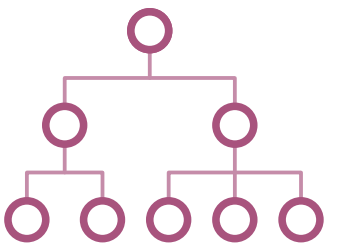
List of Activities

RBS



Resource Breakdown Structure

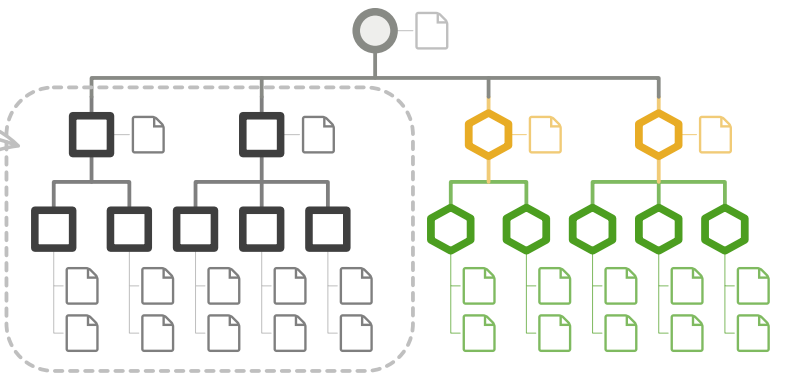
CBS



Cost Breakdown Structure

Project Breakdown Structure

to be moved to facility, item and/or asset management systems after the project is completed



6.2.3

RACI Matrix

Coordination Planning & Scheduling

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

2 types of **resources**

Renewable resources

Non-renewable resources

2.1 Identifying the **resources** that are **available**

➪ The **Resource Breakdown Structure** (**RBS**)

2.2 Estimating the **resources** that are **required**

*See section dedicated to **Project Costing***

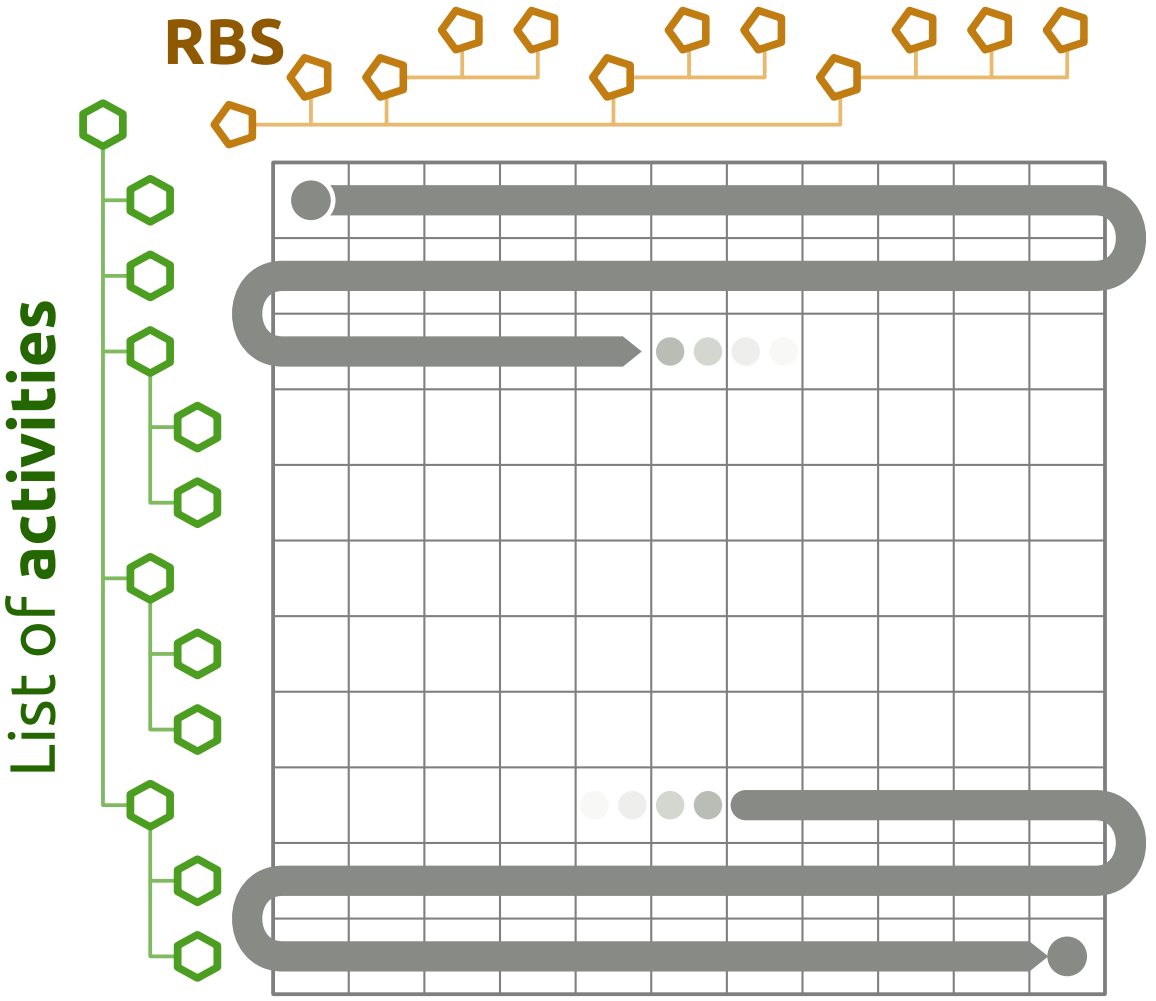
2.3 Assigning **resources** to **activities**

➪ The **RACI Matrix**

Coordination Planning & Scheduling

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

2.3 Assigning **resources** to **activities** → **RACI Matrix**



for each cell of the matrix, resource implication is elicited

Executes

X

Follows up

F

Is informed

I

Provide help

H

Is required

R

Coordination Planning & Scheduling

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

2.3 Assigning **resources** to **activities** → **RACI Matrix**

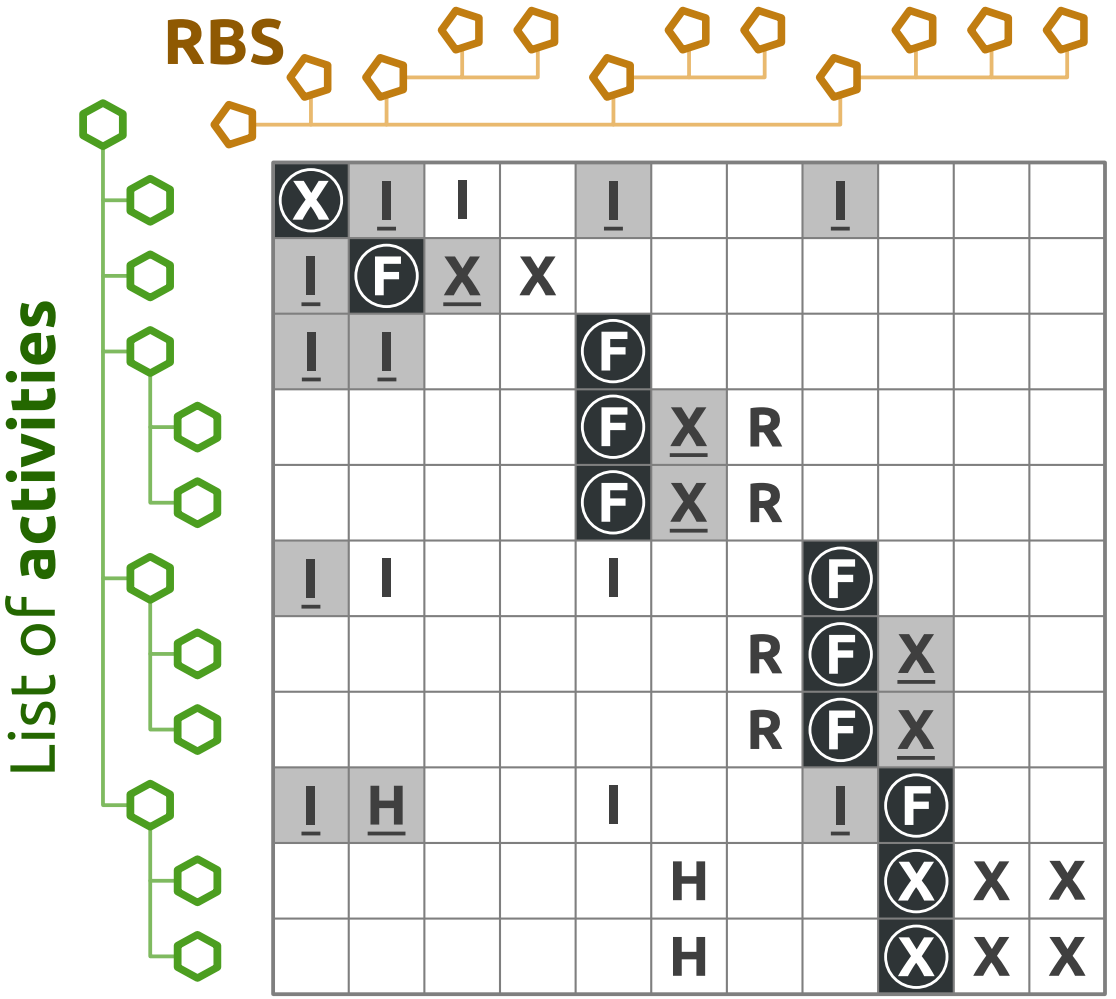
	Is responsible			Participate to decisions		
Executes	X	X	X	X	X	X
Follows up	F	F	F	F	F	F
Is informed	I			I	I	I
Provide help	H			H	H	H
Is required	R					

