Subregional Workshop on strengthening mine tailings safety for Central Asian countries

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TMF methodology: Tailings Hazard Index and TMF Checklist, application experience

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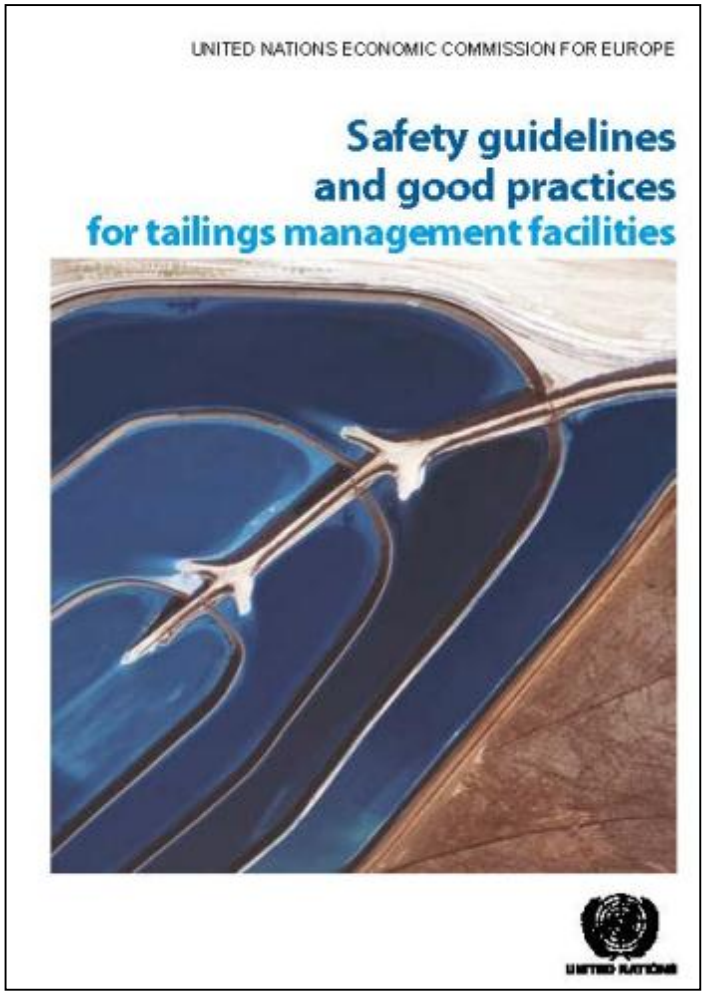
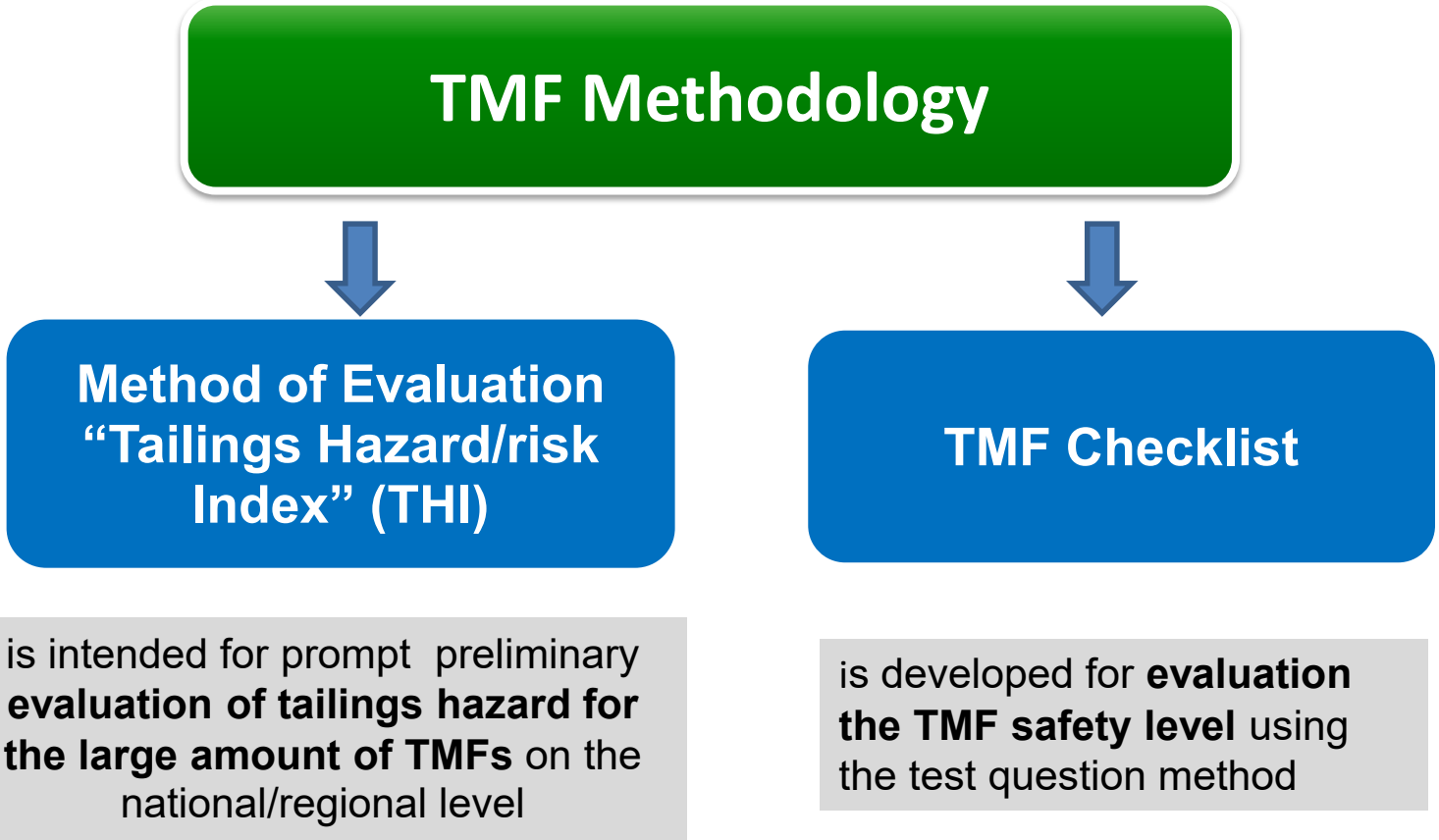
UNECE "Safety Guidelines …" as the basis for the TMF Checklist



