Managing Scientific Projects

Part ② related to Risk Management

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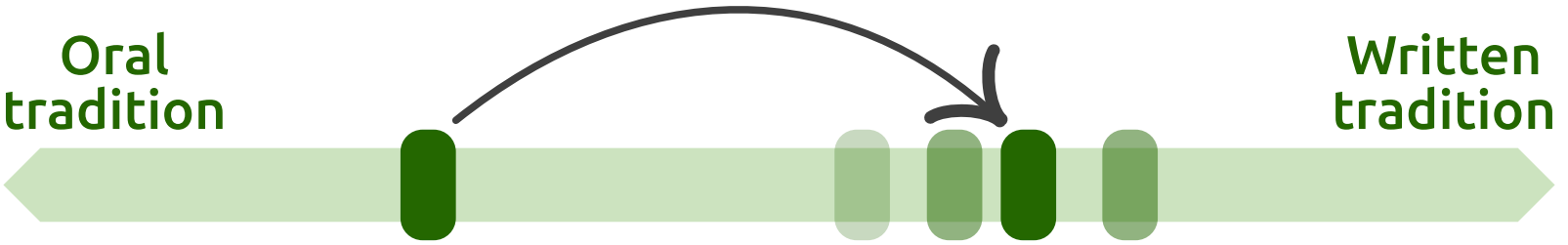
INFN Perugia
Friday 19th 2014

01

risk

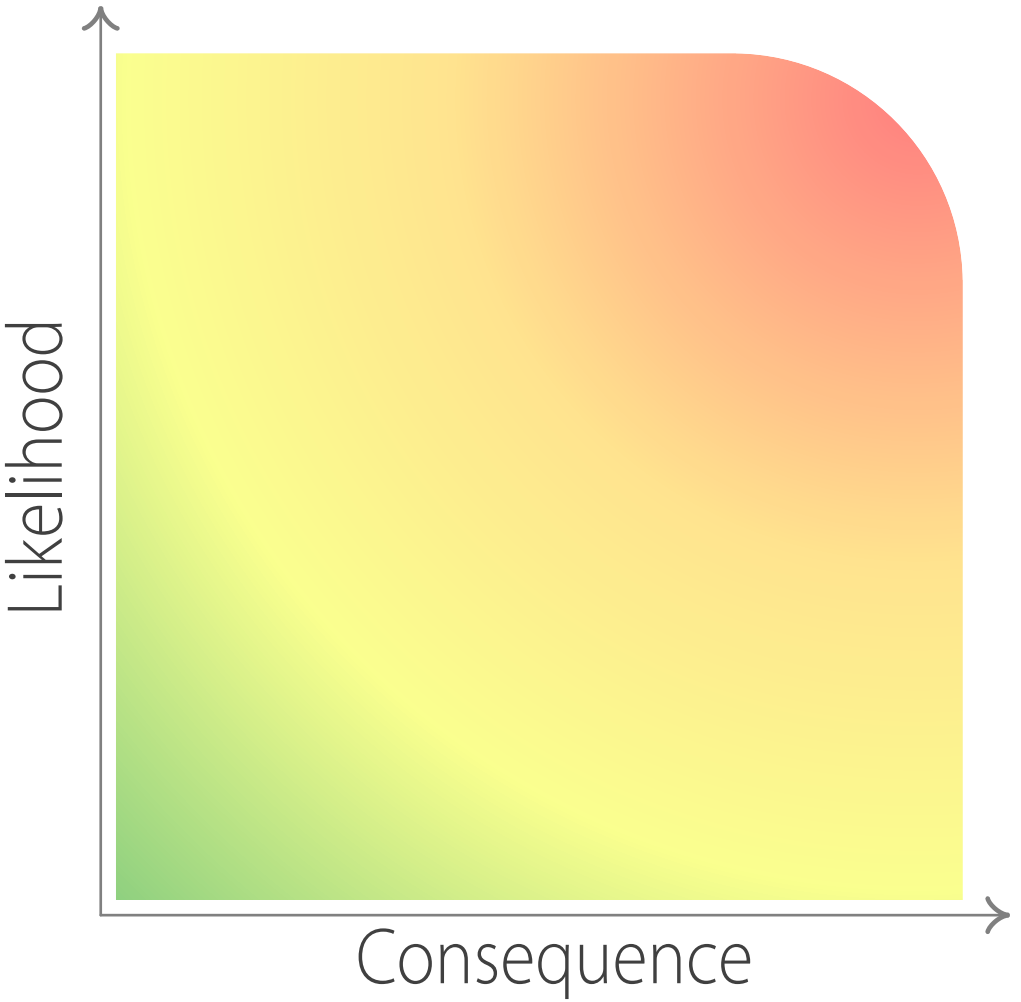
| risk | noun (pl. **risks**)

Risk Management



Etymology

- From ancient Latin : *risicare* = reef ⇢ *risk-careful*
- From ancient Greek : ριζα = root ⇢ *risk-careful*
- From Latin : *rixa* = quarrel, brawl ⇢ *risk-action*


Likelihood
Consequence

PRM → Six steps

Step 1. Strategy & risk planning

Step 2. Risk identification

Step 3. Risk evaluation

Step 4. Risk quantification

Step 5. Risk handling

Step 6. Risk follow-up

PMI Standard Committee (2000) *A guide to the project management body of knowledge*. (4th ed.) Newton Square PA: Project Management Institute. 216 p. ISBN 1880410230.

Project Risk Management

02

Risk Planning

Risk management strategy

Who decides?

- Unilateral decision
- Bilateral decision

Risk management strategy | Process

INPUTS:

- Project Roadmap
- Organization policy ⇢ PRM
- Identification of the contributors (incl. their tolerance towards risks)
- Framework for editing a Project Management Plan
- Work Breakdown Structure (WBS) of the project

TOOLS & TECHNIQUES:

- Some meetings

OUTPUTS:

- Project Risk Management Plan
  or section related to Risks in the Project Management Plan

Project Management Plan ⇢ Section Related to Risks

§ **1.** Purpose and guiding principles

§ **2.** PRM methodology

§ **3.** Responsibilities

§ **4.** Budget and resources for PRM

§ **5.** Timescale

§ **6.** Risk categories and thresholds

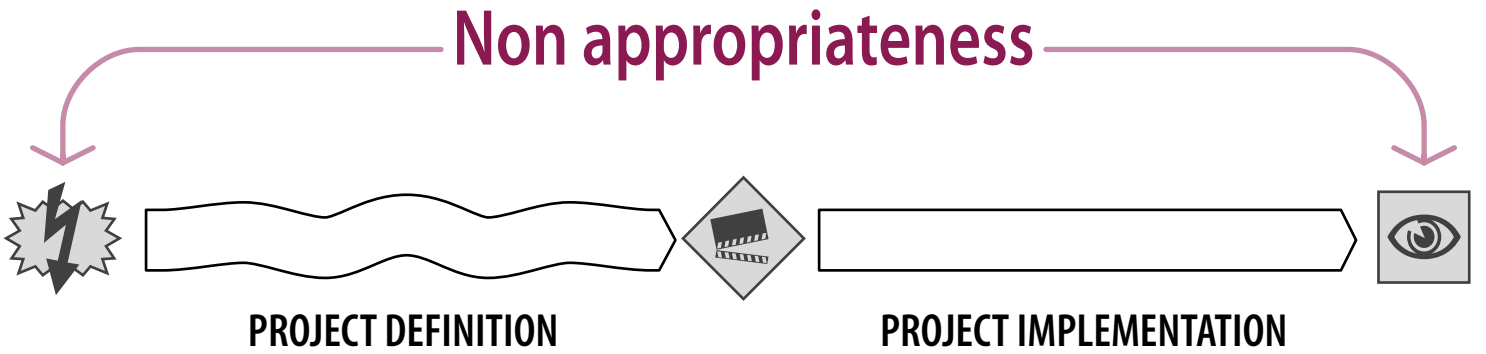
§ **7.** Risk reporting

§ **8.** Lessons learned

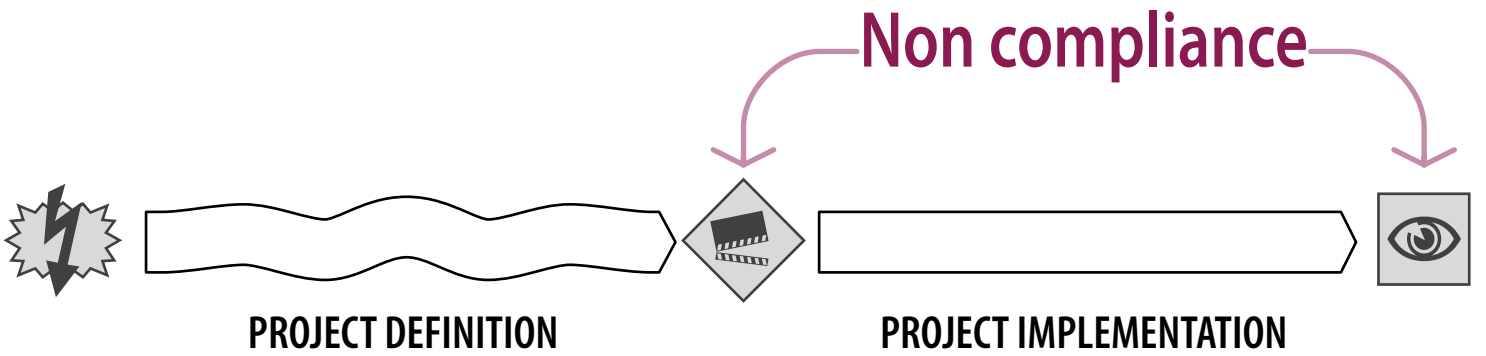
Risk categories → first scheme

- **Technical** risks → related to the product being designed and developed
- **Programmatic** risks → related to the project itself: on schedule, on budget…
- **External** risks → for which the NPD project team has no control