Only one per row !

Coordination Planning & Scheduling

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

2.3 Assigning **resources** to **activities** → **RACI Matrix**



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)

Microsoft® Excel® spreadsheet

6.2.4

Coordination Schedule

openSE

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**)

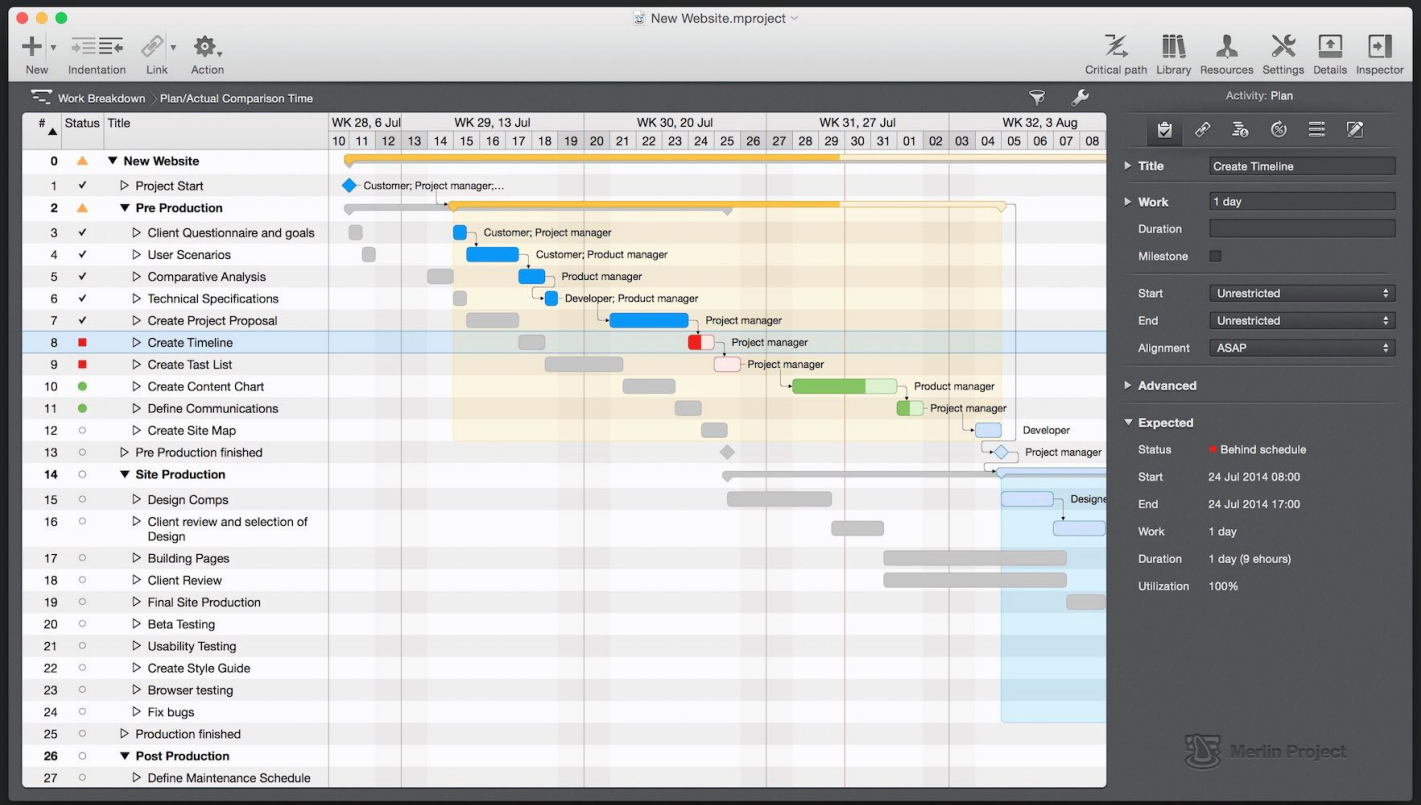
➪ **PDM** (Precedence Diagramming Method) + **Gantt Chart**

3.6 If required, defining **resource constraints**

3.7 Calculating (earliest) start/finish **dates** and **floats**

➪ **RCPS** (Resource-Constrained Project Scheduling) + **Gantt Chart**

Coordination Schedule



7

Project Costing

openSE

Project Costing

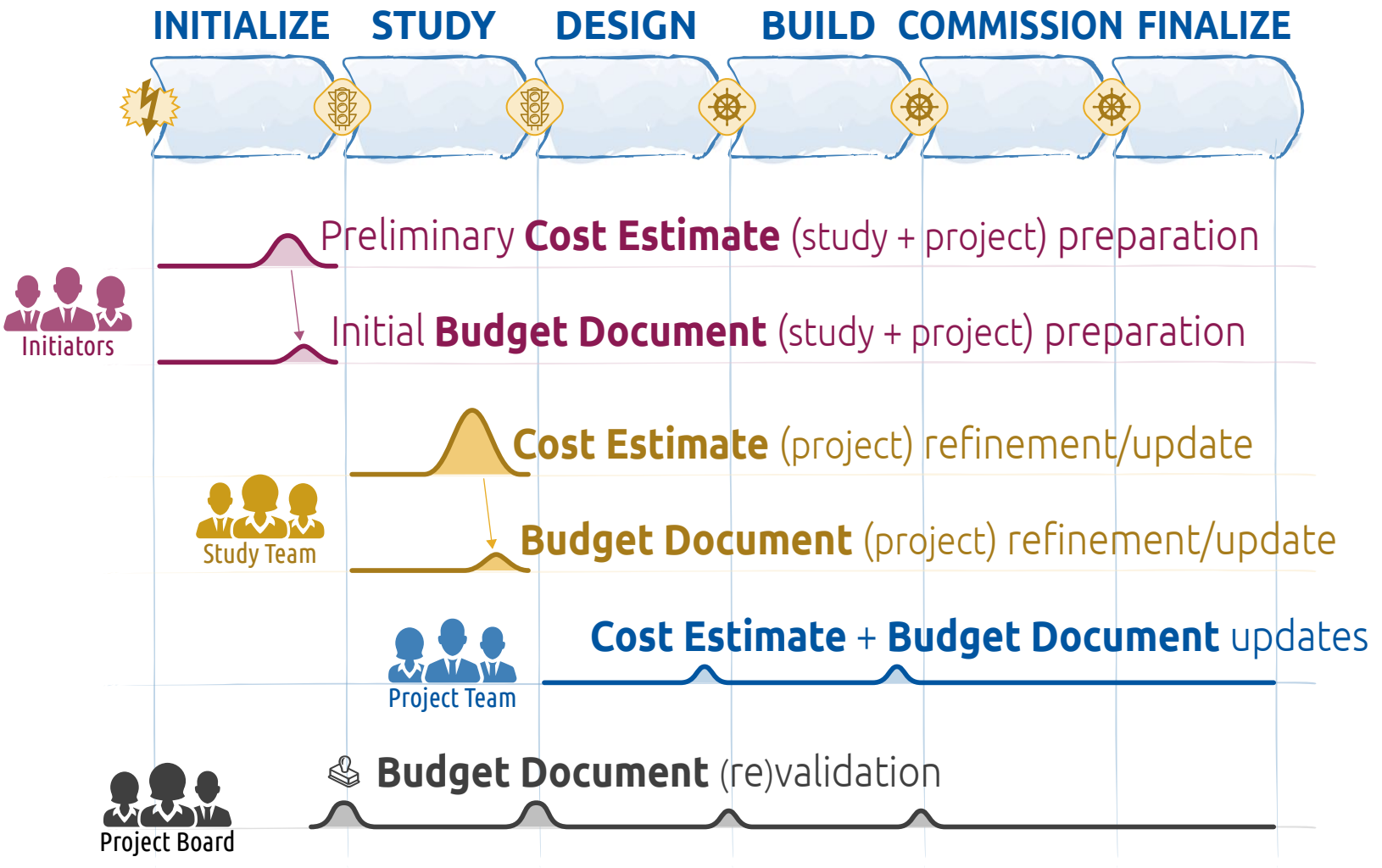
A three-step process

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?