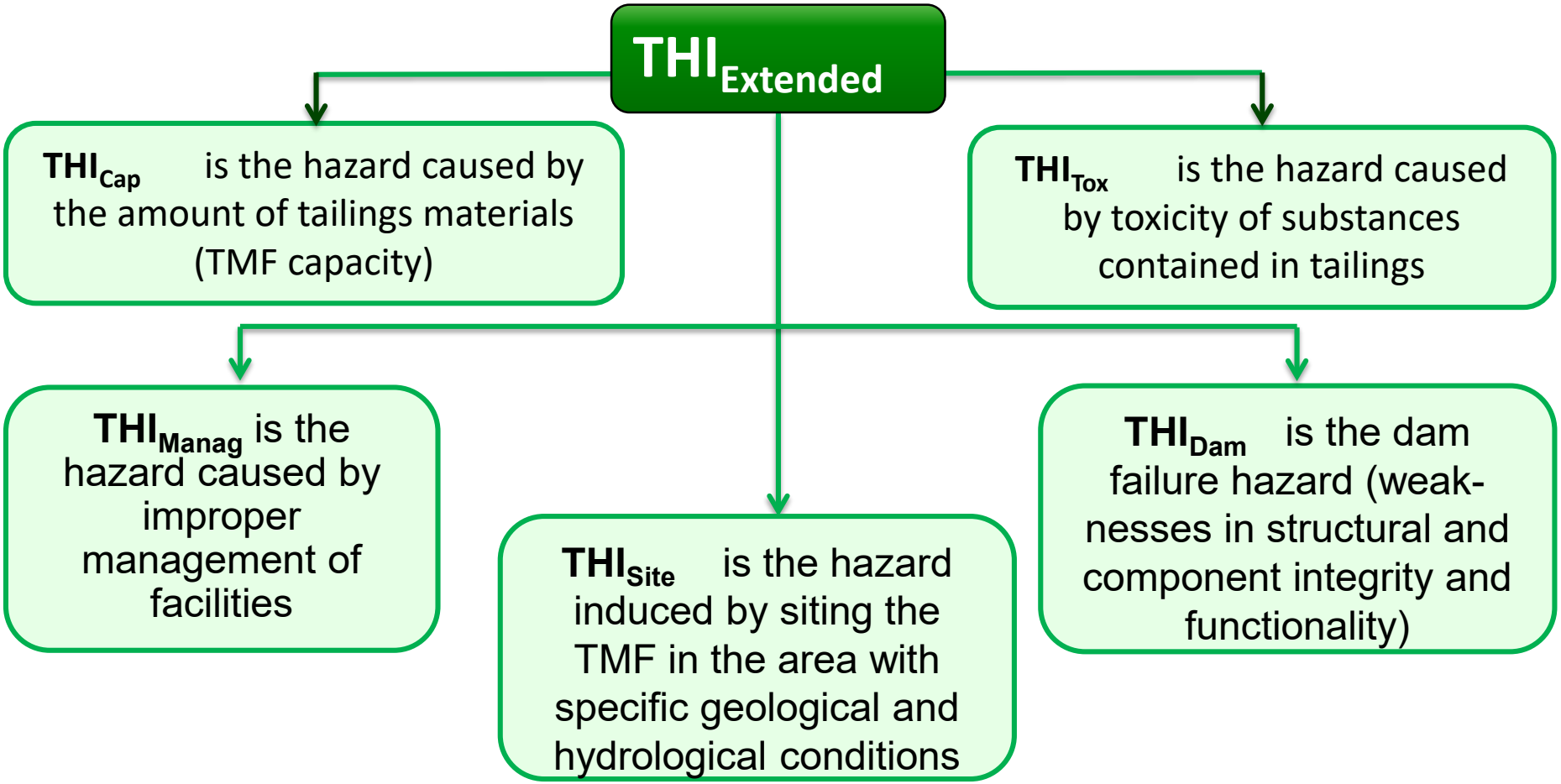
- The Guidelines were developed by the Joint Expert Group on Water and Industrial Accidents, with the support of the United Nations Economic Commission for Europe (UNECE) secretariat.
- The Guidelines were endorsed by the Conference of the Parties to the Industrial Accidents Convention (2008) and by the Meeting of the Parties to the Water Convention (2009).
- The document was updated in 2014.