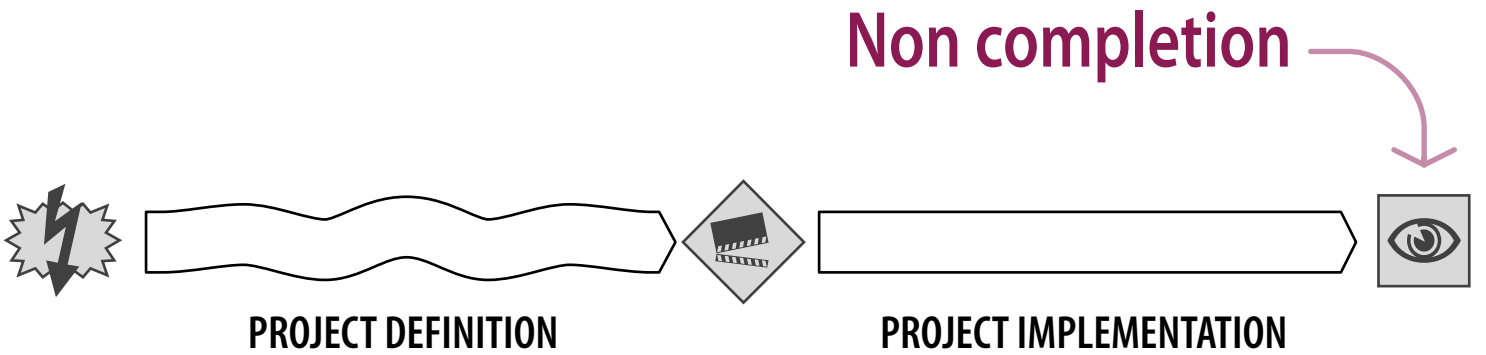
Risk categories → second scheme



Risk categories → second scheme



Risk categories → second scheme



03

Risk Identification

Risk identification | Process

INPUTS:

- Project Roadmap
- Project Management Plan
- Outputs of the project planning phase ⇢ PBS, WBS, Gantt Chart…
- Lessons learned in matter of PRM on former NPD projects
- Databases, check lists, *vade-mecum*…
- Organizational policy ⇢ PRM
- Names of NPD PRM experts ⇢ interviews

TOOLS & TECHNIQUES:

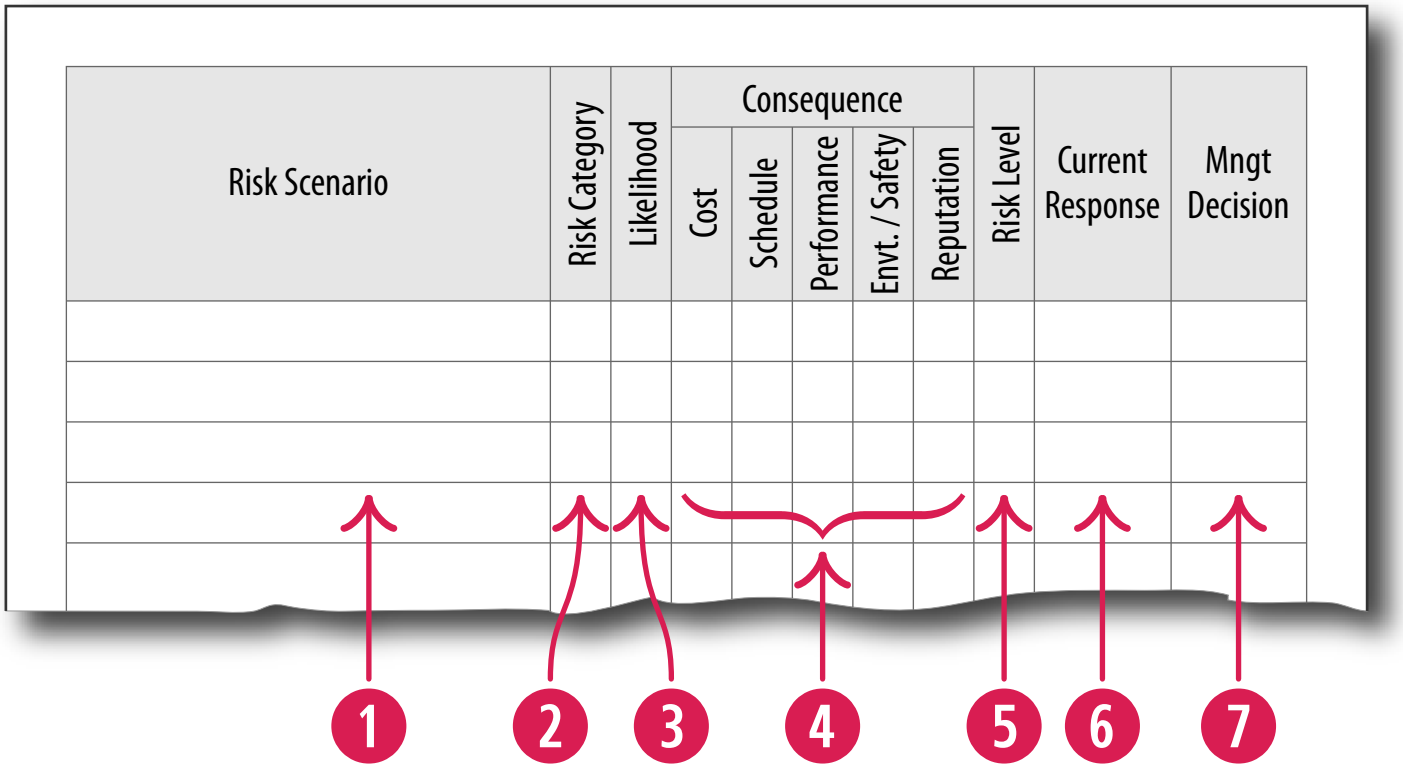
- Project document screening
- Brainstorming sessions, Six-hats, Delphi method…
- Interviews
- SWOT analysis, Ishikawa diagrams…

Risk identification | Process

OUTPUTS:

- **Project Risk Register**
- List of feared events
- Recommendations

Risk Register



04

Risk Evaluation

Risk evaluation | Process

INPUTS:

- Project Roadmap
- Project Management Plan
- Project Risk Register

TOOLS & TECHNIQUES:

- Risk Level Matrix
- Failure Mode Analysis and Consequences (FMAC)

OUTPUTS:

- Project Risk Register
- Preliminary **Risk Assessment Forms**

Risk Level Matrix

Probability	***P***
Very unlikely	.1
Rather unlikely	.3
Possible, plausible	.5
Rather likely	.7
Very likely, quite certain	.9

Consequences	***C***
Negligible	.05
Marginal	.1
Significant	.2
Major, critical	.4
Catastrophic, crisis	.8

Risk Level Matrix

Consequences	c	on budget	on schedule
Negligible	.05	$\Delta C \approx 0$	$\Delta D \approx 0$
Marginal	.1	$1\% < \Delta C \leq 5\%$	$1\% < \Delta D \leq 5\%$
Significant	.2	$5\% < \Delta C \leq 10\%$	$5\% < \Delta D \leq 10\%$
Major, critical	.4	$10\% < \Delta C \leq 20\%$	$10\% < \Delta D \leq 20\%$
Catastrophic, crisis	.8	$\Delta C > 20\%$	$\Delta D > 20\%$

Risk Level Matrix

Consequences	***C***	on the project performance
Negligible	.05	Minimal or no consequence
Marginal	.1	Small reduction of the performance
Significant	.2	Significant degradation of the performance
Major, critical	.4	Technical goals cannot be achieved
Catastrophic, crisis	.8	Project cannot be completed

Risk Level Matrix

$$S = P \times C$$

$S < 0.05$		low risk
$0.05 \leq S < 0.20$		medium risk
$S \geq 0.20$		high risk

Risk Level Matrix

P \ C	.05	.1	.2	.4	.8
.9	.05	.09	.18	.36	.72
.7	.04	.07	.14	.28	.56
.5	.03	.05	.10	.20	.40
.3	.02	.03	.06	.12	.24
.1	.01	.01	.02	.04	.08

05

Risk Quantification

Risk quantification

Four approaches for dealing with probabilities:

- **Classical** approach
- **Mathematical** approach
- **Frequentist** approach
- **Bayesian** approach

Risk quantification

Four approaches for dealing with probabilities:

- **Classical** approach:

The probability P(*A*) of an event *A* is the property that determines its frequency of occurrence.

E.g.:
P(head) = P(tail) = 1/2
P(⚀) = P(⚁) = 1/6
P(⚅ and ⚅) = 1/36

Risk quantification

Four approaches for dealing with probabilities:

- **Mathematical** approach:

P(A) is a number that obeys the many axioms of the theory built up by A. Kolmogorov in the '30s:

$0 \leq P(A) \leq 1$
$P(A \vee B) = P(A) + P(B)$
$\sum P(A_i) = 1$
…

Risk quantification

Four approaches for dealing with probabilities:

- **Frequentist** approach:

P(*A*) is a limit over a set, when the number of elements of this set tends to ∞

Risk quantification

Four approaches for dealing with probabilities:

- **Bayesian** approach:

P(*A*) is the degree of belief in the occurrence of an event

Risk quantification | Process

INPUTS:

- Project Roadmap
- Project Management Plan
- Project Risk Register
- Risk Assessment Forms
- Outputs of the project planning phase ⇢ PBS, WBS, Gantt Chart…
- Lessons learned in matter of PRM on former NPD projects
- Names of NPD PRM experts ⇢ interviews

TOOLS & TECHNIQUES:

- Math toolbox ⇢ probability, combinatory…
- Decision trees
- Monte-Carlo simulations

Risk quantification | Process

OUTPUTS:

- Project Risk Register
- Risk Assessment Forms
- Quantitative risk analysis calculation notes…

