FUTURE CIRCULAR COLLIDER
Innovation Study

FCCNoW 2020 - MATEX Workshop

Risk management applied to excavated materials

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Technical Risk management in tunnelling in France

Specificities for excavated materials

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Conditions different from those expected
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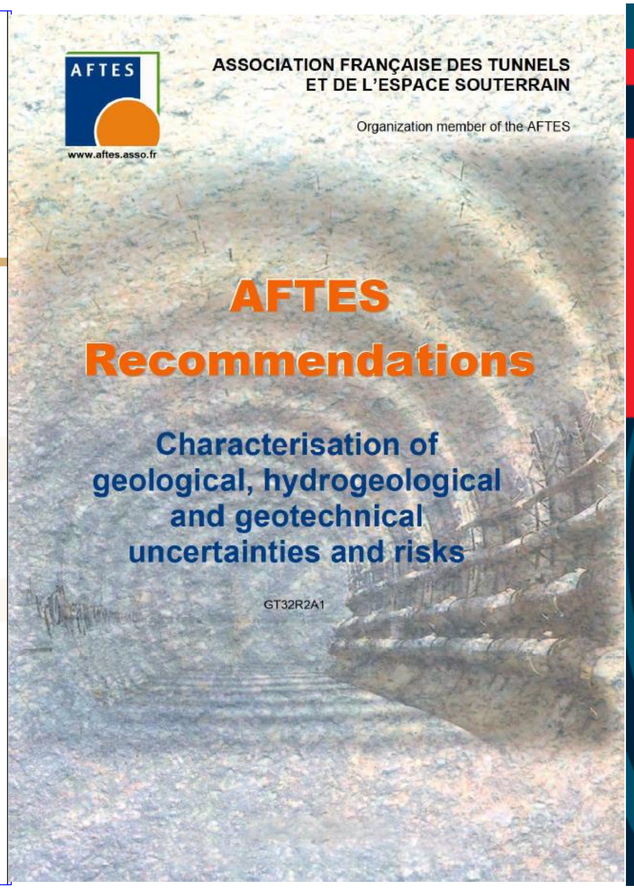
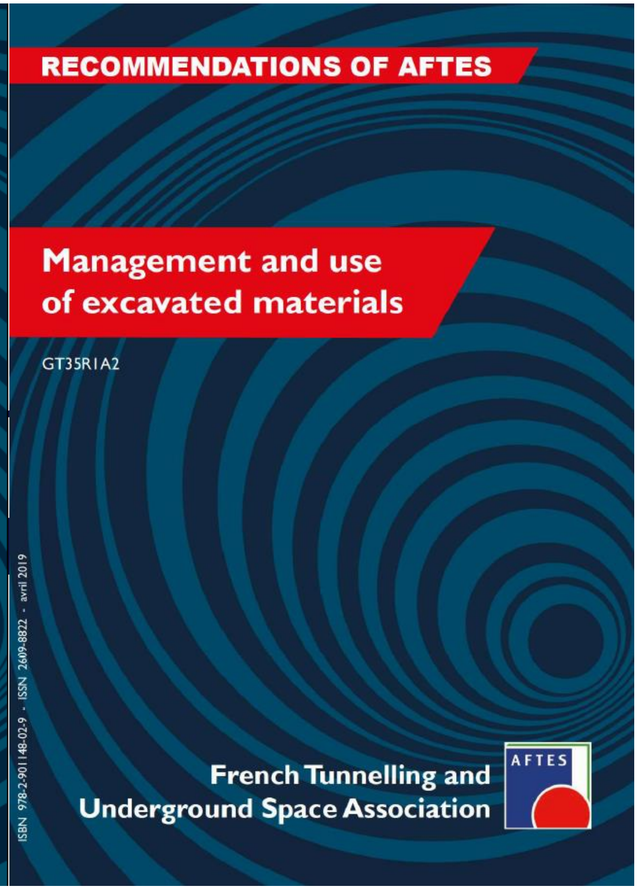
RISKS or opportunities