TMF Methodology has been developed by the team of Ukrainian experts with the support of international experts within the project of German Environmental Agency (UBA) "Improving the safety of industrial tailings management facilities based on the example of Ukrainian facilities" (2013-2015).

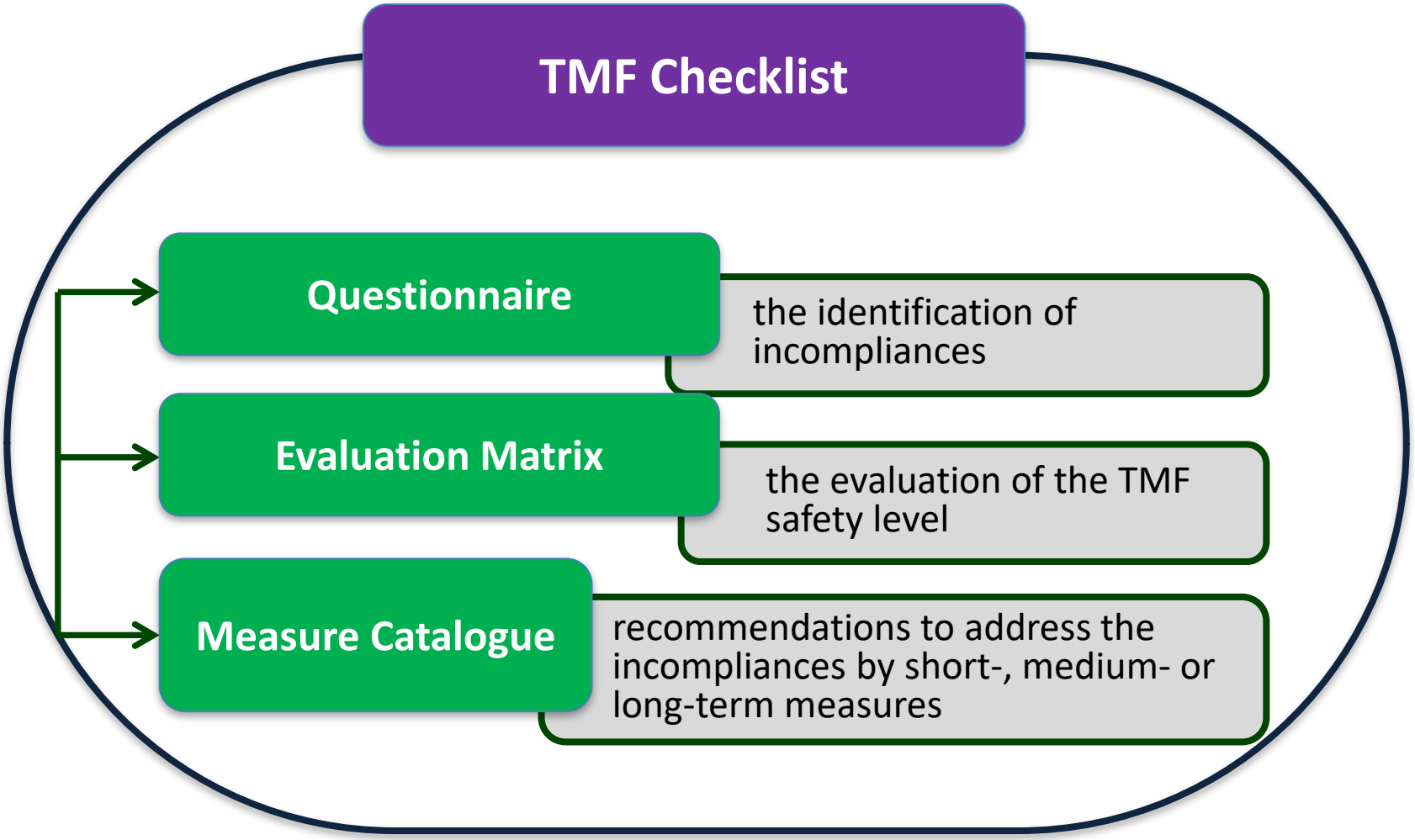


Tailings Hazard Index (THI)

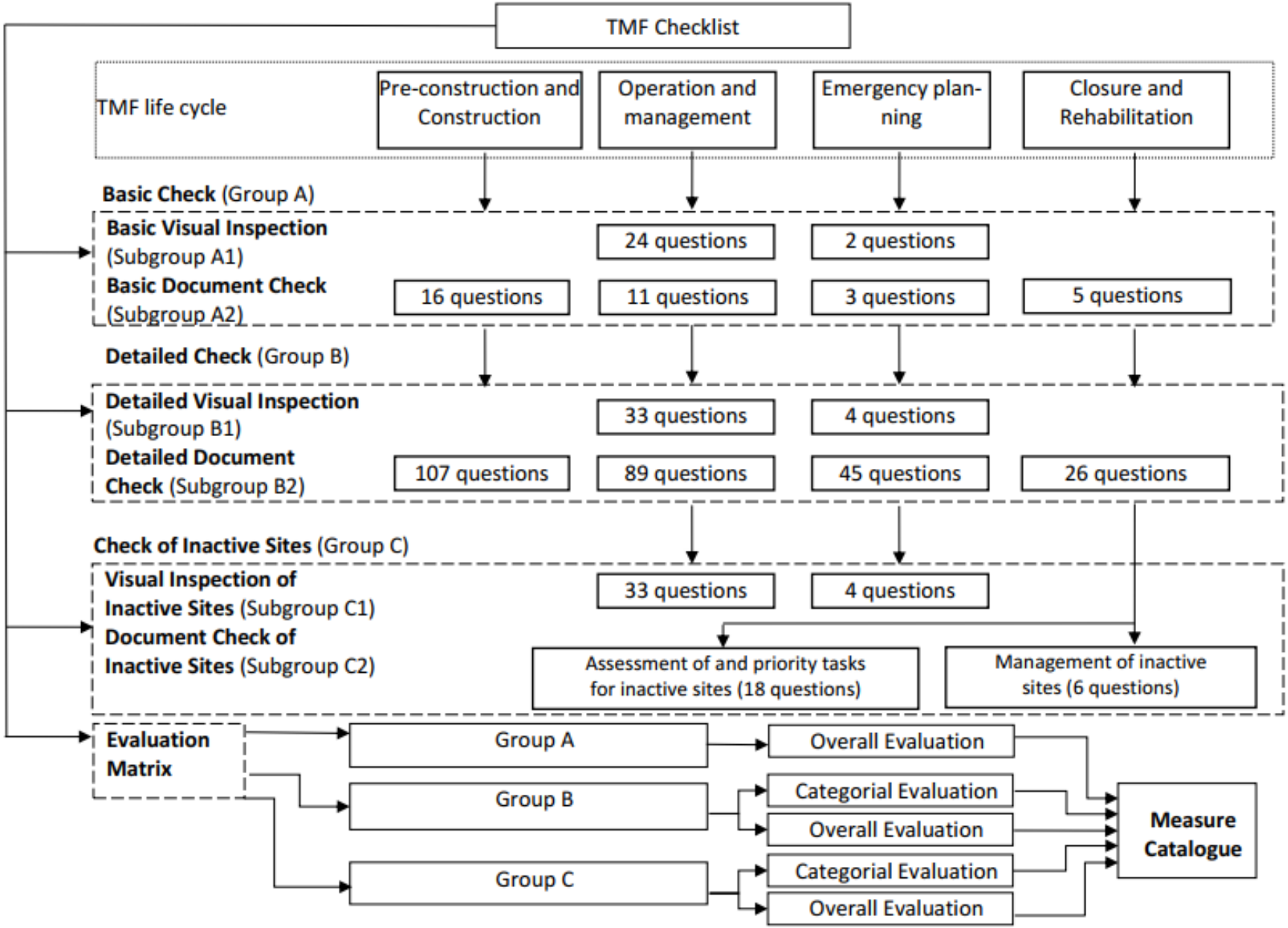
$$THI_{Extended} = THI_{Cap} + THI_{Tox} + THI_{Manag} + THI_{Site} + THI_{Dam}$$