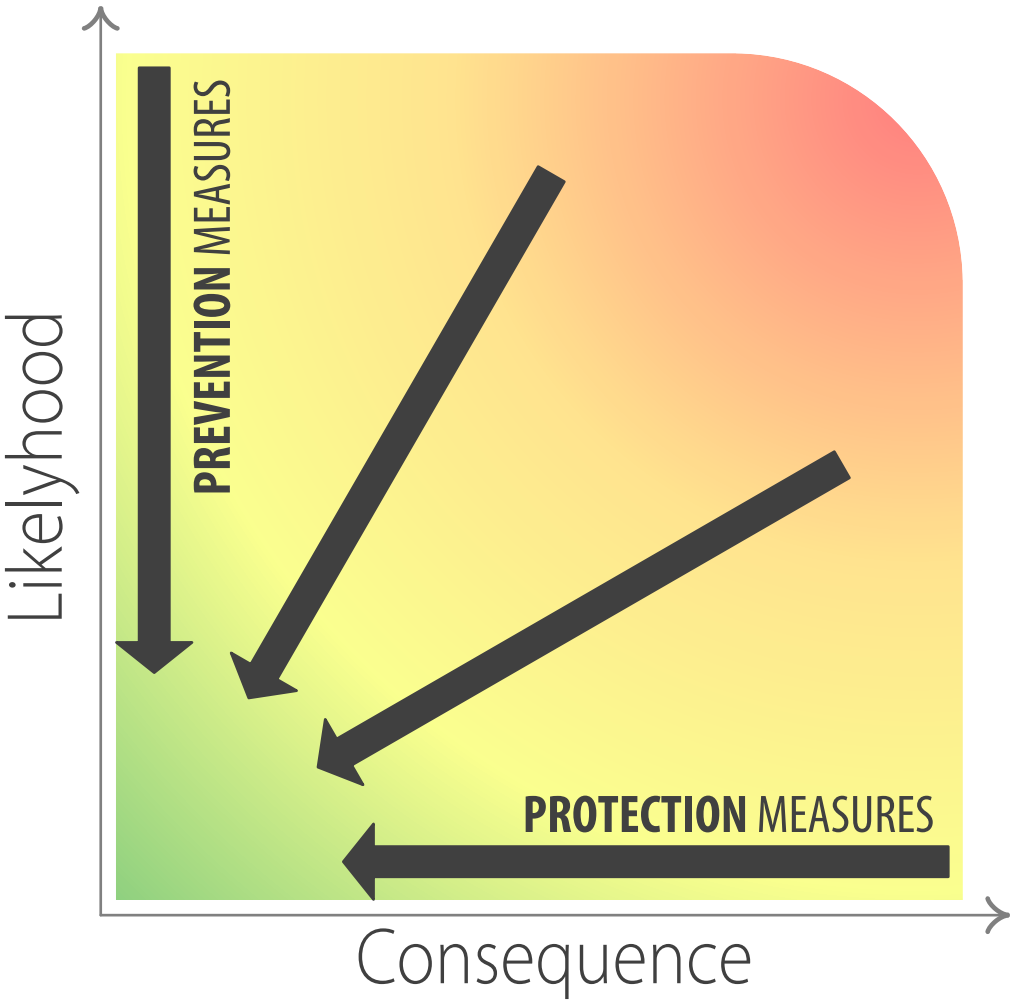
06

Risk Handling

Risk handling

Four strategies:

- **mitigate**
- **accept**
- **avoid**
- **transfer**


Likelyhood
PREVENTION MEASURES
PROTECTION MEASURES
Consequence

Risk handling | Process

INPUTS:

- Project Roadmap
- Project Management Plan
- Project Risk Register
- Risk Assessment Forms
- Lessons learned in matter of PRM on former NPD projects
- Names of NPD PRM experts ⇢ interviews

TOOLS & TECHNIQUES:

- Brainstorming sessions, Six-hats, Delphi method…
- Interviews

Risk handling | Process

OUTPUTS:

- Project Risk Register
- Risk Assessment Forms
- **Response Plans**
- **Contingency Plans**

PizzaExpress

Consegno a domicilio da drone

Your lab is invited to design and develop a remotely operated **drone** for pizza delivery by the air.