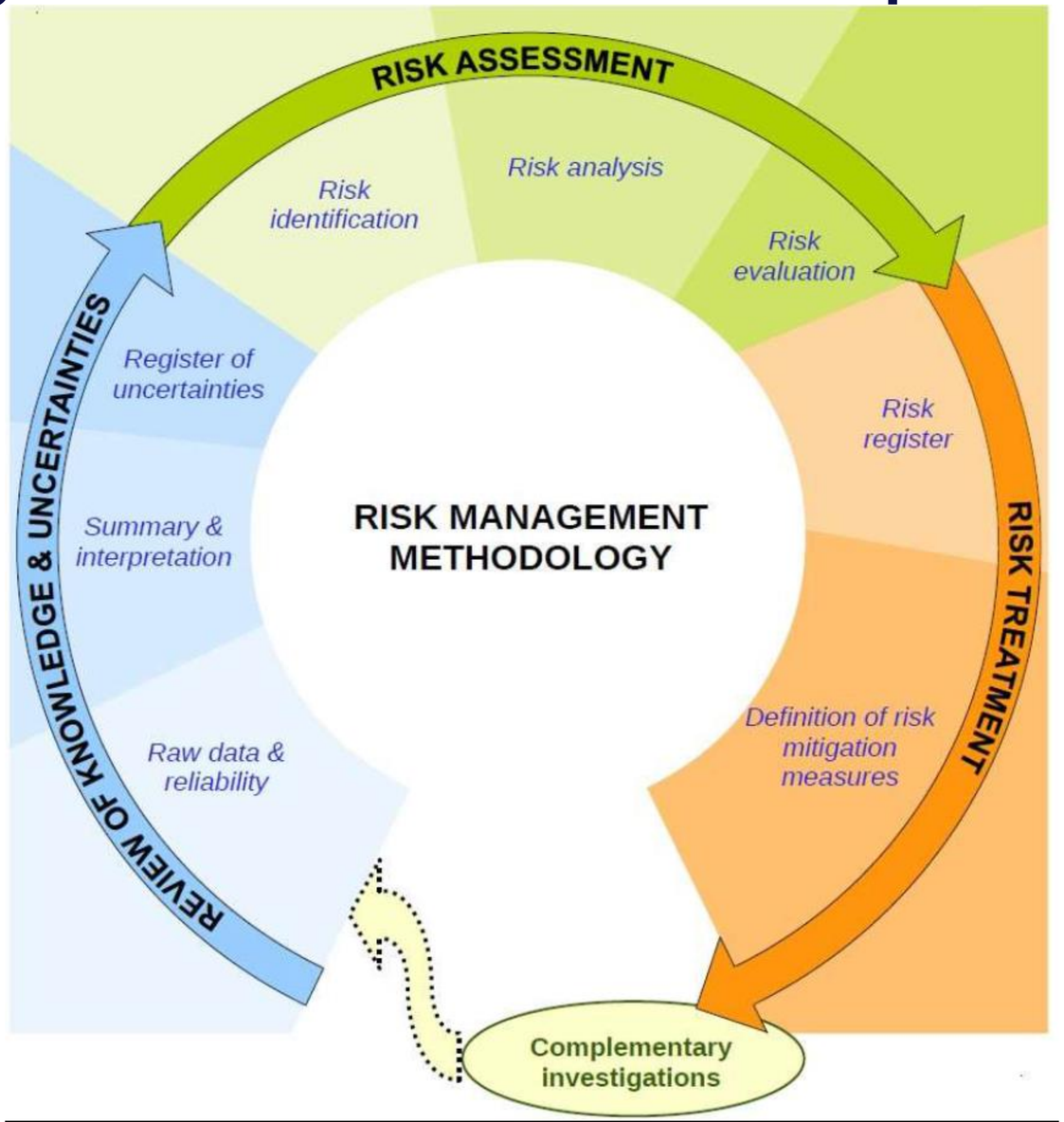
How to anticipate these risks from the outset?