TMF Checklist structure



Detailed structure of the TMF Checklist



General view of the Checklist questionnaire

#	Question	Recommendation (Factors and parameters to be taken into consideration to answer the questions)	Answer					Data source (requisites of documents or photos as evidences))
			Not applicable	Yes	Mostly yes	Mostly no	No	
Cross-checking of data								
1	Does the design documentation correspond to actual locations of TMF elements?	Matching of charts and maps to the displayed TMF elements on-site.						

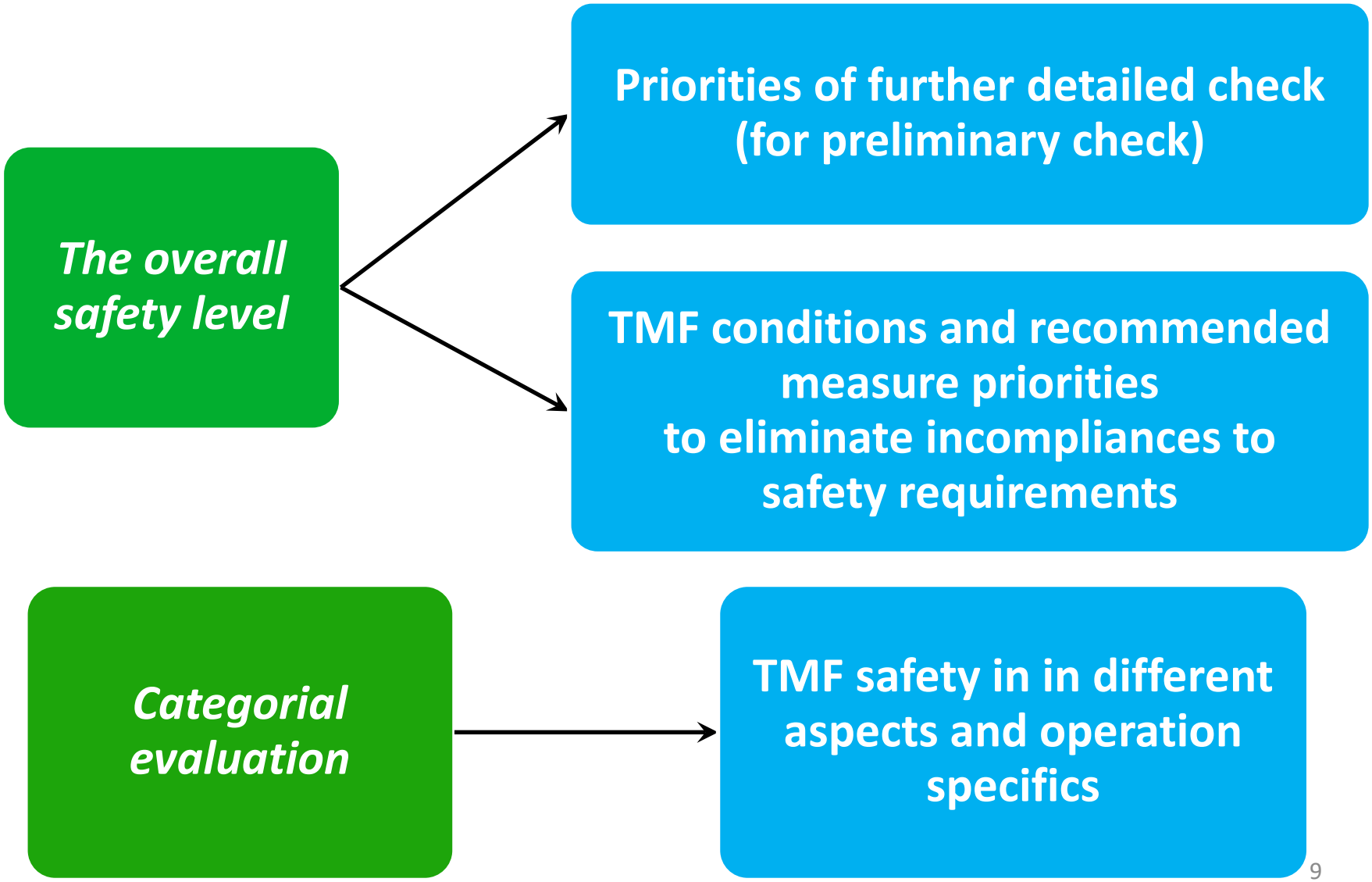
Evaluation Matrix

Quantification of answers

- The positive answer **”Yes”** is interpreted as the maximum level of TMF safety per the evaluated factor.
- The negative answer **”No”** is considered as the minimum level of TMF safety per the evaluated factor or does not have any information to answer the question .