7.1

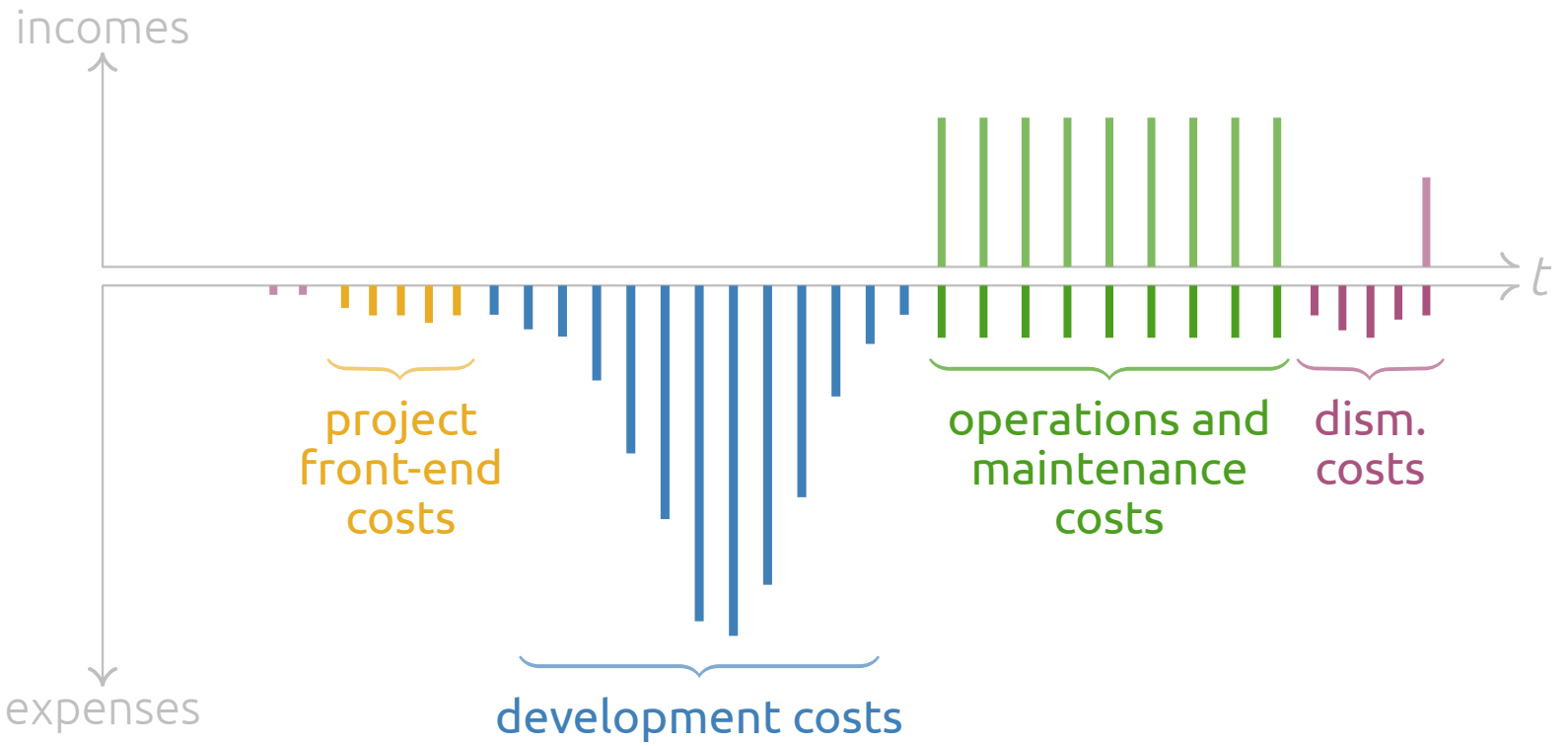
(Project) **Cost Estimate**

openSE

Project Costing

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

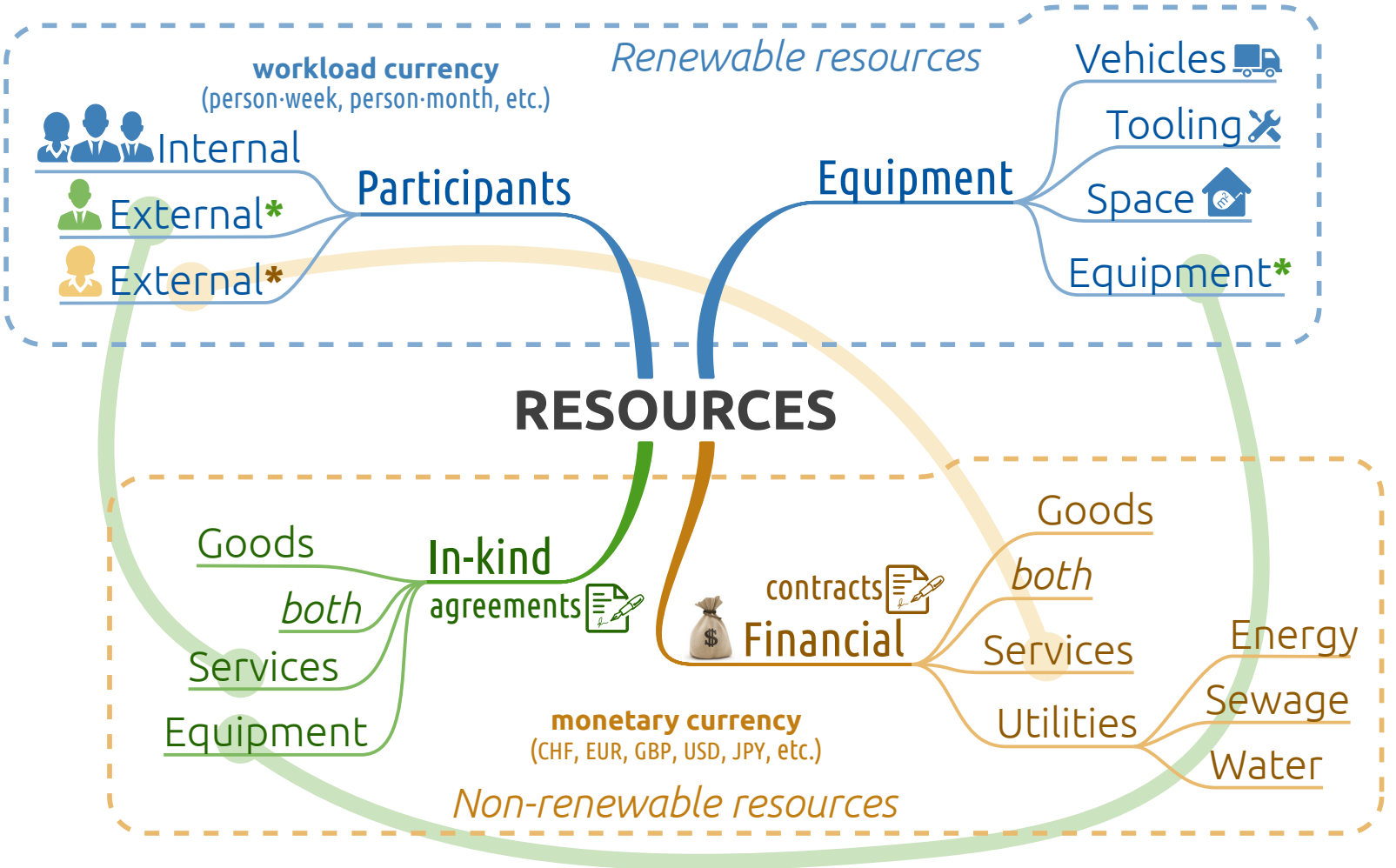
   ? Which **costs** (and incomes) to take into account?