Risk Management references in France





Risk Management: an iterative process



Register of uncertainties

Uncertainty
State, even partial, of deficiency of information related to understanding or knowledge of an event, its consequences or its likelihood

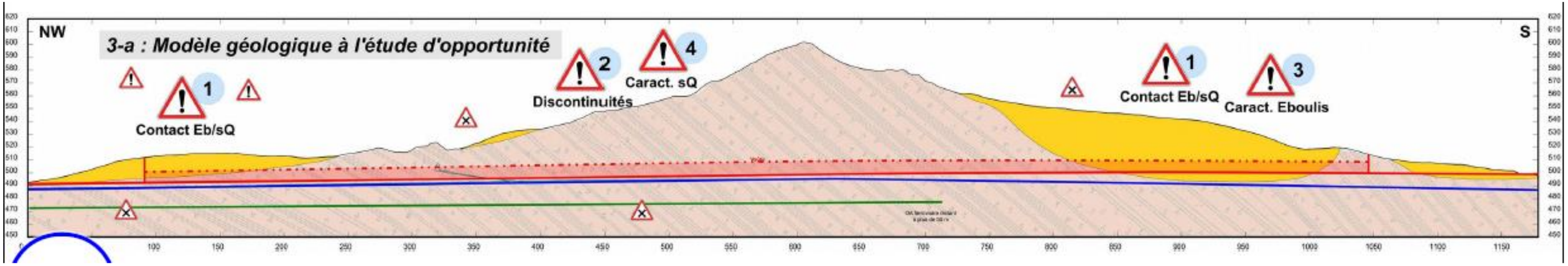
BILAN DES CONNAISSANCES		
N° du risque	**partie d'ouvrage concernée**	**source du risque (incertitude)**
1	section courante tunnel	Longueur du tronçon avec front mixte
2	section courante tunnel	comportement des éboulis à l'excavation
3	section courante tunnel	conditions de stabilités à l'excavation
4	section courante tunnel	comportement des schistes
5	section courante tunnel	venues d'eau
6	section courante tunnel – pm 90/300	stabilité du versant rocheux latéral dû à couverture faible
7	têtes	stabilités en grand des falaises
8	têtes	stabilités de blocs en falaises
9	section courante tunnel – croisement tunnel SNCF	sensibilité aux vibrations du tunnel ferroviaire existant
10	section courante tunnel – croisement galerie de sécurité	sensibilité aux vibrations de la galerie
11	section courante tunnel	dureté et abrasivité des bancs de calcaire

Risk identification

Event
occurrence or change of a particular set of circumstances

Identification of events of geological, hydrogeological, geotechnical origin
Research of uncertainties that affect the objectives (→ source of risk)

N°	Source of risk	Parameter	Dreaded event (simplified wording)	Explanations
1	variation	Contact geometry	Mixed front over long length	Mixed-face section area of greater than expected length, depending on the geometrical arrangement of the contact. This front length is estimated at 180m. It is the exceeding of this length that is feared.
3	contrast	cohesion	Pulverulent screeds	Encounter of pulverulent scree formation leading to frontal instabilities



Risk analysis

Possible
Not likely
Very unlikely
Improbable

Likelihood chance of something happening

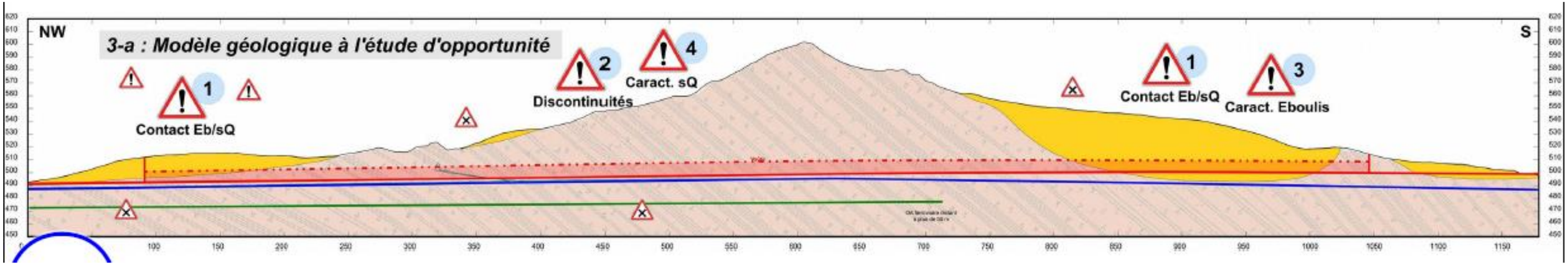
Event 1
mixed front over a longer length than expected