- The ambiguous answers **“Mostly yes”** and **“Mostly no”** allow the Checklist user to be flexible in evaluations taking into account availability and credibility of data sources.

Answer	Yes	Mostly Yes	Mostly No	No
Value (answer numerical equivalent)	3	2	1	0

Types of TMF safety level evaluation



Parameters of the TMF safety level

- **“MSR” rank** (“Meeting Safety Requirements”) within the TMF Checklist is the index quantifying how the parameters of the inspected TMF meet the minimum set of requirements of environmental and industrial safety.

- **“Credibility” rank** within the TMF Checklist is the index quantifying the sufficiency and consistency of data used for calculating the “MSR” rank.

An example of TMF overall evaluation

The results of evaluation by Group A

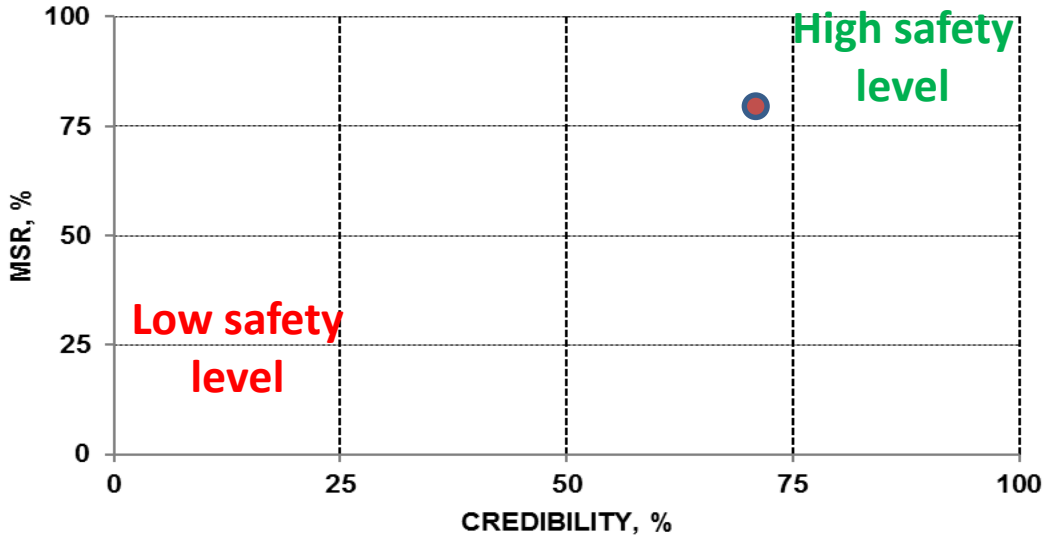
The number of applicable questions	Yes	Mostly yes	Mostly no	No
60	38	10	8	6