Project Costing

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

? Which **costs** to take into account?

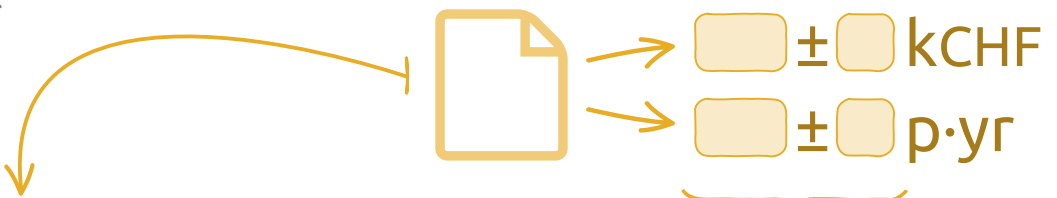


Cost Estimate

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!

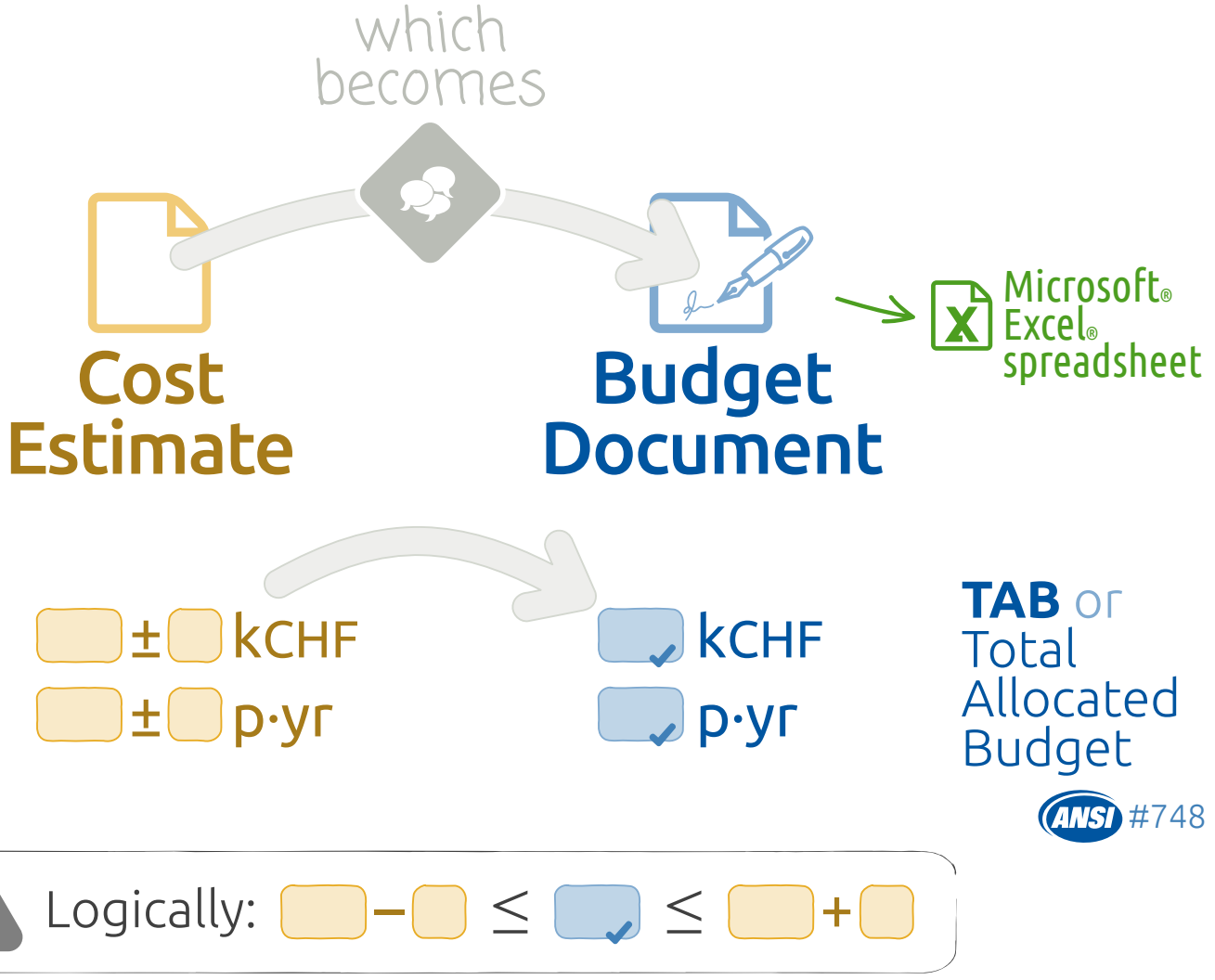
7.2

(Project) **Budget Document**

openSE

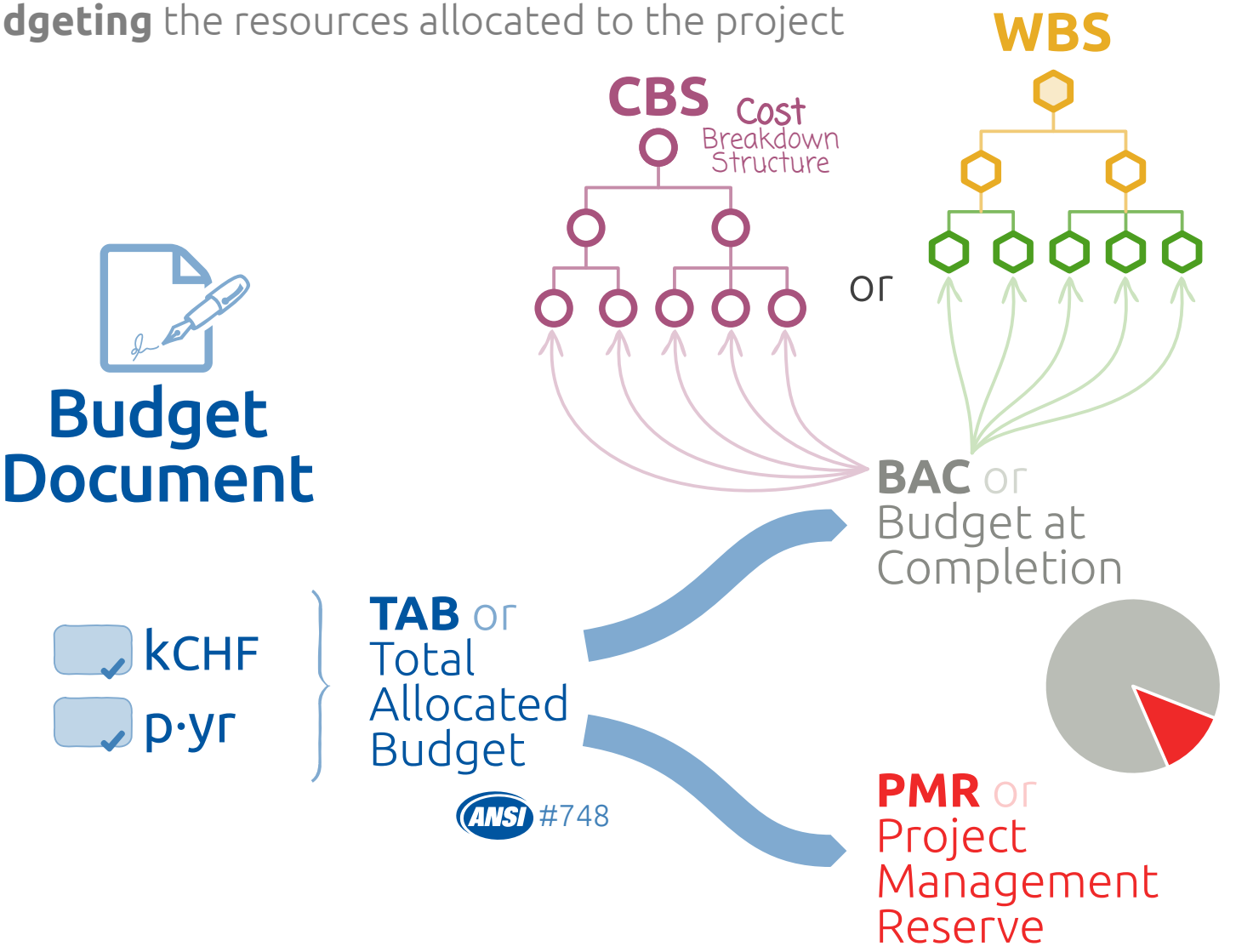
Project Costing

2 **Budgeting** the resources allocated to the project



Project Costing

2 **Budgeting** the resources allocated to the project



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:

8

Project Risk Management

openSE

Project Management

What are we going to see together?

openSE

Lifecycle

Inspired from Hermes

Roles

- Initiators
- Project Board
- Project Manager
- Project Team
- Study Team
- Study Leader
- Project Stakeholders

Processes

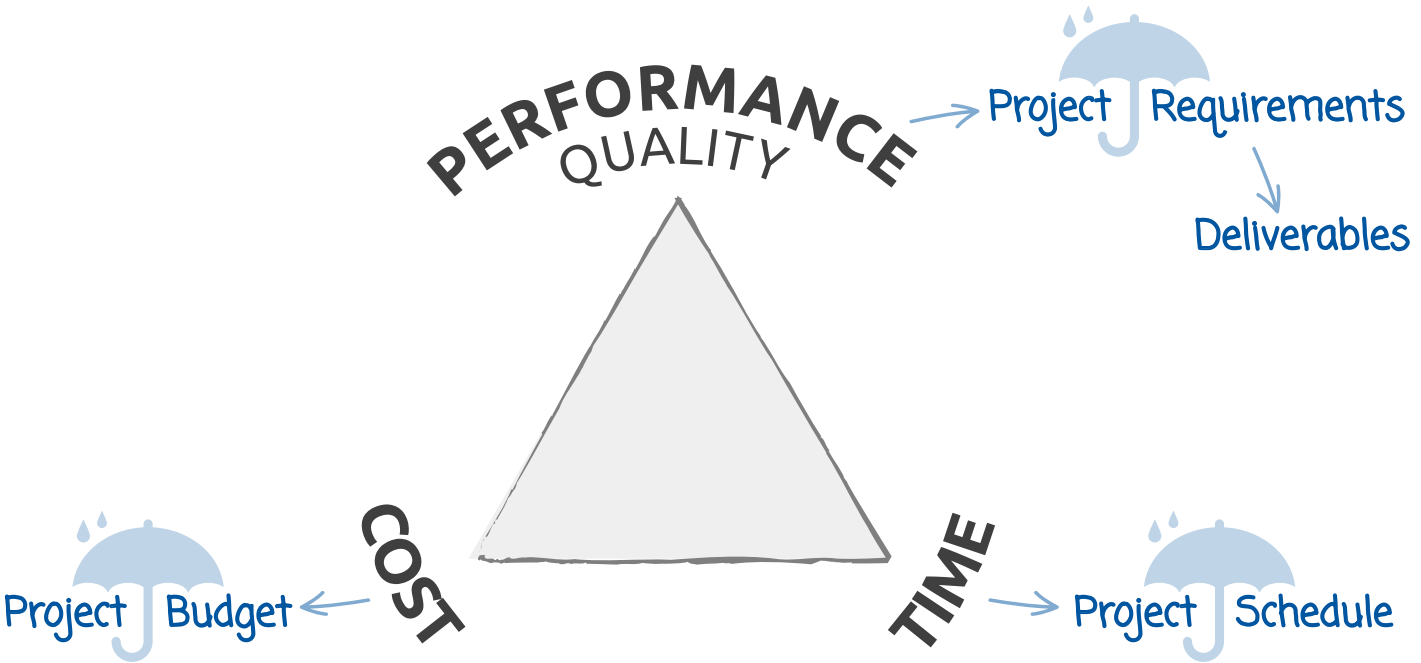
- Launching a project
- Ensuring quality
- Defining requirements
- Planning & scheduling
- Costing
- Managing risks
- Reporting progress
- Handling issues
- Finalizing a project

Artefacts

- Project Proposal
- Project Roadmap
- Project Mngt Plan
- Project PBS & WBS
- Project Schedule
- Project Budget
- Reqts. Register
- Risk Register
- Progress Report(s)

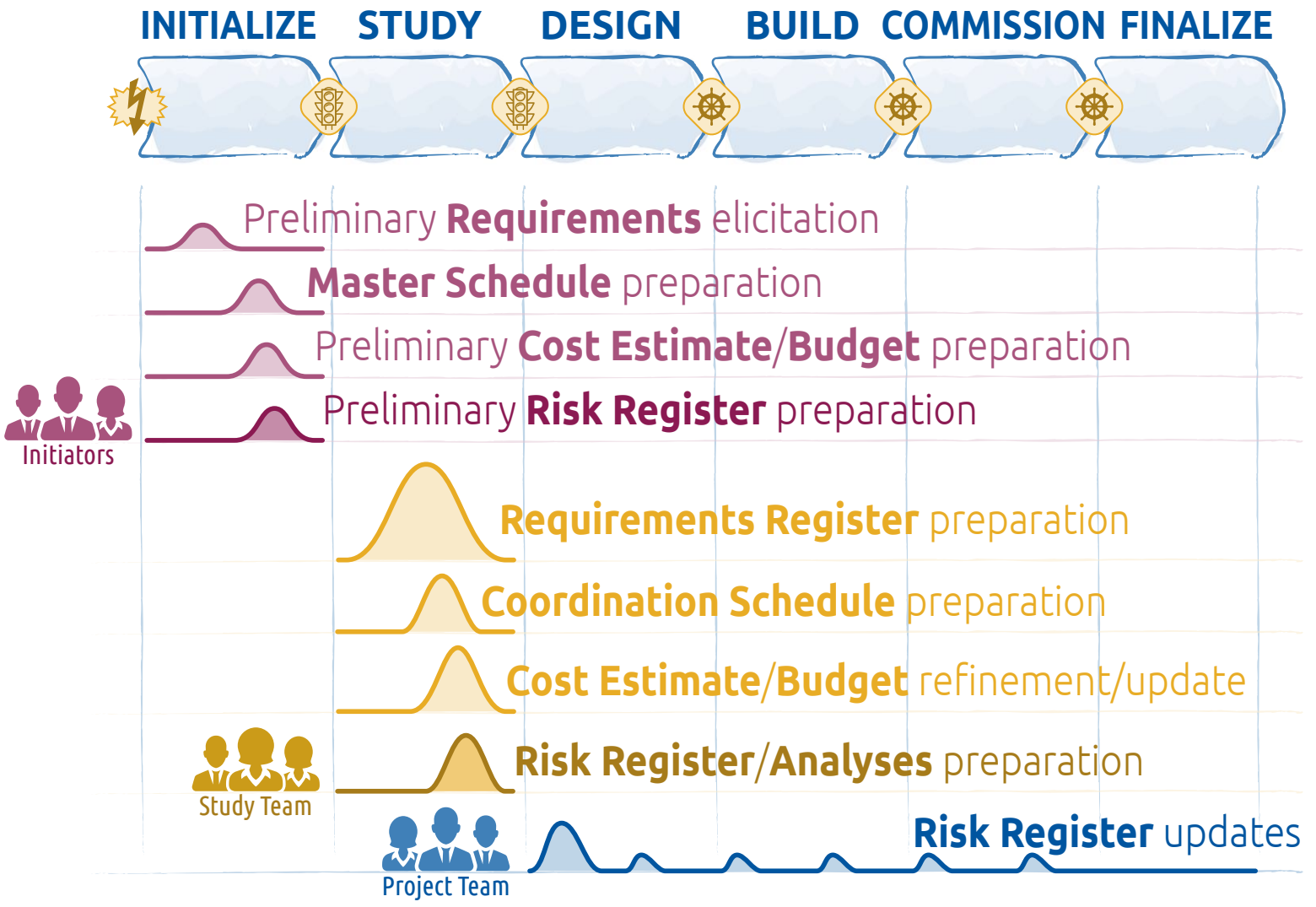
Project Risk Management

"Project triangle"



Project Risk Management

When and which effort?



Risk

Definition

The effect of uncertainty on objectives.

ISO 31000:2009 § 2.1

Can be seen as:

- **Threats**, i.e. with negative impact ⇢ common/regular meaning
- **Opportunities**, i.e. with positive impact ⇢ often forgotten!