Event 3
encounter of powdery scree, less favourable behaviour than expected

Qualitative approach

Possible

Possible



Risk analysis

High
Significant
Medium
Slight

Consequence
outcome of an event affecting the objectives

Event 1
mixed front over a longer length than expected

Consequence
heavy profile over a larger linear area

Qualitative approach Significant

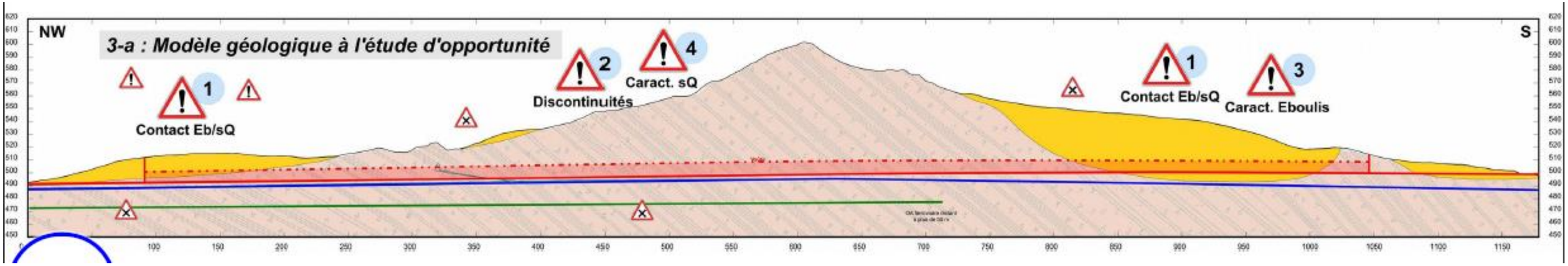
Quantitative approach €€

Event 3
encounter of powdery scree, less favourable behaviour than expected

Consequence
Larger supports or presupports

Medium

€



Risk evaluation

Risk matrix

L \ C				
4	8	12	16
3	6	9	12
2	4	6	8
1	2	3	4

C

Unacceptable
Major, to be monitored
Significant, but in principle acceptable
Negligible, minor

Level of risk
Magnitude of a risk or combination of risks, expressed in terms of the combination of consequences and their likelihood