Drafting a **Project Risk Register**


RiskLite 0.1
http://cern.ch/bonnal/risklite.html
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Abstract
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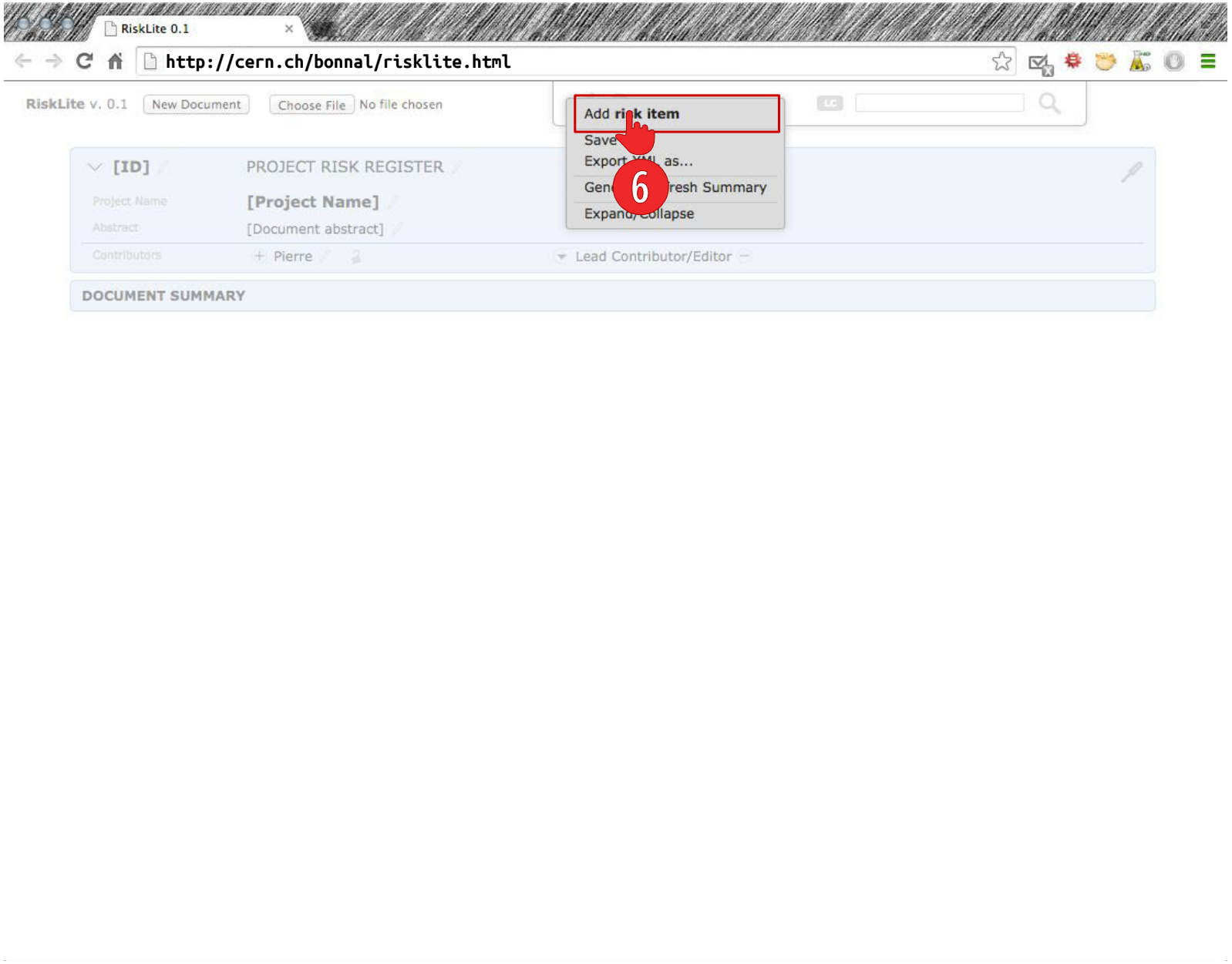
Contributors
Pierre
Lead Contributor/Editor
DOCUMENT SUMMARY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Contributors
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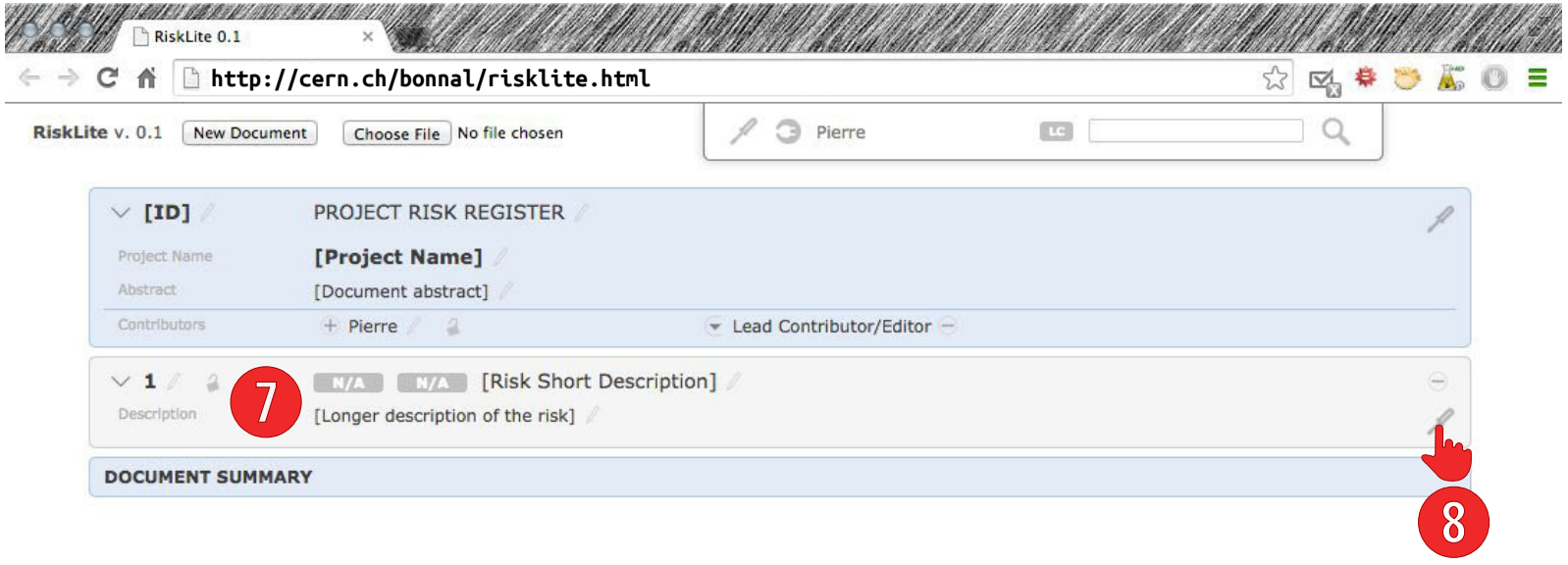
DOCUMENT SUMMARY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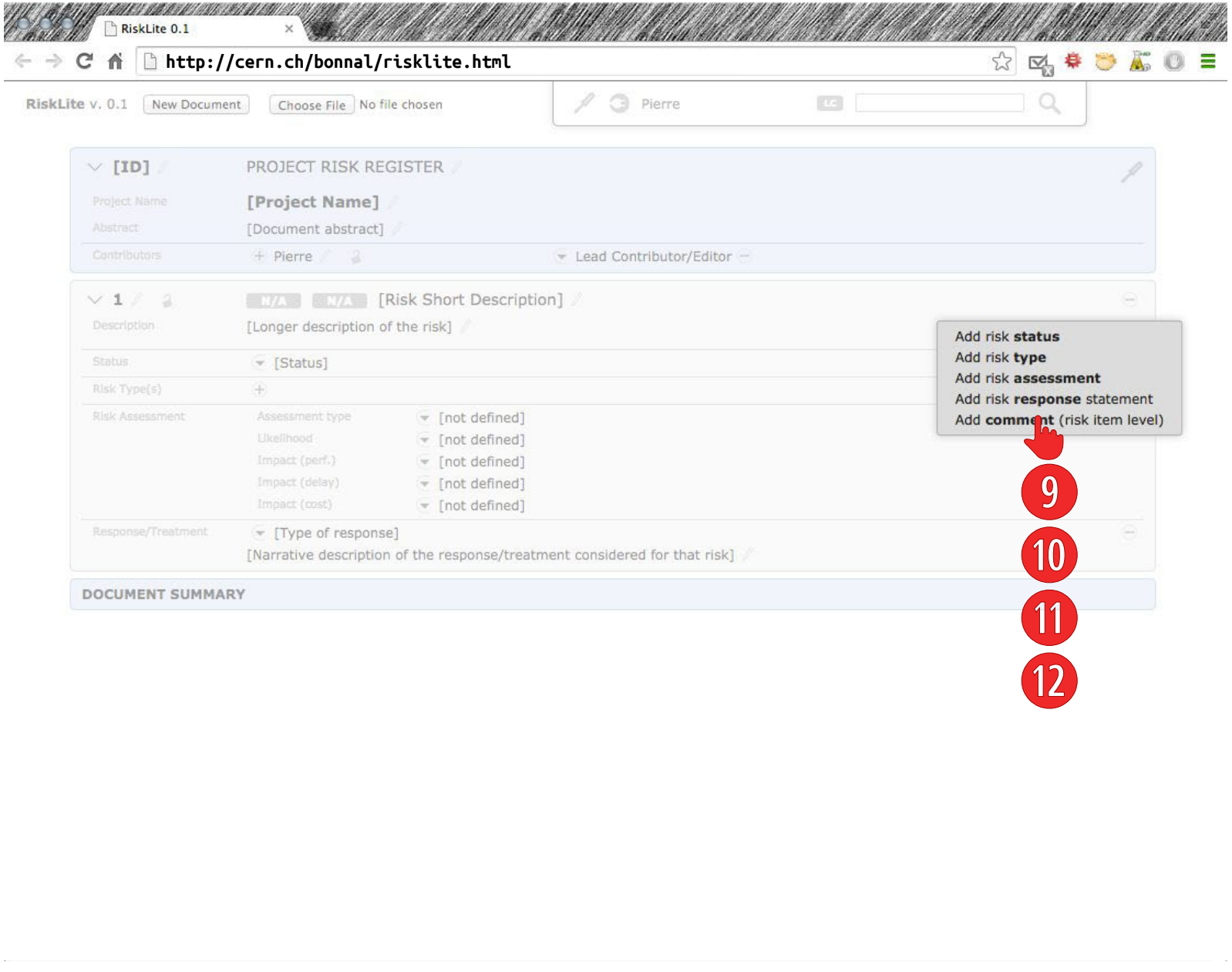
1
7
N/A
N/A
[Risk Short Description]
Description
[Longer description of the risk]
DOCUMENT SUMMARY
8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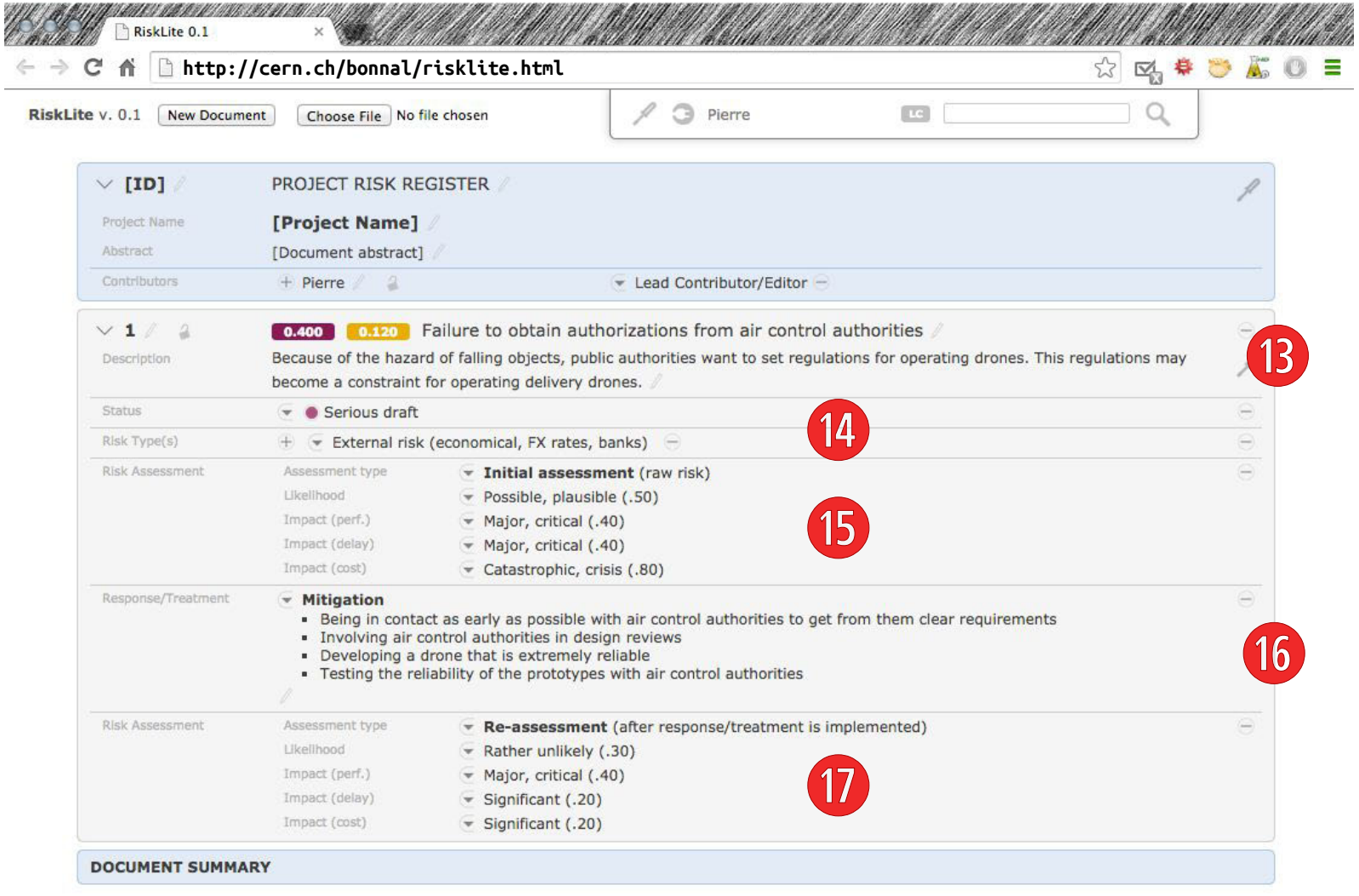
Lead Contributor/Editor
1
N/A
N/A
[Risk Short Description]
Description
[Longer description of the risk]
Status
[Status]
Risk Type(s)
Risk Assessment
Assessment type
[not defined]
Likelihood
[not defined]
Impact (perf.)
[not defined]
Impact (delay)
[not defined]
Impact (cost)
[not defined]
Response/Treatment
[Type of response]
[Narrative description of the response/treatment considered for that risk]
DOCUMENT SUMMARY
Add risk status
Add risk type
Add risk assessment
Add risk response statement
Add comment (risk item level)
9
10
11
12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PROJECT RISK REGISTER
Project Name
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Abstract
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1
0.400
0.120
Failure to obtain authorizations from air control authorities
Description
Because of the hazard of falling objects, public authorities want to set regulations for operating drones. This regulations may become a constraint for operating delivery drones.
13
Status
Serious draft
14
Risk Type(s)
External risk (economical, FX rates, banks)
Risk Assessment
Assessment type
Initial assessment (raw risk)
Likelihood
Possible, plausible (.50)
Impact (perf.)
Major, critical (.40)
Impact (delay)
Major, critical (.40)
Impact (cost)
Catastrophic, crisis (.80)
15
Response/Treatment
Mitigation
Being in contact as early as possible with air control authorities to get from them clear requirements
Involving air control authorities in design reviews
Developing a drone that is extremely reliable
Testing the reliability of the prototypes with air control authorities
16
Risk Assessment
Assessment type
Re-assessment (after response/treatment is implemented)
Likelihood
Rather unlikely (.30)
Impact (perf.)
Major, critical (.40)
Impact (delay)
Significant (.20)
Impact (cost)
Significant (.20)
17
DOCUMENT SUMMARY

07

S

Risk Monitoring

Risk follow-up

Consists of:

- Following up the risks identified of the Project Risk Register
- Detecting the emergence of residual risks, and engaging the appropriate Contingency Plans
- Following up the implementation of the Contingency Plans and appraising their efficiency
- Scrutinizing the emergence of **new risks** (i.e. risks that weren't identified during the Planning phase of the project) and applying to them all the methodology presented here before

Risk follow-up | Process

INPUTS:

- All PRM documents
- Project performance indices ⇢ EVM…
- Checklists

TOOLS & TECHNIQUES:

- Project audits and reviews focused on PRM

OUTPUTS:

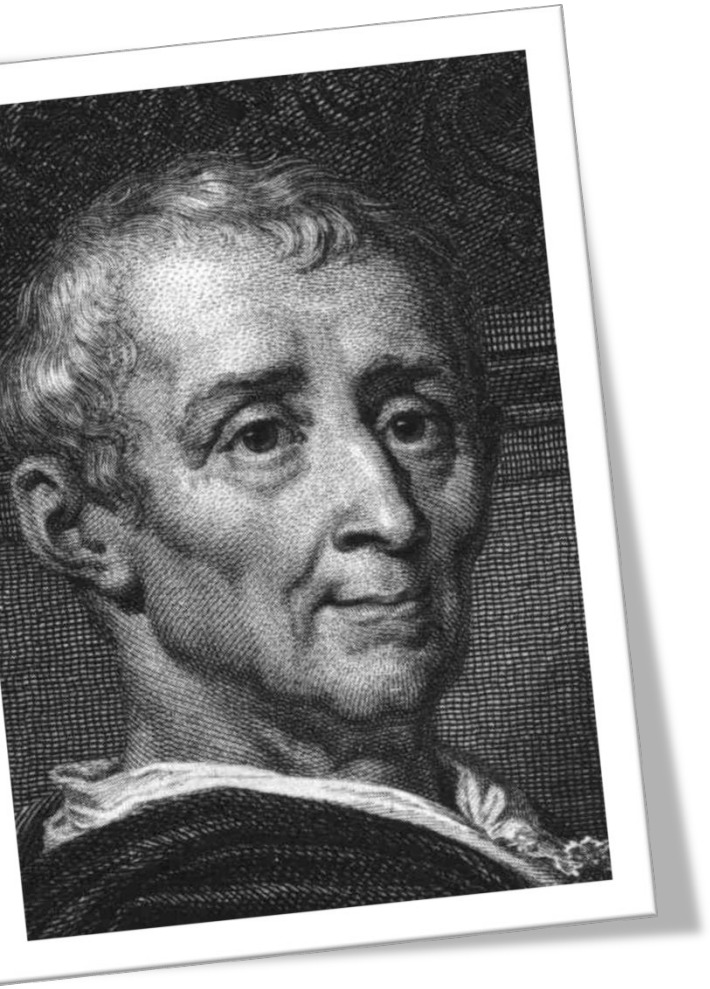
- Updated PRM documents

08

S

Safety Risk Management

Montesquieu *The spirit of the laws* 18th century



Executive

Study Team then
Project Team then
Operations Team then
Dismantling Team

Legislative

Safety
Regulations
& Prescription

Judiciary

Safety
Inspectors
or Licensing
Authority

Two perspectives

Workers should not fall victim of accident or occupational illness because of the facility or system

Occupational health and safety, *Sécurité*

The presence of the facility should not represent any hazard to the people or the environment

to do so, it should operate **reliably**

Facility integrity, *Sûreté*

Aim (Documenting Safety)

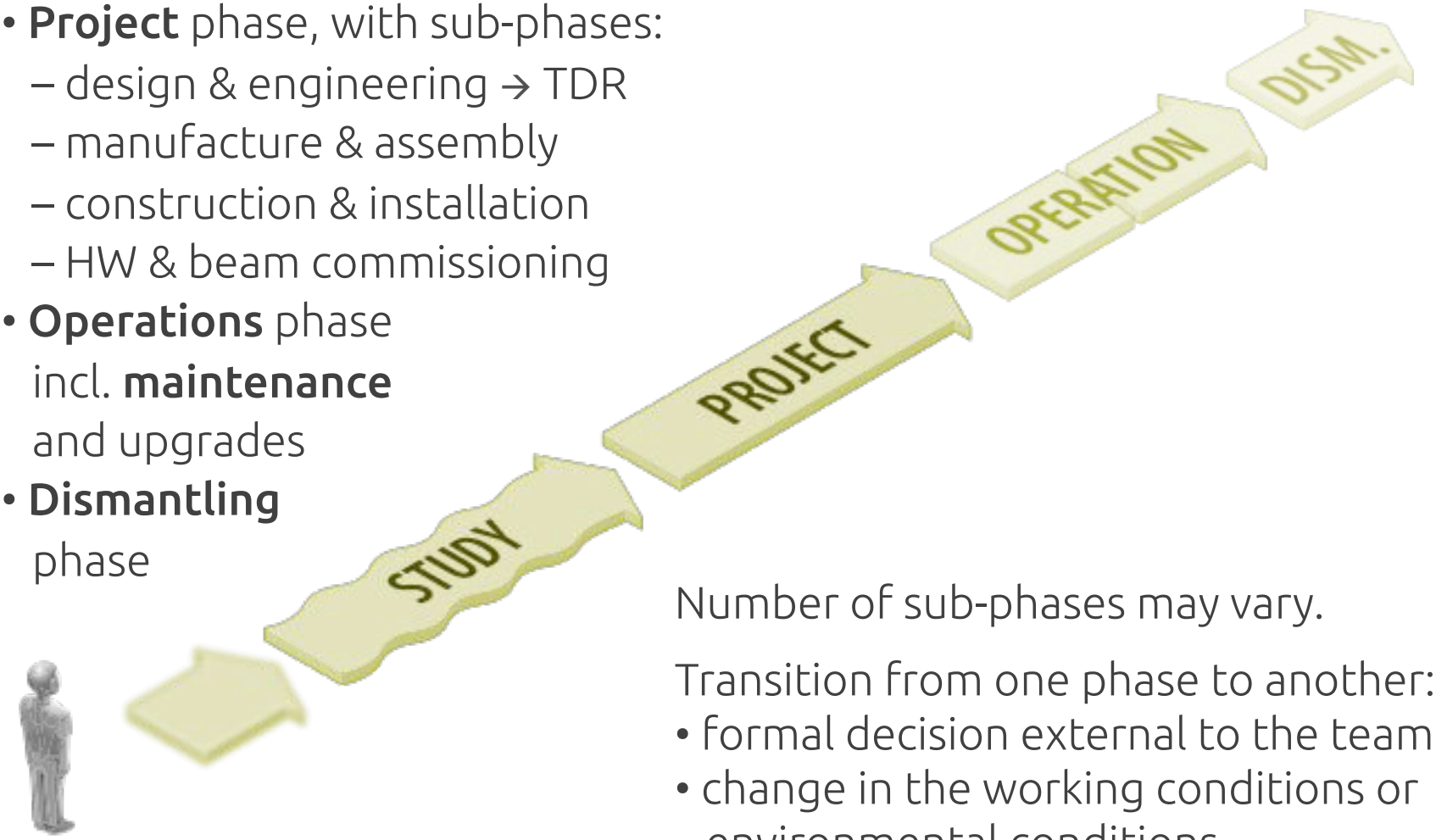
Demonstration by the study / project / operations / dismantling team that the **safety regulations and requirements are fulfilled** from the two perspectives of safety and integrity

Providing team members with procedures for **safe operation and maintenance** of the facility or the system

Facility Lifecycle

4 major phases:

- **Study** phase → Study Report / CDR
- **Project** phase, with sub-phases:
  - design & engineering → TDR
  - manufacture & assembly
  - construction & installation
  - HW & beam commissioning
- **Operations** phase
  incl. **maintenance**
  and upgrades
- **Dismantling**
  phase



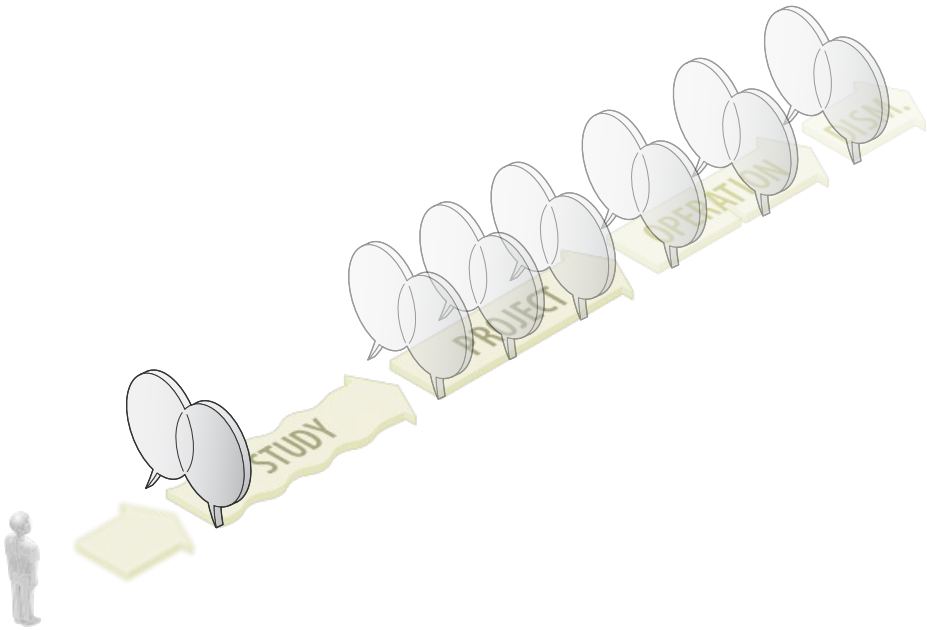
Number of sub-phases may vary.