Risk

Etymology

- From ancient Latin: *risicare* = reef ⇢ ***risk-snag***
- From (ancient) Greek: *ρίζα* = root ⇢ ***risk-snag***
- From (ancient) Latin: *rixa* = quarrel, brawl ⇢ ***risk-action***
- From ancient Greek: *ριζικόν* = soldier's pay ⇢ ***risk-action***

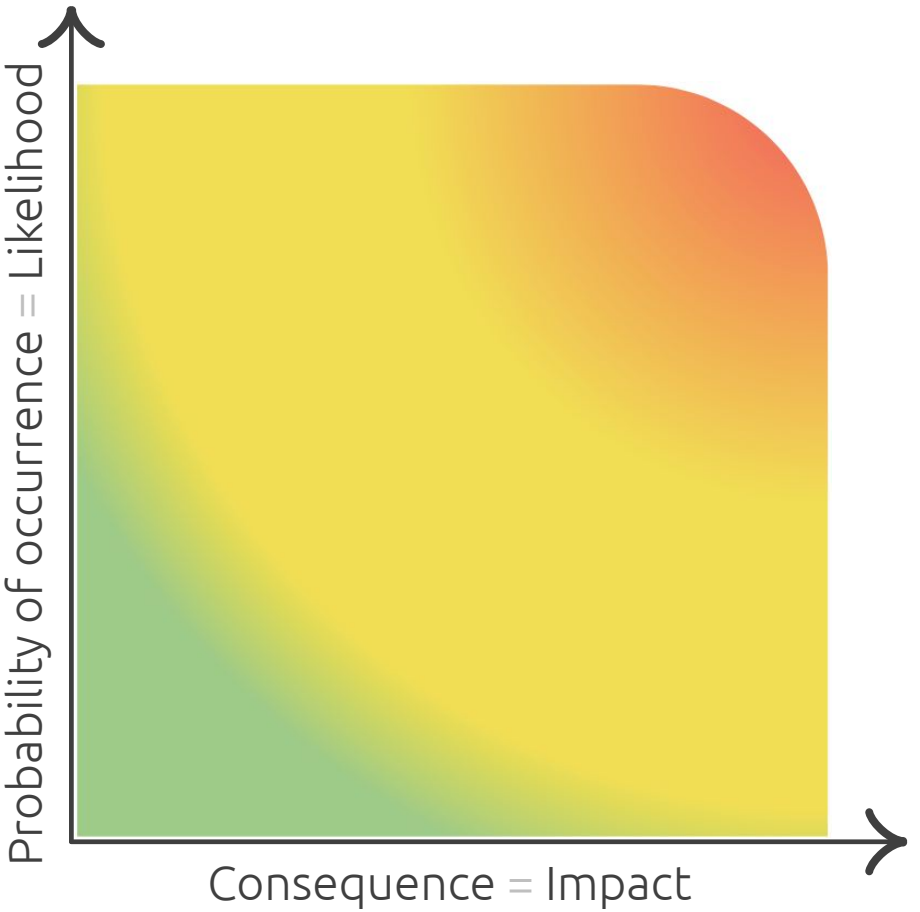
Risiko, Risiken in German

Fabio Sabelli (mars 1999) Les risques de l'économie, l'économie des risques. Le point de vue de l'anthropologue. présentation donnée lors du 7e Congrès de la Société suisse de management de projet à Lausanne, Suisse

Risk

Heatmap

Likelihood × Consequences



Risk Management

Enterprise RM vs. Project RM

ERM

Strategic risks

Operational risks

Financial risks

Reputational risks

Safety risks

Environmental risks

PRM

Technical risks

related to the **system/product** being developed, incl. technical **reqts**.

Programmatic risks

related to the **project**: on schedule, on budget

External risks

for which the project team has no real control

Project Risk Management

The 'very basic toolbox'

SIMPLE approach

Simplified
Risk Register

→

Bullet list consisting of **risk statements:**

- ⟨risk⟩, *however* ⟨response⟩

examples

- Unsufficient funding, *however* initial investigations have shown that stakeholders are likely to fund this proposed project
- Unrealistic master schedule, *however* discussions in conferences and workshops have shown that one year to have an experimental setup in operation is realistic
- Technical problems with instrumentation, *however* according to a few interviewed experts, the solutions considered are totally feasible
- Enhanced experimental setups by other labs, *however* our scientific watch shows that this set-up will be very competitive

Project Risk Management

The 'intermediate toolbox'

INTERMEDIATE approach

Regular
Risk Register

Spreadsheet table consisting of **risk scenarios**:

RISK SCENARIO	RISK MAGNITUDE	RISK RESPONSE

Project Risk Management

A 5-step process

INTERMEDIATE approach

1. Agreeing a risk management approach for the project ✓
   - risk management planning
2. Identifying risk scenarios
   - risk searching
3. Evaluating their magnitude
   - risk sorting
4. Defining responses to these risk scenarios
   - risk treatment or risk planning
5. Following up the risks as the project progresses
   - risk monitoring

Generic Response Types

Type of response	Method of handling
Modify objectives	Reduce or raise performance targets; change tradeoffs between objectives
Avoid	Plan to avoid specified sources of risk/uncertainty
Influence probability	Change the probability of potential variations, i.e. prevent
Modify consequences	Modify the possible consequences of variations, i.e. protect
Transfer consequences	Transfer consequences to another party, e.g. contract provision, insurance
Develop continuity plans	Set aside means or make other plans to provide a reactive ability to cope
Keep options open	Delay choices and commitments, choosing versatile options
Monitor	Collect and update data about sources of uncertainty
Accept	Acknowledge and accept uncertainty
Remain unaware	Ignore uncertainty, take no action to identify, evaluate or handle it
Optimize all the above	Explicitly recognise the value of selecting an optimal combination

Stephen Ward, Chris Chapman (2011) How to Manage Project Opportunity and Risk: Why Uncertainty Management can be a Much Better Approach than Risk Management (3 ed). Wiley

Generic Response Types

In practice

INTERMEDIATE
approach

4 types of **responses** to risks

Mitigation

↓

preventive and **protective** measures

Avoidance

↓

bare suppression of the source of risk (**precautionary principle**)

