International Symposium on Underground Excavation and Tunnelling

RISK EVALUATION AND CONTROL

IN UNDERGROUND CONSTRUCTION

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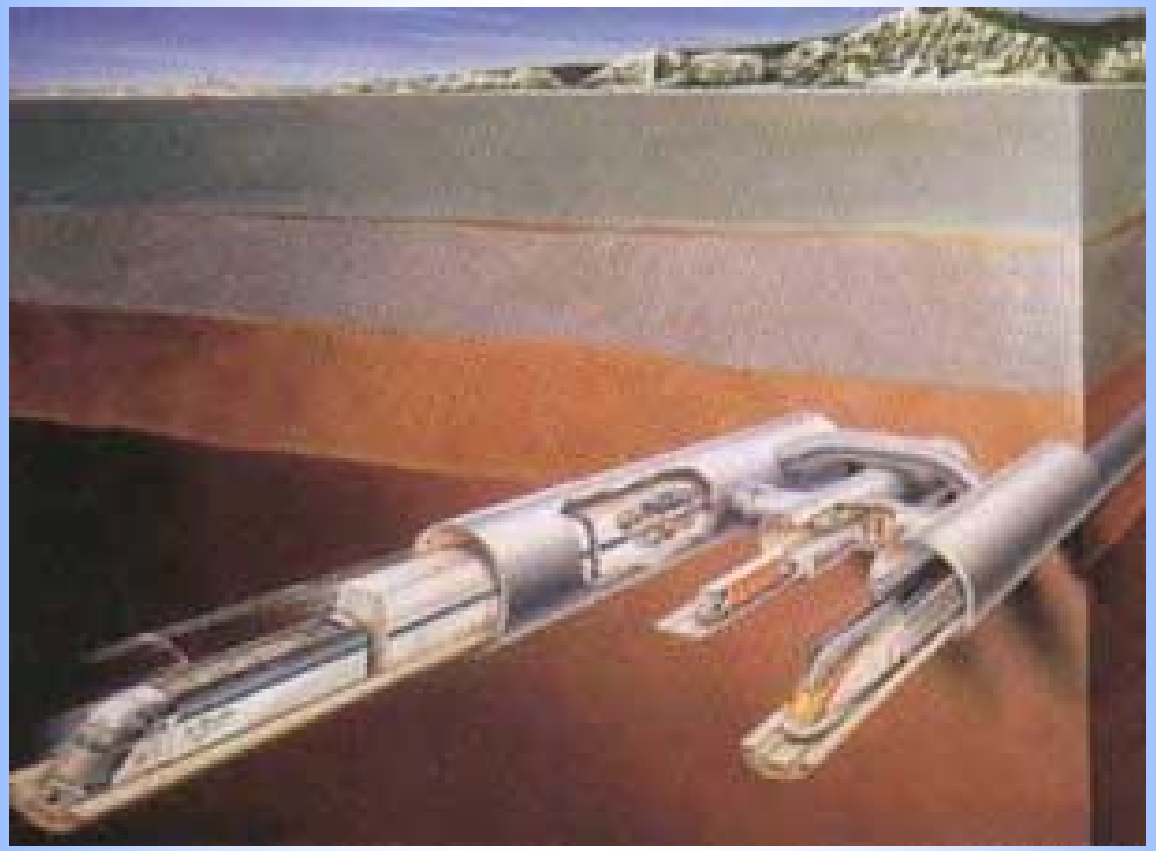
Introduction

- Risk is the ultimate factor, deciding upon success or failure of a project.
- Risk needs to be covered and needs to be managed to finalize a project successfully.
- Risk needs to be shared between the parties involved.

Risk is the ultimate factor

TBM Driven Unidirectional Tunnels with Cross Passages
(Changjiang Tunnel Project, Wuhan)