The values of "MSR" and "Credibility" ranks

$$\mathbf{MSR} = 100\% \cdot \frac{1}{3 \cdot 60}(36 \cdot 3 + 10 \cdot 2 + 8 \cdot 1 + 6 \cdot 0) = 100\% \cdot \frac{136}{180}$$

$$\approx \mathbf{76\%}$$

$$\mathbf{Credibility} = 100\% \cdot \frac{1}{60 - 18}(60 - 18) = 100\% \cdot \frac{42}{42} \approx \mathbf{70\%}.$$



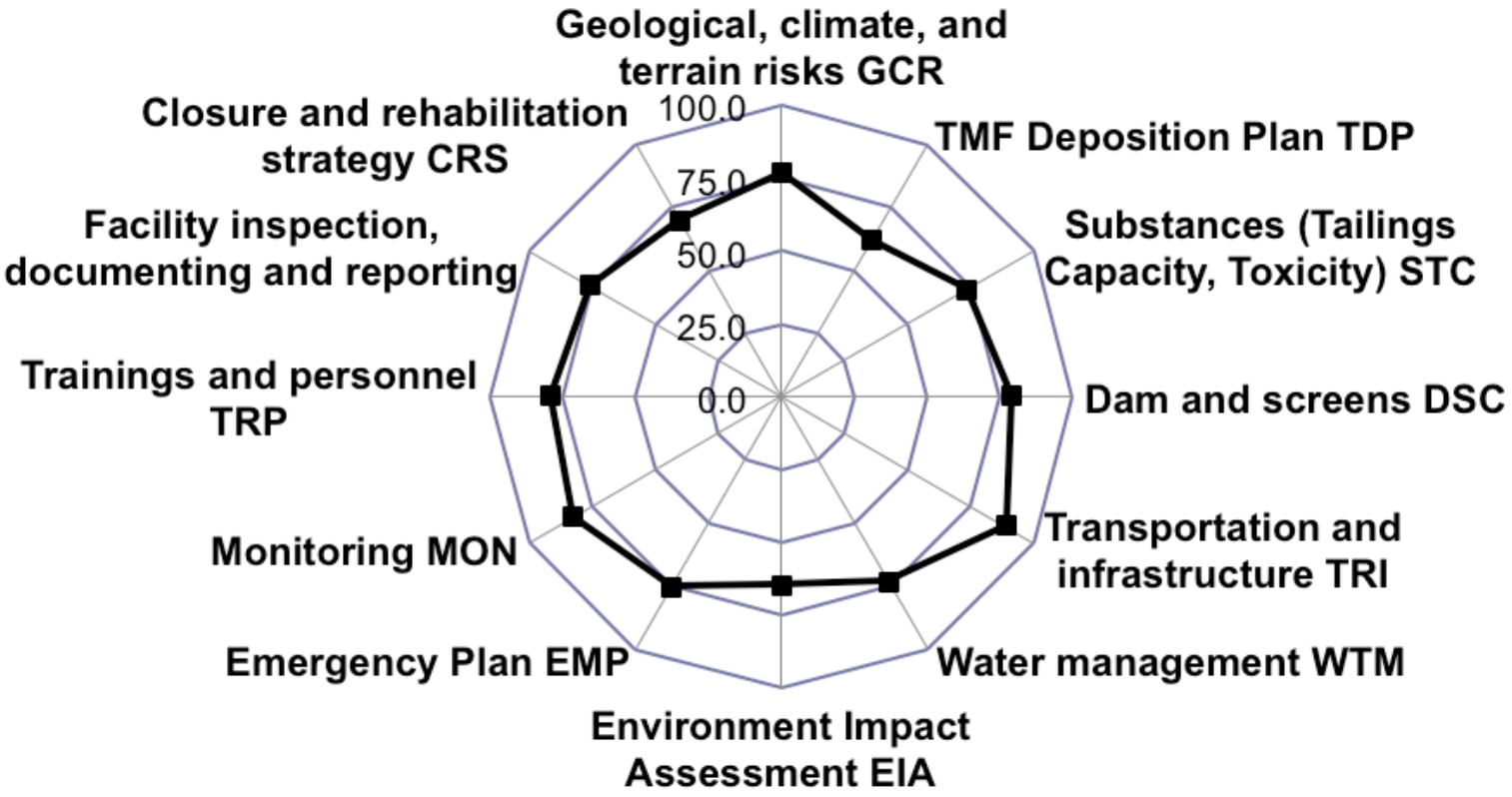
Classification of TMF by the evaluation results