Event 1
mixed front over a longer length than expected

L x *C* = ***LR***

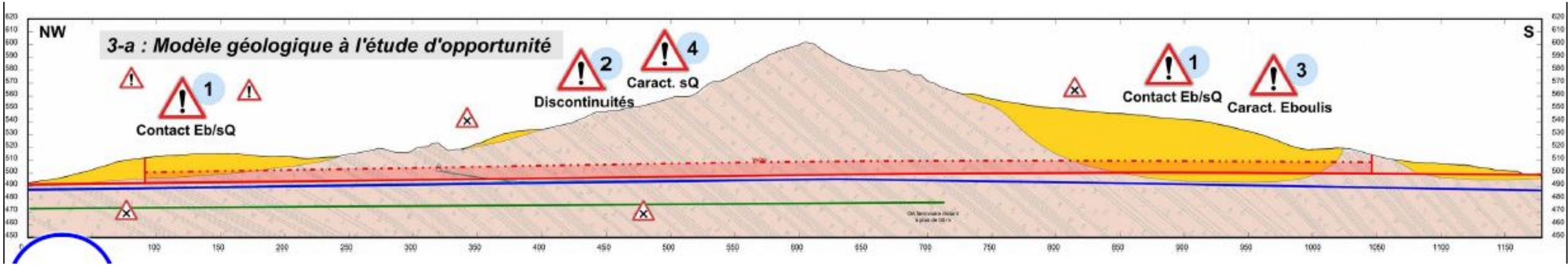
Qualitative approach

Possible 4 | Significant 3 | Unacceptable **12**

Event 3
encounter of powdery scree, less favourable behaviour than expected

L x *C* = ***LR***

Possible 4 | Medium 2 | Major 8



Risk evaluation

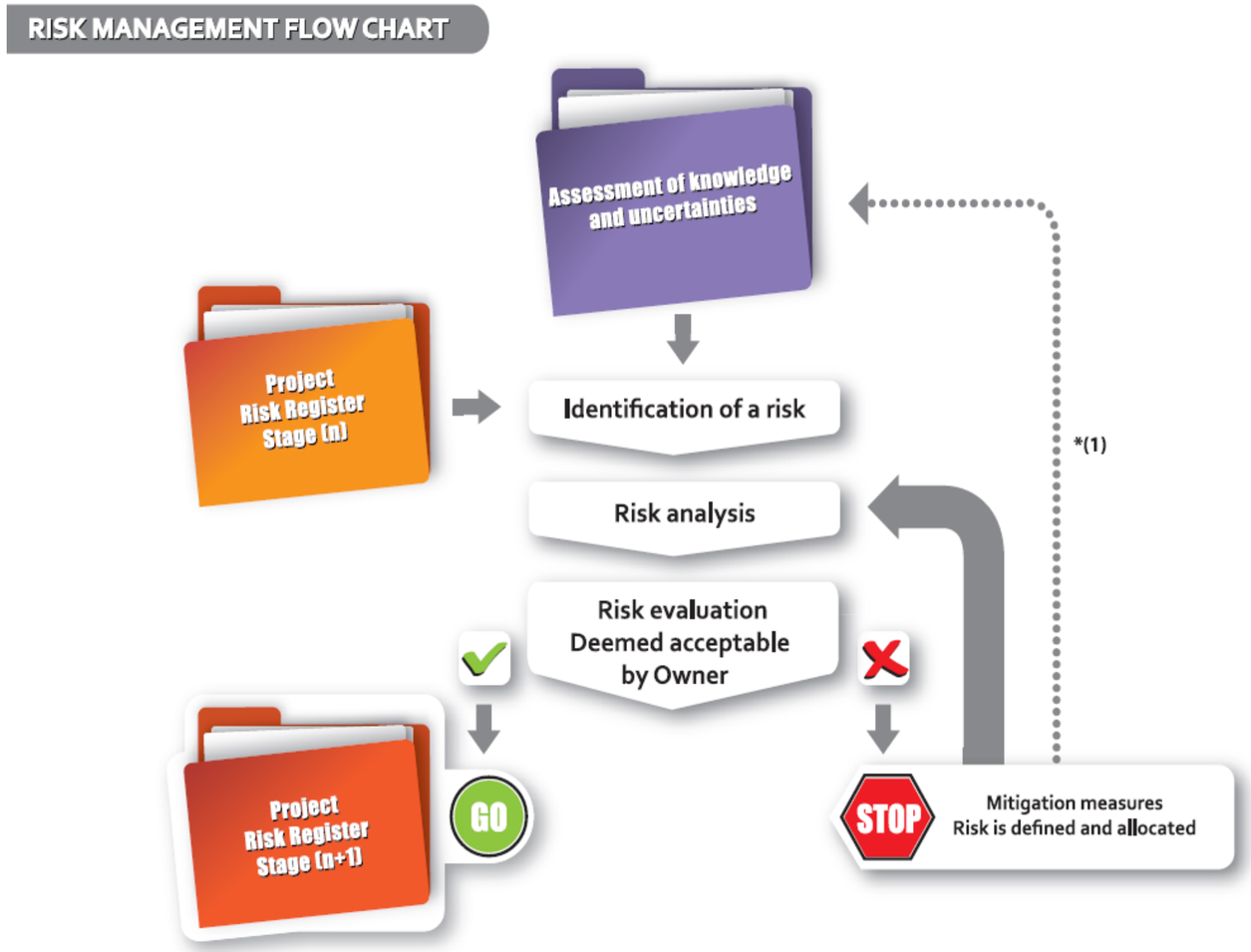
Monetarization of the risk level
(Provision for Identified Risks: PIR)

PIR = Σ1n Li x Ci
With Li Qualitative likelihood
Ci Financial consequence

= amount that the project owner must set aside to cover possible risks

Risk management

An iterative process throughout the project:



Contractualization

At the end of the process, a risk management plan that includes:

- A residual risk register
  - preventive measures
  - curative measures
- Special technical specifications for risks
- Specific prices for risks