Transition from one phase to another:

- formal decision external to the team
- change in the working conditions or environmental conditions

Step 1 – Launch discussion

When:
Study phase, then
after each **transition**



Instigator:

- **Project Manager**

Participants:

- **Key team members**
- **Safety engineers / officers**
- **Safety authority**

Step 1 – Launch discussion (cont'd)

Topics to be addressed:

- A **description** and a **common understanding** of the facility or system and of its processes in term of safety
- The review of the **hazards and safety risks** identified
- The review of the **technical and organizational risk control measures** identified
- The identification of the **safety requirements** that shall be considered in the specific framework of the study
- The strategy in matter of **safety documentation** (their contents, editorial schedule, reviewing processes…)
- The identification of **safety checks** (clearances)

Step 2 – *Launch Agreement*

When: after the **launch discussion** is held

What: typically a memorandum, entitled:

Launch Agreement on Safety Aspects

Author and releaser: **Safety authority**

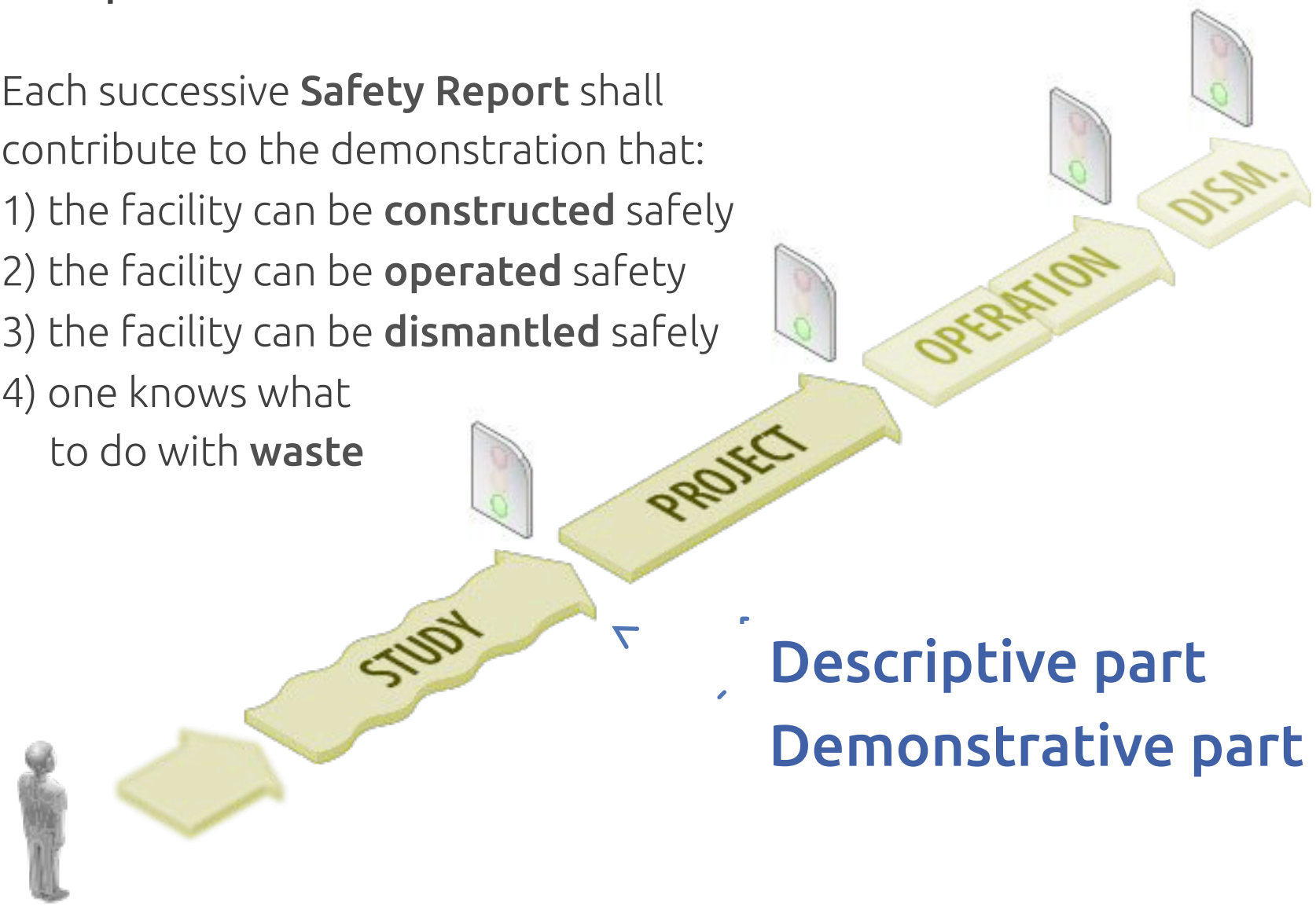
Dispatching:

- **Project manager**
- **Key team members**
- **Safety engineers / officers**
- **Management** (directors, heads of entities concerned)

Step 3 – Editorial work

Each successive **Safety Report** shall contribute to the demonstration that:

1) the facility can be **constructed** safely
2) the facility can be **operated** safety
3) the facility can be **dismantled** safely
4) one knows what to do with **waste**



Step 3 – Editorial work (cont'd)

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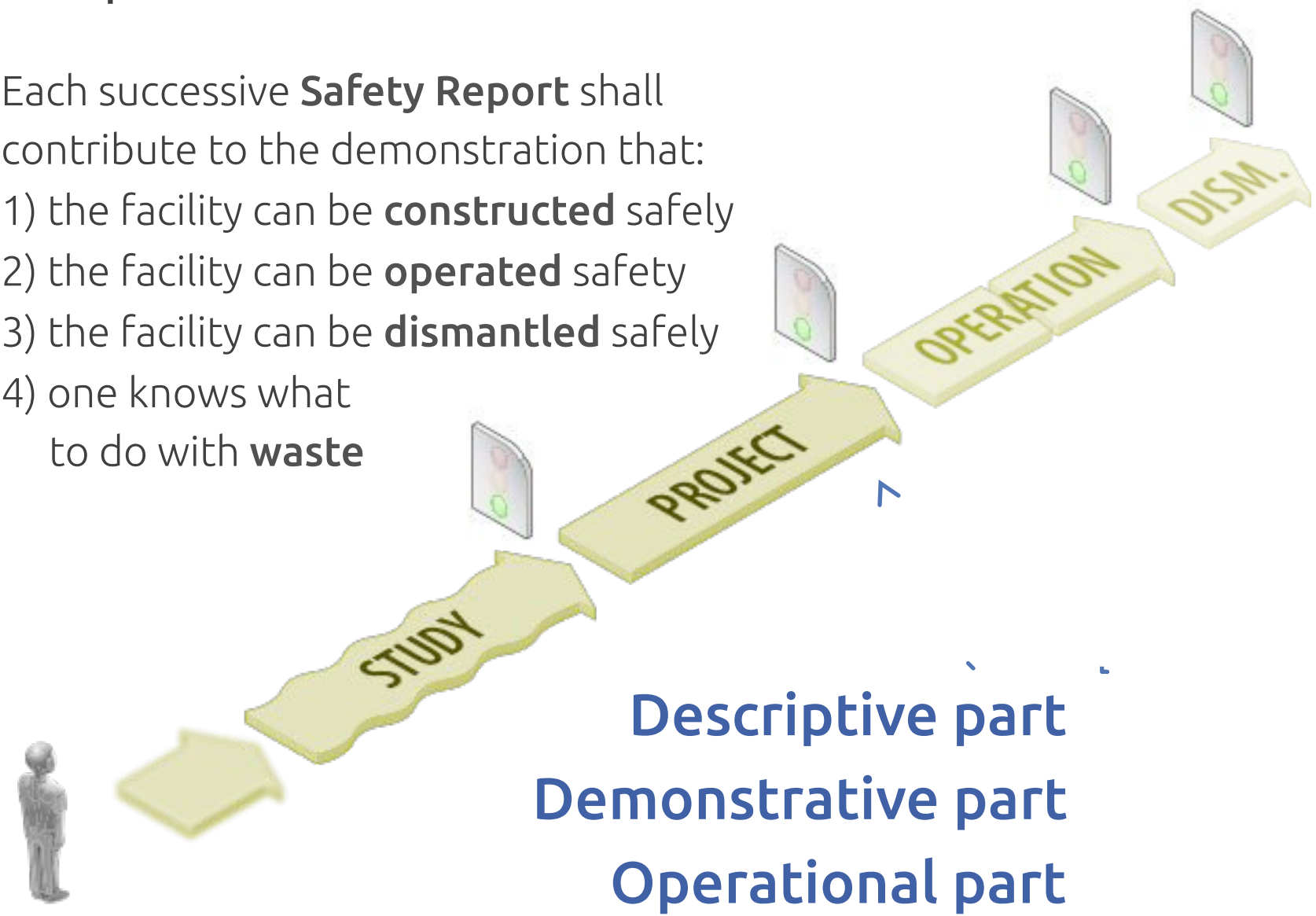

Descriptive part

Demonstrative part

Operational part

Step 3 – Editorial work (cont'd)

Each successive **Safety Report** shall contribute to the demonstration that:

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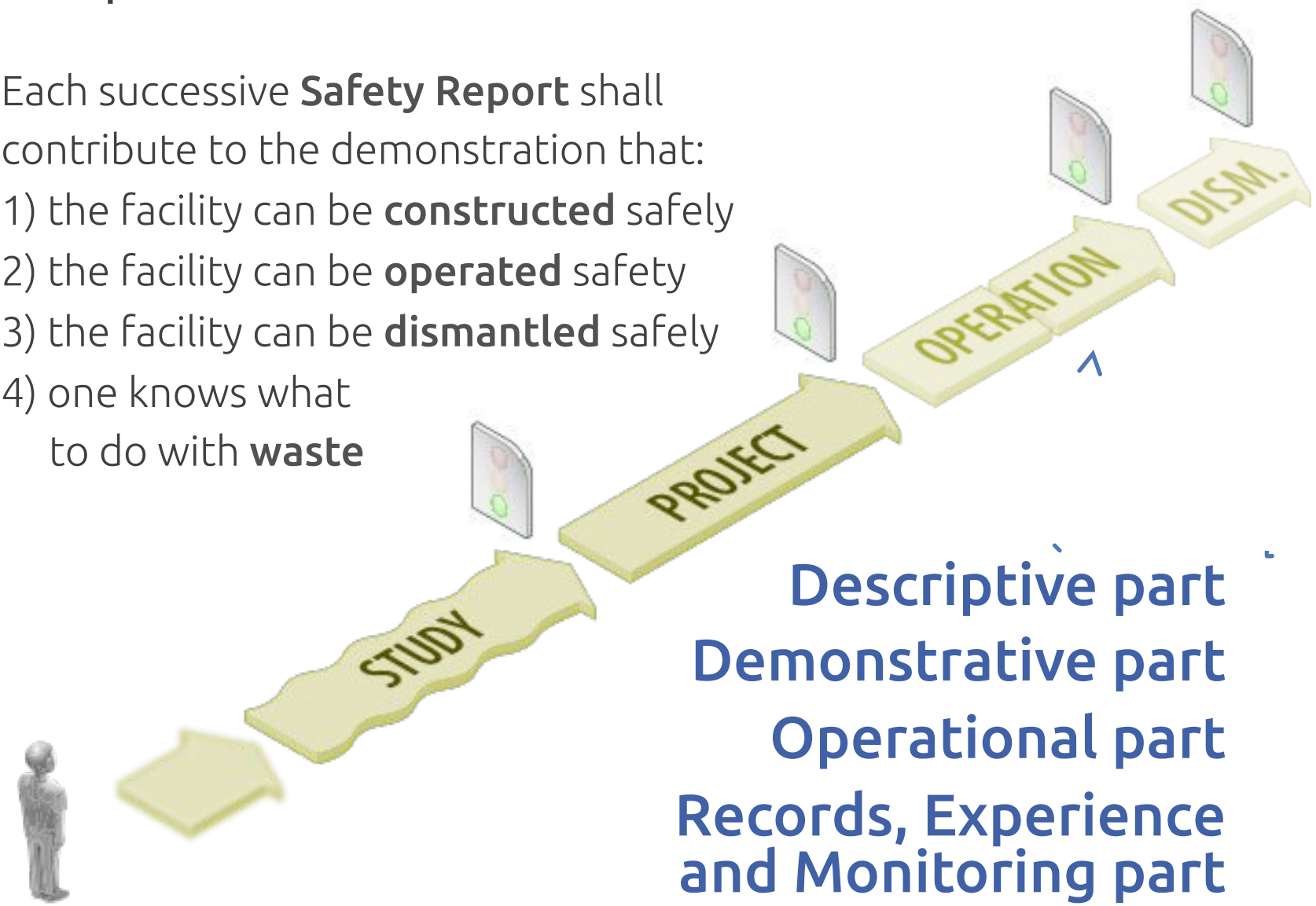


Descriptive part

Demonstrative part

Operational part

Records, Experience and Monitoring part

Part 1 – Descriptive Part

Description of the facility or of the process

- Why is it useful
- Where is it located
- What is it made of
- How does it work
- When will it be constructed, operated, dismantled
- Who is responsible for its construction…
- How will it be constructed…
- Who will be responsible for its operation, dismantling…
- How will it be operated, dismantled…

« Quis, Quid, Ubi, Quibus auxiliis, Cur, Quomodo, Quando »

Part 1 – Descriptive part (cont'd)

Description of the facility and of the process

« Quis, Quid, Ubi, Quibus auxiliis, Cur, Quomodo, Quando »

Which **hazards** are present in the facility or in the process?

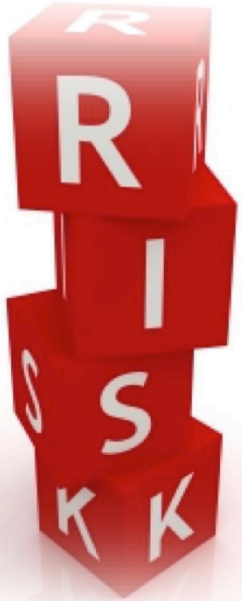
- Energy and radiological source terms
- External (environmental) hazards
- Internal (processes/utilities) hazards

Identification:

- Vade mecum, knowledge sharing…
- Systematic approaches
  (process/utility diagrams, layouts)

Safety philosophy (incl. applicable regulations…)

Demonstrative part (1/2)



- Risk **identification** (see hazard identification)
  - Sequence of events
  - Potential incidental/accidental situations

- Risk **evaluation**
  - Risk assessment matrix

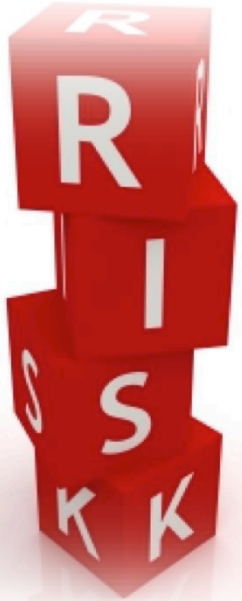
    risk level = likelihood × consequence
  - Failure mode and effects analysis (FMEA)

    severity = probability × detectability × gravity

- Risk **analyses**

Demonstrative part (2/2)

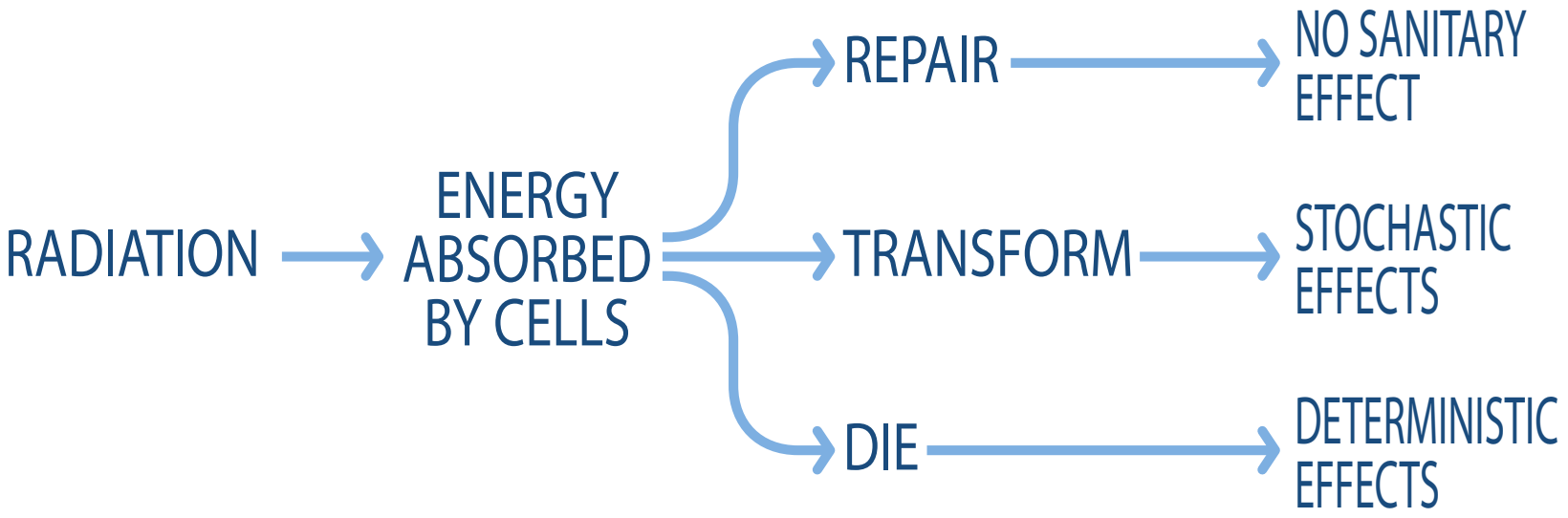
- Risk **responses/treatments**
  - **Technical** (**structural**) measures or provisions implemented to mitigate the risks
    Conception documents (notes, drawings…)
    Zoning principles
    Calculation notes…
  - **Organizational** measures or provisions planned to mitigate the risks
    Outline of the instructions and procedures
  - **Operations thresholds**



Safety philosophy

All (most) nuclear safety regulations suggests
that individual exposures and number
of exposed persons is maintained to a level
that is **a**s **l**ow **a**s **r**easonably **a**chievable,
taking into account economical and social factors

Safety philosophy



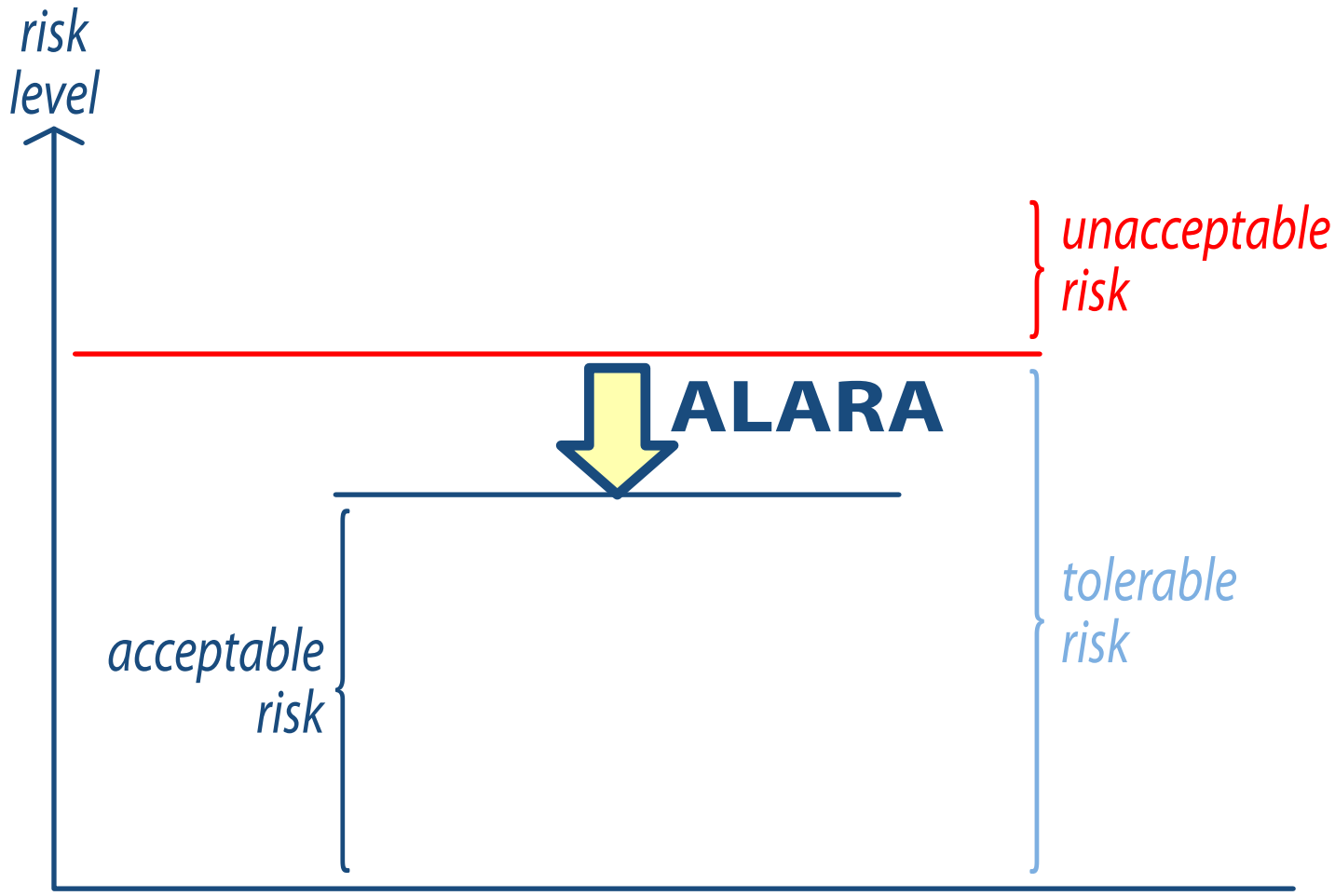
DETERMINISTIC EFFECTS

- Effect = ƒ(dose)
- Gravity = ƒ(dose)
- Early effects
- ∃ thresholds
- Probability = 1