Acceptance

↓

no action
except documentation of the risk

Transfer

↓

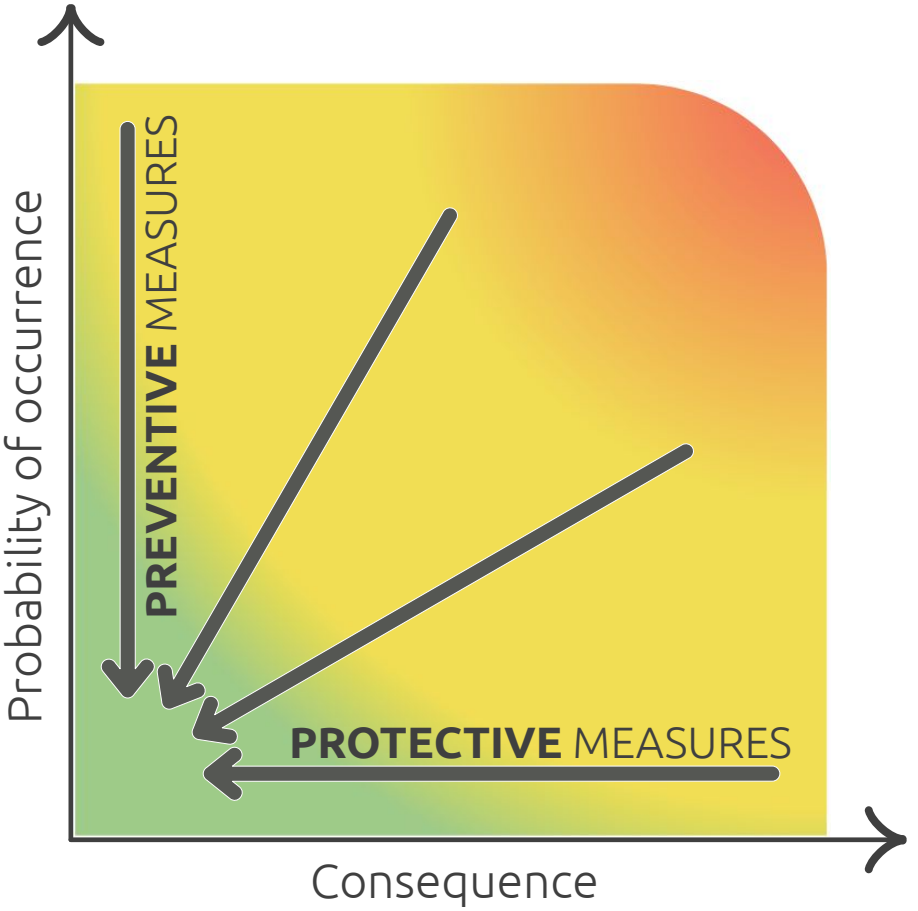
provision
insurance

~~Ignorance~~

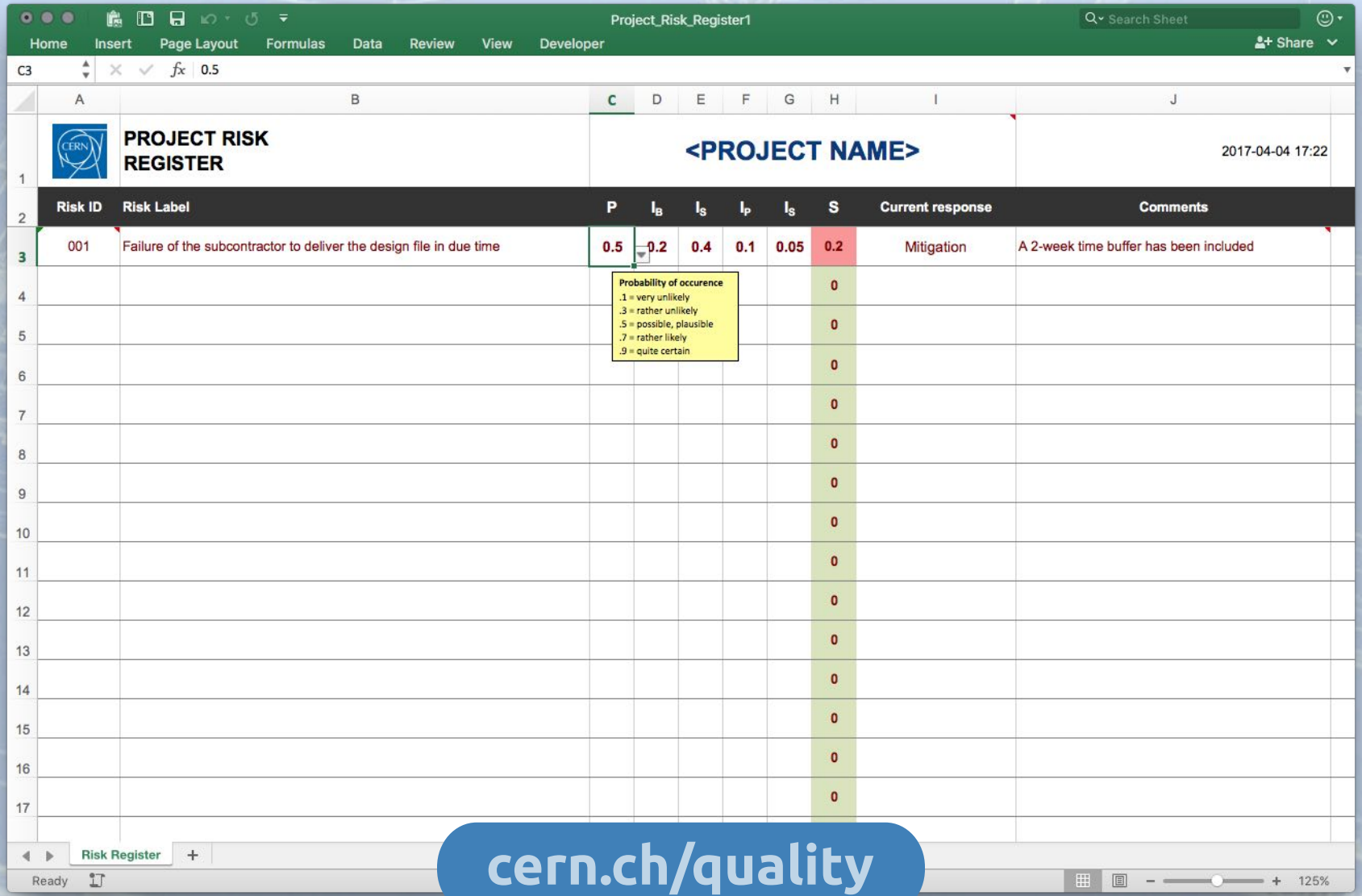
Risk

Heatmap

Prevention vs. Protection



At **CERN** (in the A&T Sector)



Project_Risk_Register1

Home Insert Page Layout Formulas Data Review View Developer

C3 0.5

PROJECT RISK REGISTER

<PROJECT NAME>

2017-04-04 17:22

Risk ID	Risk Label	P	I_B	I_S	I_P	I_S	S	Current response	Comments
001	Failure of the subcontractor to deliver the design file in due time	0.5	0.2	0.4	0.1	0.05	0.2	Mitigation	A 2-week time buffer has been included
							0		
							0		
							0		
							0		
							0		
							0		
							0		
							0		
							0		
							0		
							0		
							0		
							0		
							0		
							0		

Probability of occurence
.1 = very unlikely
.3 = rather unlikely
.5 = possible, plausible
.7 = rather likely
.9 = quite certain

Risk Register

Ready

125%

cern.ch/quality

Project Progress Follow-up

Project Management

What are we going to see together?

openSE

Lifecycle

Inspired from Hermes

Roles

- Initiators
- Project Board
- Project Manager
- Project Team
- Study Team
- Study Leader
- Project Stakeholders

Processes

- Launching a project
- Ensuring quality
- Defining requirements
- Planning & scheduling
- Costing
- Managing risks
- Reporting progress
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- Finalizing a project

Artefacts

- Project Proposal
- Project Roadmap
- Project Mngt Plan
- Project PBS & WBS
- Project Schedule
- Project Budget
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- Risk Register
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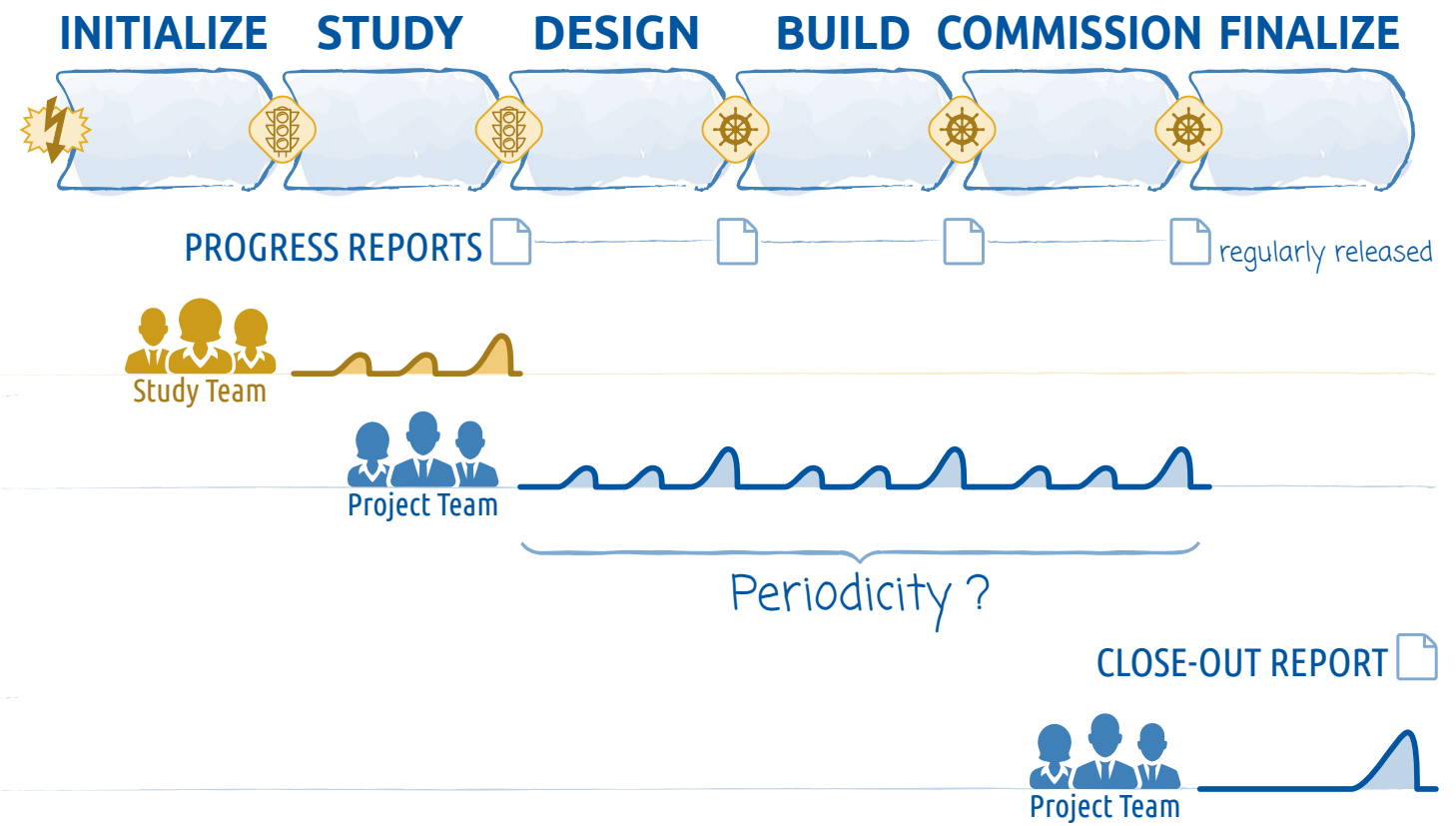
Project Control and Follow-up