Risk needs to be covered and shared



Gibraltar Tunnel

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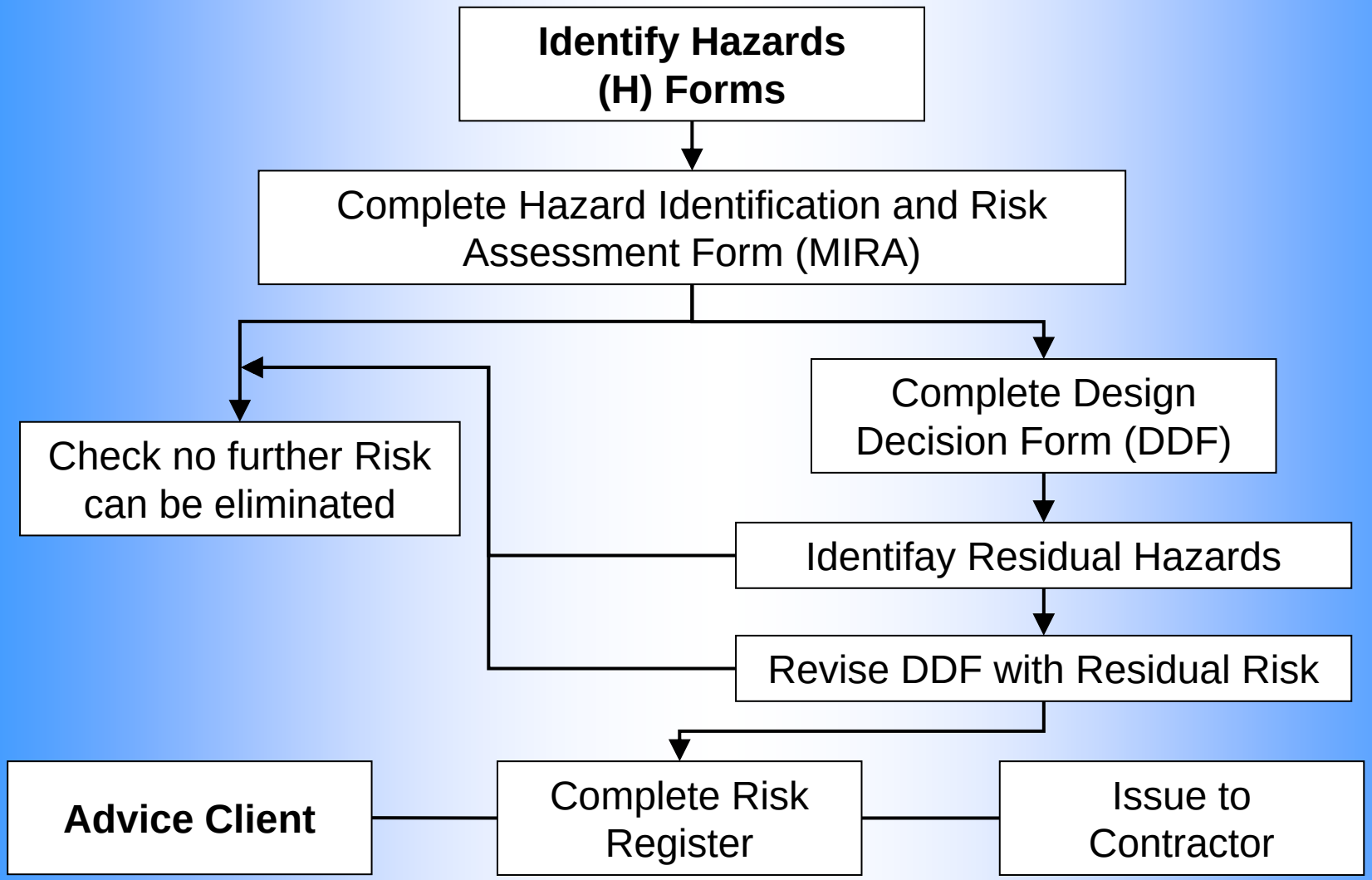
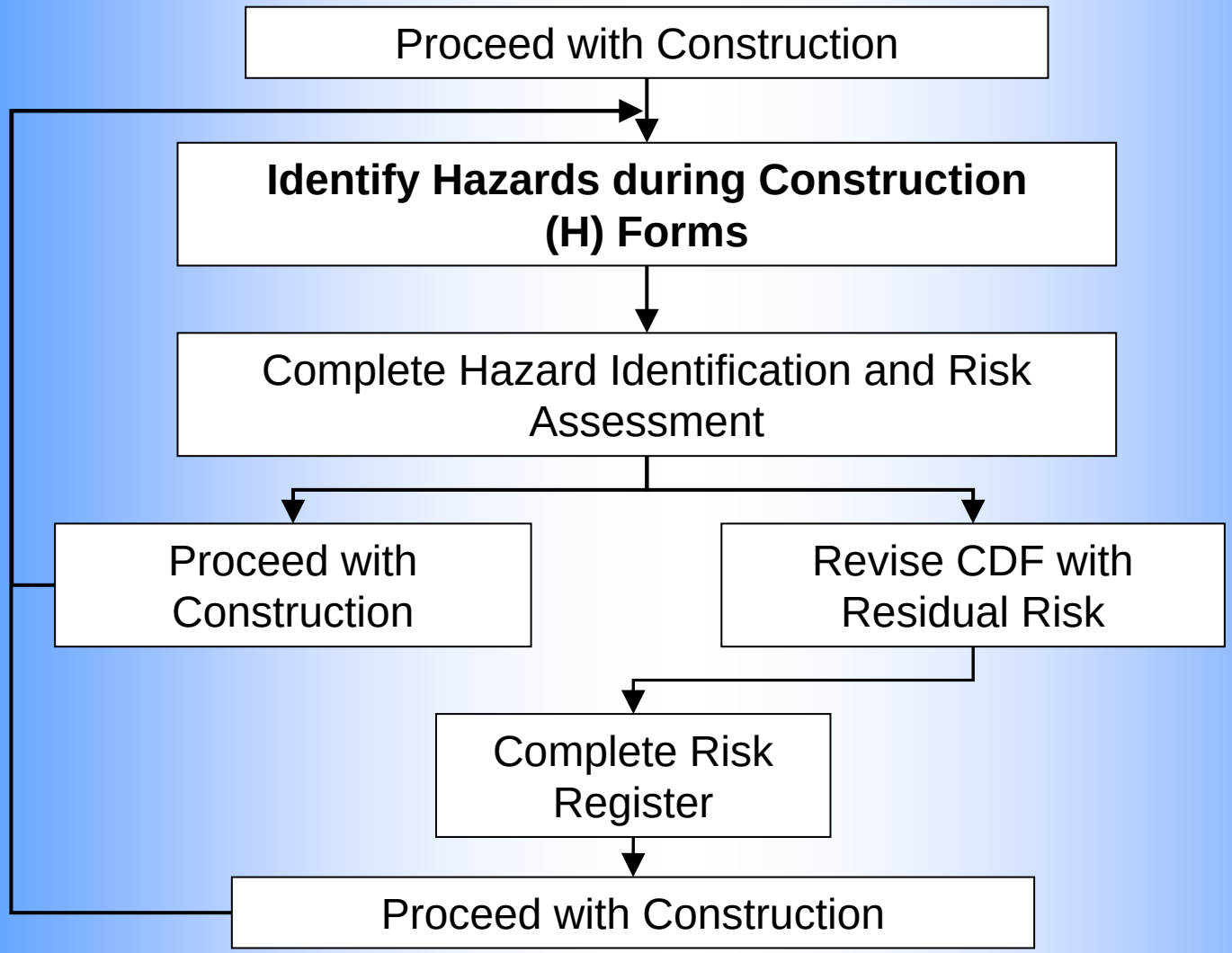
Short Risk Evaluation of Technology