STOCHASTIC EFFECTS

- Effect ≠ ƒ(dose)
- Gravity ≠ ƒ(dose)
- Late effects
- “**No threshold**”
- Probability = ƒ(dose)

Safety philosophy



Safety philosophy

Practically:

For a given hazardous situation,

- Evaluate **risk level** (radiation exposure…)
- Identify possible **protection** and **prevention**, structural and organizational treatments
- Estimate their **impact** on the performance (incl. construction/operation costs and schedule)
- Select the most appropriate one(s)

Step 4 – Safety review / Clearance

When:
before the end of the **study phase**,
then before each **transition**

Instigator:

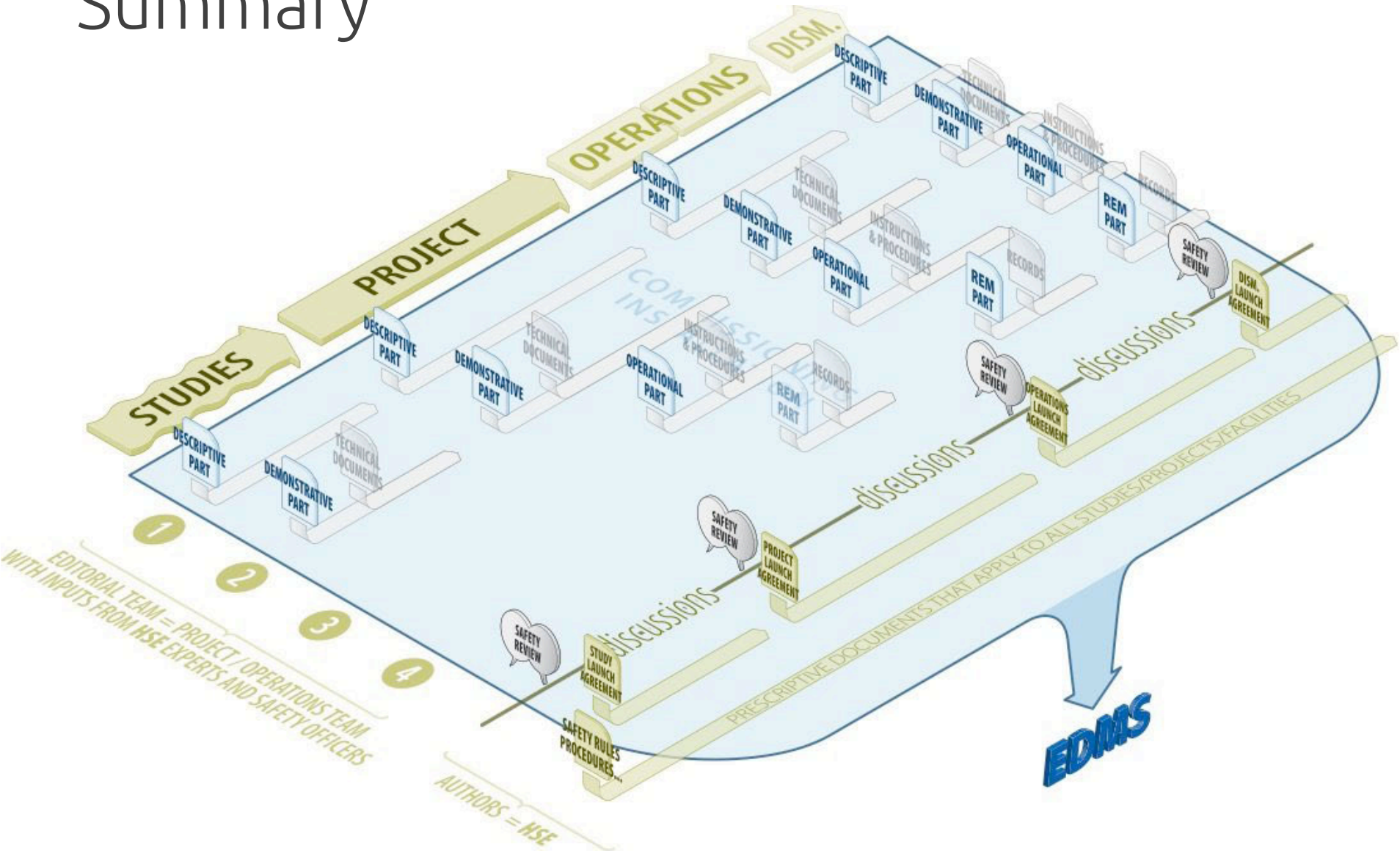
- **Project manager** and **Safety authority**

Participants:

- **Key project team members**
- **Safety engineers** / **officers**

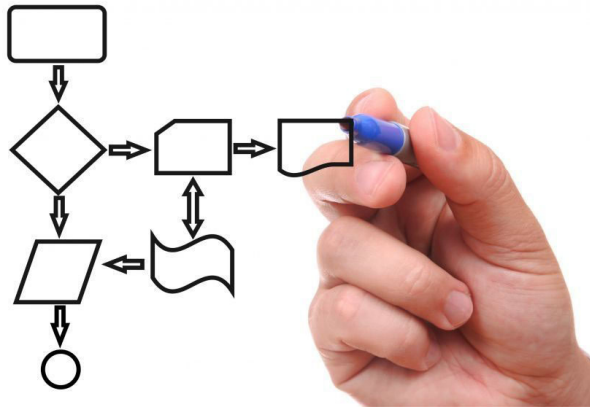
Outcome: **Safety Clearance** (or **Safety Refusal!!**)

Summary


STUDIES
PROJECT
OPERATIONS
DISM.
DESCRIPTIVE PART
DEMONSTRATIVE PART
TECHNICAL DOCUMENTS
OPERATIONAL PART
INSTRUCTIONS & PROCEDURES
REM PART
RECORDS
SAFETY REVIEW
DISM. LAUNCH AGREEMENT
OPERATIONS LAUNCH AGREEMENT
PROJECT LAUNCH AGREEMENT
STUDY LAUNCH AGREEMENT
SAFETY RULES PROCEDURES...
discussions
1
2
3
4
EDITORIAL TEAM = PROJECT / OPERATIONS TEAM WITH INPUTS FROM HSE EXPERTS AND SAFETY OFFICERS
AUTHORS = HSE
PRESCRIPTIVE DOCUMENTS THAT APPLY TO ALL STUDIES/PROJECTS/FACILITIES
EDMS

Part 3 – Operational Part

- Operations limits (thresholds) not to be exceeded
- Operations instructions and procedures
  - for operating the facility
  - for maintaining and ensuring its integrity
  - quality management framework



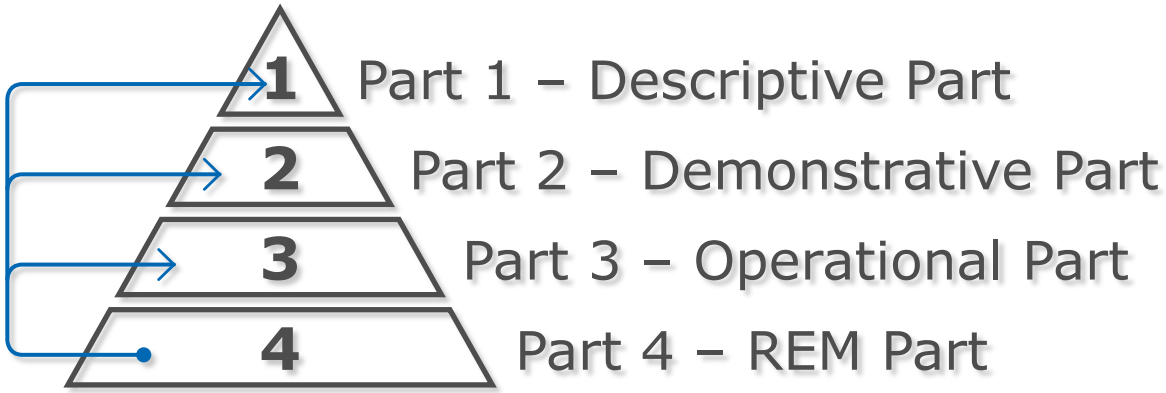
- Organizational structures
  - for handling the project, constructing the facility
  - for operating and maintaining the facility
  - for dismantling the facility and handling waste

Part 4 – REM Part (Records, Experience and Monitoring)

Elicitation of storage and retrieval facilities for:

- **Records** (safety and inspection reports…)
- **Lessons learned** from the development, operations, maintenance and dismantling
  so that all concerned can benefit from them

List of the actions run to continuously improve the level of safety of the facility or system



Document Lifecycle

Safety document **prepared** by:

- Members of the project team
- Safety engineers / officers

Safety document **verified** (**checked**) by:

- Other safety engineers / experts
- Key equipment/technology experts
- Etc.

Safety document **validated** (**approved**) and released by:

- Project manager
- Directors and heads of entities involved

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