TMF safety level	Criteria
Acceptable	100% of minimum set of safety requirements are met (MSR = 100%)
Unacceptable	Less than 100% of minimum set of safety requirements are met (MSR < 100%)

Category importance

- **Critical (Highly important) safety categories** are the categories of TMF safety that cover, primarily, the technical aspects of TMF operation and are vitally important for maintaining tailings facilities in safe condition.
- **General safety categories** cover the issues related mostly to documentation, personnel, and paperwork.

An example of categorial evaluation. Spider diagram



Measure Catalogue

- Detected problem at the TMF
- Intended (prescribed) measures
- Measure priority

#	Problem to be solved	Measures prescribed	Priority
		PRE-CONSTRUCTTION AND CONSTRUCTTION	
1	Design documentation is incomplete	1A. Update design documentation made by a licensed company	Short-term
		1B. Update design documentation involving licensed and skilled staff	Short-term
		1C. Perform expert analysis of design documents for authorities	Short-term
		1D. Prepare or complete design documentation according to regulatory requirements	Short-term
		1E. Prepare a detailed map of the TMF site and the surrounding area	Short-term

UNECE "Reference Document on Best Available Techniques for Management of Tailings and Waste-Rock in Mining Activities"
https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/best-available-techniques-bat-reference-document-management-waste-extractive-industries

Key measures to improve TMF safety

- Strengthening of dams and other critical components.
- Improving the methods for neutralization of toxic substances, drainage facilities, monitoring procedures, Emergency plan as well.
- Updating design documentation.
- Conduct expert assessments, including within the EIA.
- Personnel training, improving of reporting.
- Development of plans for closure and rehabilitation, the use of man-made mineral resources.

TMF Checklist application experience in 2018-2019

- Lower scores for the visual check compared to the document check (50-85% and 85-95%, respectively). These checks do not completely coincide in the categories of questions; they were obtained in a fundamentally different way and cannot be directly averaged.
- **Recommendation.** These evaluations should be considered only individually with the priority of visual inspection.

Visual check is to save the dam;
Document check is to save reputation.

TMF Checklist application experience in 2018-2019

- The causes of differences in the results of visual and document checks.
  Objective: Actual changes at TMFs are ahead of changes in documentation, many processes are not very noticeable at first, they appear weakly and not recognized in time.
  Subjective: stricter criteria for visual check, the desire of TMF operators to show a more favorable picture in reporting.
- **Recommendations.**
  1. Enhance the role of visual check and instrumental observations in the conclusions of the evaluations.
  2. Train the TMF personnel and inspectors on how to recognize external signs of dam failure and timely diagnosis.
  3. Update recommendations on visual check in the UNECE TMF Safety Guidelines …(clause 100, section B2).

TMF Checklist application experience in 2018-2019

- It makes sense to use a quantitative scale to evaluate the TMF safety level.
  The versions of the TMF methodology used in Kazakhstan and Armenia do not have such a scale, the result is estimated as 100% (compliance) and <100% (non-compliance). This does not allow formally distinguishing between the very different results of a detailed check, for example, evaluated with a safety level of 30% and 80%.

- **Recommendation.** Consider using the Leopold matrix (1971), used in particular by the US. EPA, to assess the environmental impact of projects.

TMF Checklist application experience in 2018-2019

- The need to improve the application sequence of the Checklist, in particular, Measure catalogue. The current version of the methodology does not describe the procedure for repeated checks with the control over the safety actions taken.

- **Recommendation.** Formulate and describe the priority principle how to re-check TMFs depending on the evaluated safety level and the effectiveness of measures taken after previous inspections.

Thank you for attention!