- NATM and TBM have been fundamentally differing competing technologies
- Interaction between excavation and geomechanical response is differing
- New findings of interactive risk behaviour between soils, rock and water

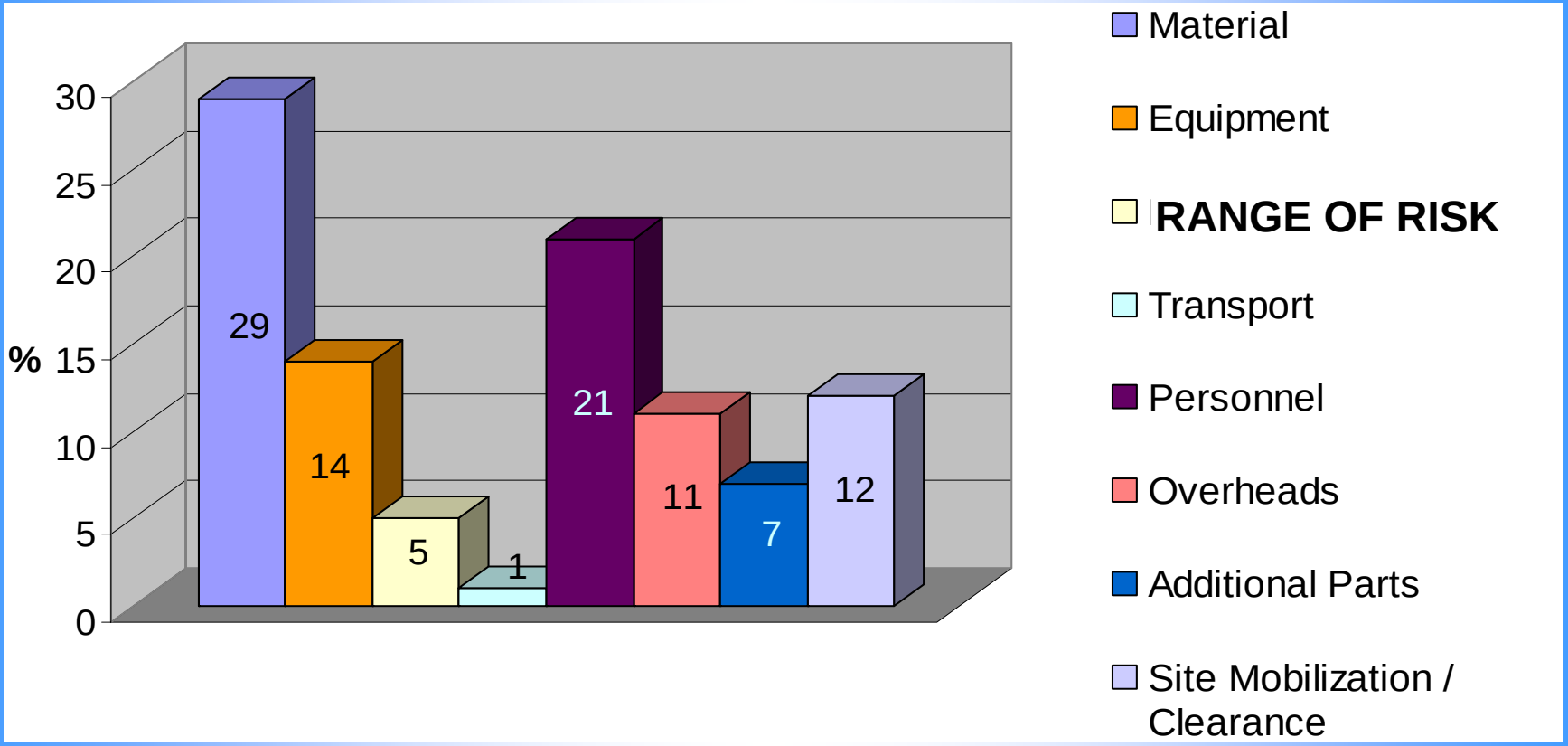
Flow Chart – Design Risk



Flow Chart – Construction Risk



Conventional Tunnelling Technology

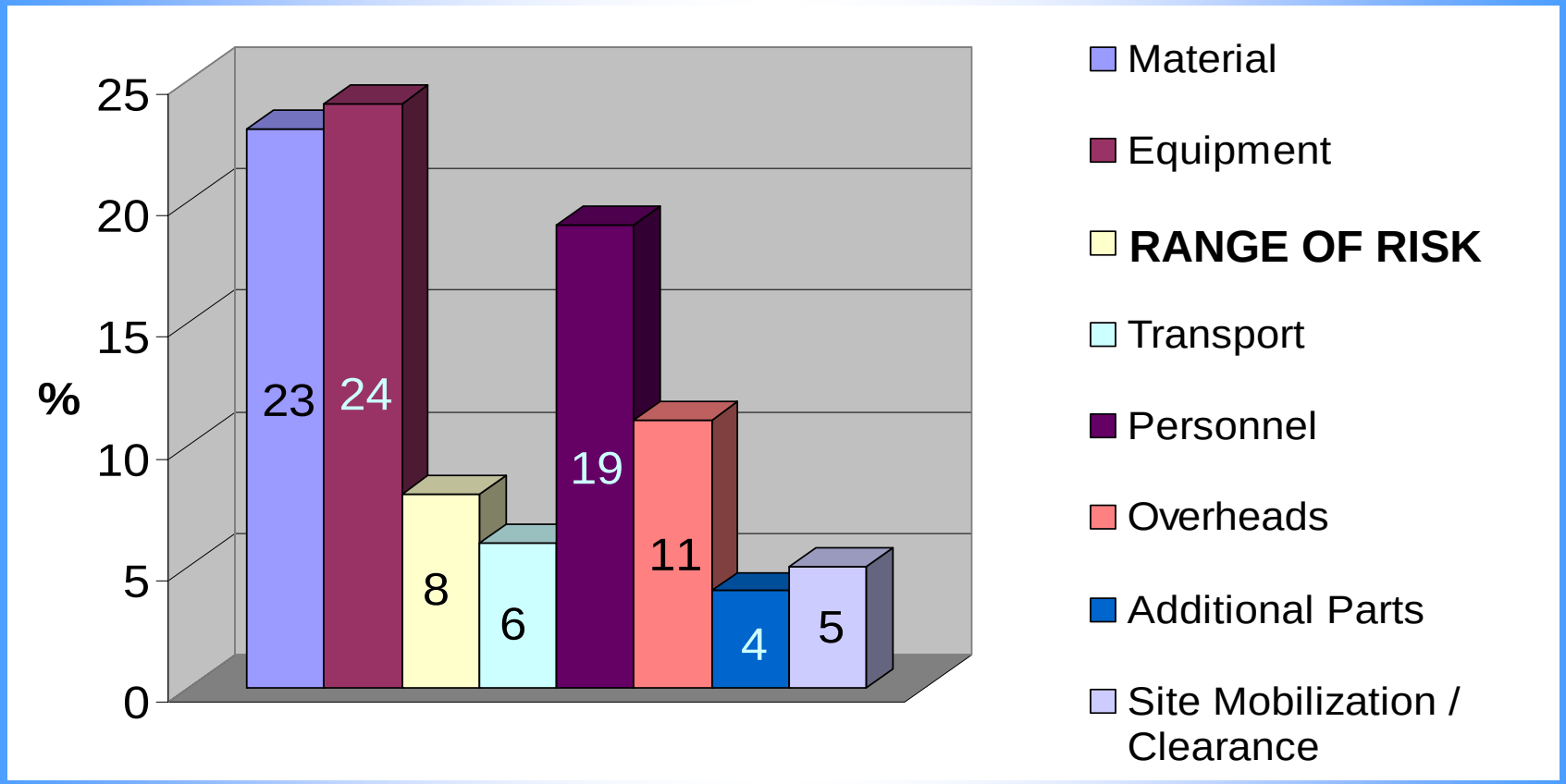


Typical Cost Distribution – Conventional Tunnelling

Conventional Tunnelling Technology

Tunnel BEG Lot H5 (Austria 2003)

Mechanized Tunnelling Technology



Typical Cost Distribution – Mechanized Tunnelling

Mechanized Tunnelling Technology

WSKE-TBM (Vienna 2004)

Mechanized Tunnelling Technology

WSKE-TBM Tunnel (Vienna 2005)

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Risk Analysis vs. Cost Overrun

The three most important risk factors are:

- **The “Retained Risk”**
  (e.g. Risk of fair revenue)
- **The “Base Cost”**
  (e.g. Investment, Maintenance, etc.)
- **The “Risk Adjustment“**
  (e.g. Cost Overruns, Technical Problems, etc.)

Risk Register - Main Project Risks

- Design and Construction Risks
- Demand and Revenue Risks
- Operating and Maintenance Risks
- Other Risks

  (e.g. changes in law, taxation, etc.)

Risk Management Methodology

- Establish objectives and risk appetite
- Risk identification, classification and allocation
- Assessment, impact and quantification
- Identify mitigation procedures
- Prepare or update risk register

Risk Allocation Matrix

Risk category	Procurement Agency	Private Partners	Shared Risks
Land acquisition	■		
Railway order			■
Utilities			■
Design, Construction, Supply		■	
Commissioning, Operating, Mainten.		■	
Demand			■
Residual value		■	
Technology and obsolence		■	
Regulatory, Legislative		■	
Environment		■	
Financial		■	
Safety		■	

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Balancing of Cost

Identify issues of risk sharing, quality, design and construction cost and schedule

- **Construction Issues**
- **Geotechnical Risks**
- **Geotechnical Disclosure**
- **Risk Management / Sharing**

Unit prices in a fair combination of lump sum costs will help to avoid disputes

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Risk Reducing Measures

- The Basis is formed by project descriptions, drawings, technical specifications, etc.
- The main layout needs to be evaluated
- Sufficient safety measures, e.g. fire protection, emergency escape routes have to be foreseen

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Summary

- A new contract model for financing of underground projects is recommended
- Recommended transferring risk from the public to the private sector
- Analyse comparable projects as adapted to local circumstances and to link it with respective risk analysis
- Implement a dynamic risk and cost management throughout the life time of the project