When and which effort?



Project Control and Follow-up

The ‘basic toolbox’

SIMPLE approach

Progress Status

Progress Reviews

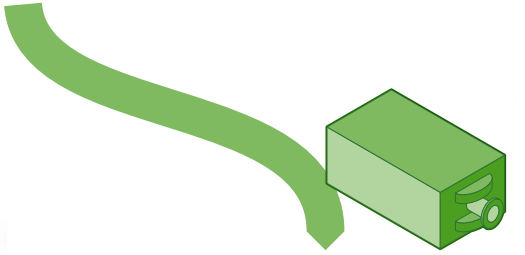
1. **Major achievements** (as bullet points)
2. **Problems encountered**
3. **Cost and schedule statuses**
   - 3.1 Cost status
     Table (actuals vs. budgeted)
   - 3.2 Schedule status
     Milestone Trend Chart
     (**gdpm Milestone Plan**)
   - 3.3 Physical progress status
     Dashboard
4. **Work 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.]

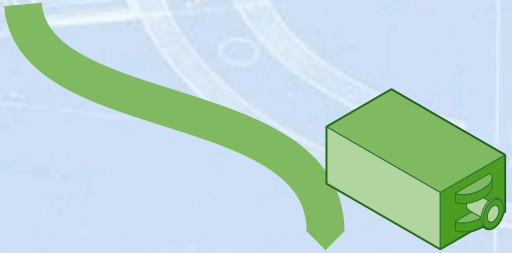


In-kind
contributions
[various cur.]

planned	manpower budget	financial budget	agreement figures
actuals	**time spent**	**expenses**	(= planned)
data	**timesheeting system** ⚠	**accounting books** ✓	∅

At CERN Project Costing

3 types of **resources**

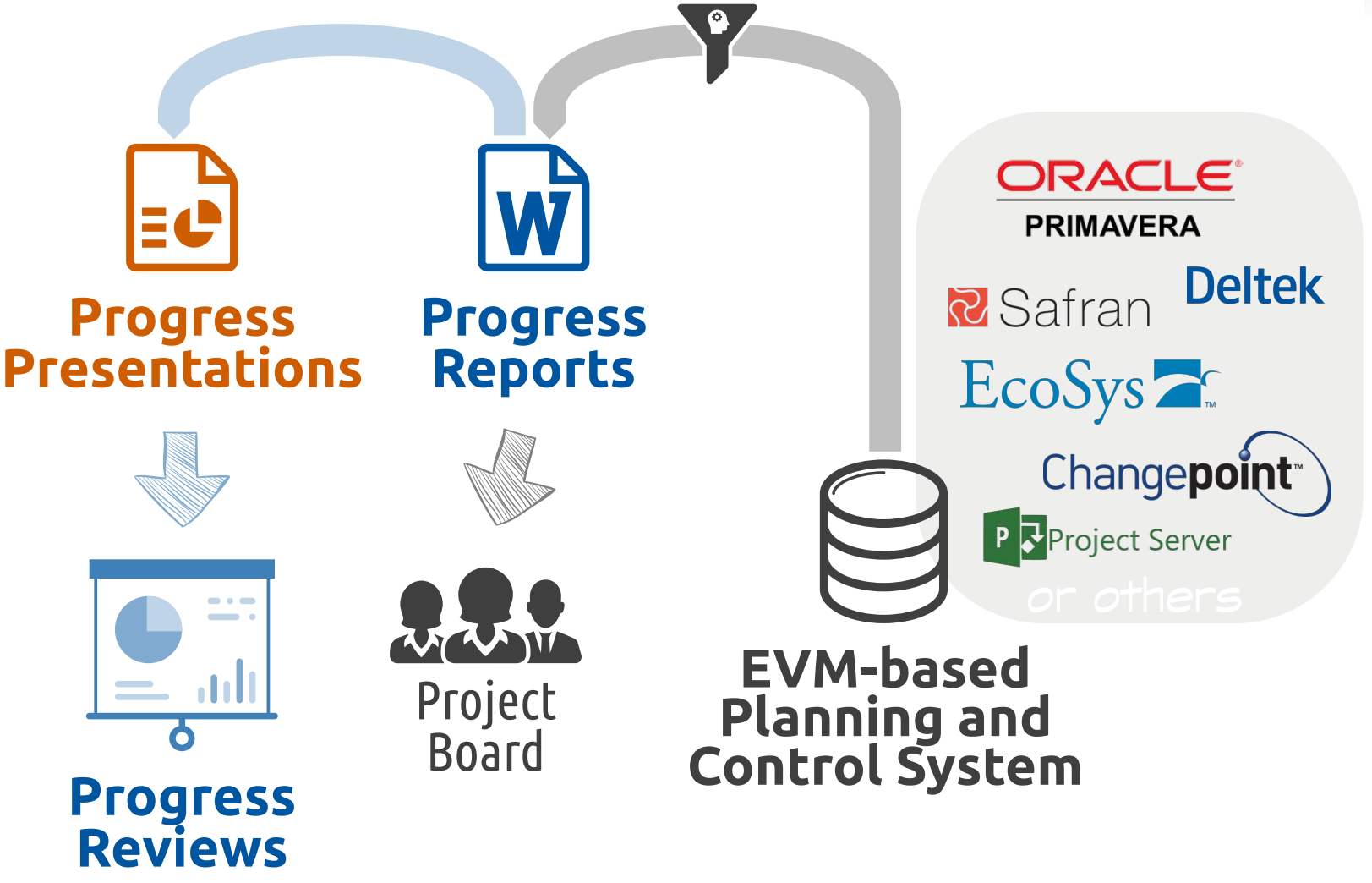


	Manpower (project participants) [workload currency]	**Financial** resources [monetary cur.]	**In-kind** contributions [various cur.]
planned	manpower budget	financial budget	agreement figures
actuals	(**= planned**)	**expenses**	(= planned)
data	Ø	**accounting books** ✓	Ø

Project Control and Follow-up

The 'advanced toolbox'

ADVANCED approach



At **CERN**

Beam-facility related projects or large infrastructure projects

Progress Presentations

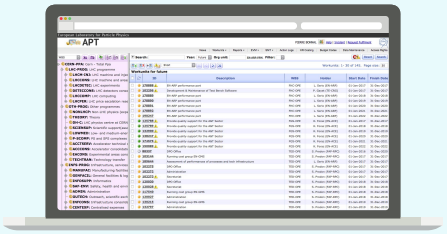
Progress Reports

Progress Reviews

Project Board

EVM-based Planning and Control System

APT



Contact
Benoit Daudin
FAP-AIS-PM

Project Management

What are we going to see together?

Inspired from Hermes

Lifecycle

openSE

Roles

Processes

- Launching a project
- Ensuring quality
- Defining requirements
- Planning & scheduling
- Costing
- Managing risks
- Reporting progress
- Handling issues
- Finalizing a project

Artefacts

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cern.ch/quality

cern.ch/go/8rMF

Pierre.Bonnal@cern.ch +41 22 767 5710 +41 75 411 2072