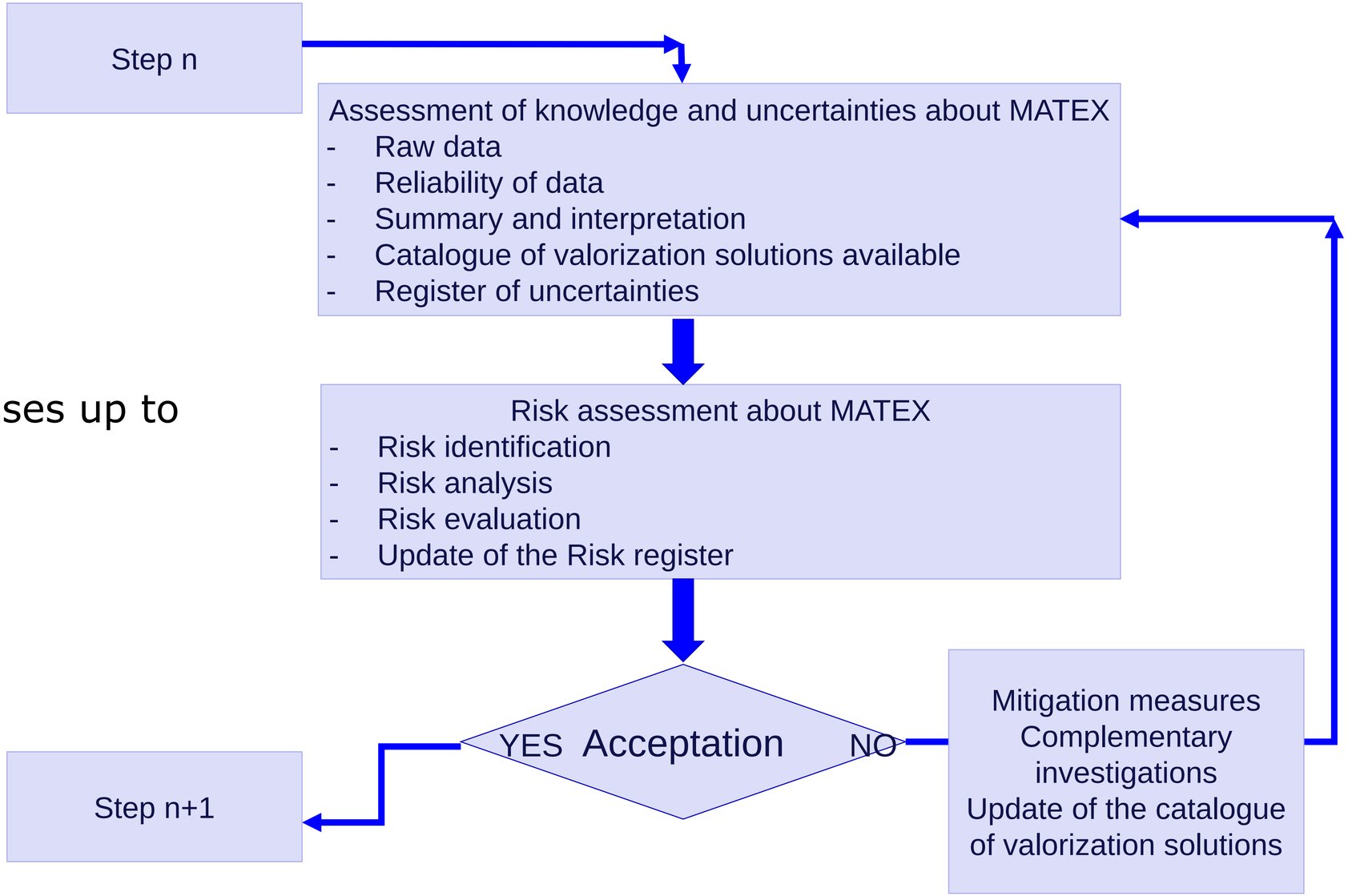
In the event of the occurrence of an identified risk, the cost is covered by the PIR

Specific risk management for excavated materials

Iterative process

At each stage of study phases up to the actual works

Updating the Risk register



Example of risk register for excavated materials

- Uncertainty about the nature of materials
- Mixed front of the tunnel
- Uncertainty about volumes
- Uncertainty about water content
- Materials extraction rates variation
- Excavation methods impact
- Logistics, storage, treatment
- Possible uses available
- Regulation change
- Etc.

Road map for the project owner

- Anticipate from the design stage
- Characterize the excavated materials with the purpose to foster valorization
- Identify as early as possible the possibilities for reuse
- During the work phase, ensure that reuse is implemented according to market conditions
- Seek help from competent project designers

Thank you for your attention.