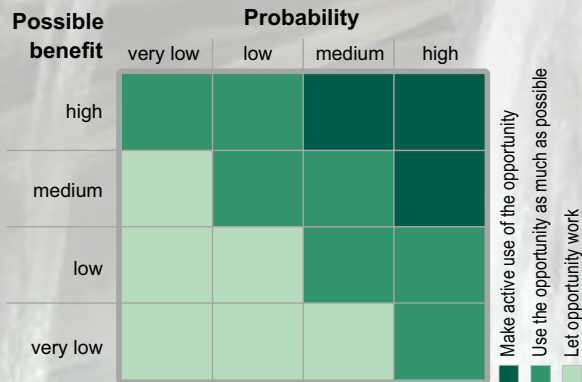
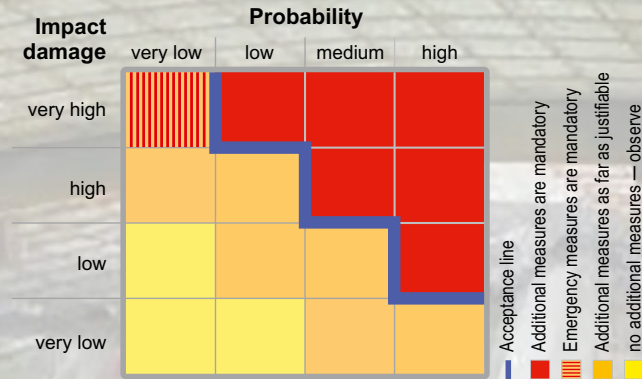


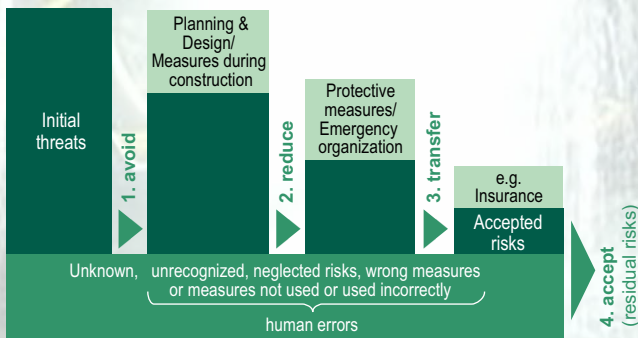
## Risk analysis and risk assessment

As simple and comprehensible as possible, e.g. using the semi-quantitative method. Assess probabilities qualitatively, impacts quantitatively.



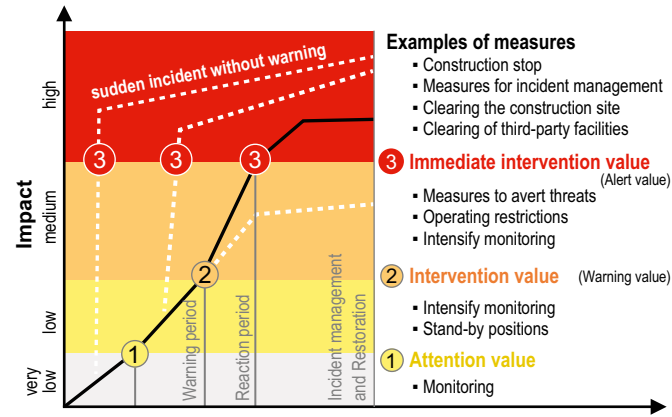
## Select options for action in a targeted manner

- Prevent dangers, promote opportunities
- Reduce the impact of hazards
- Maximize impact from opportunities
- Transfer risks
- Consciously accept the unavoidable remaining risks



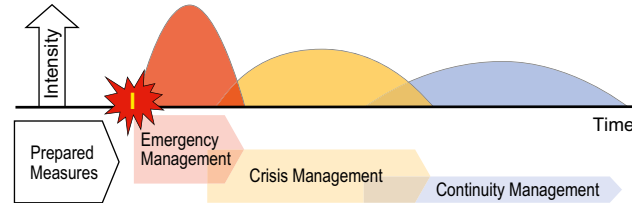
## Determine measures at an early stage

Threshold values must be defined for each risk in order to trigger the right measures in good time.



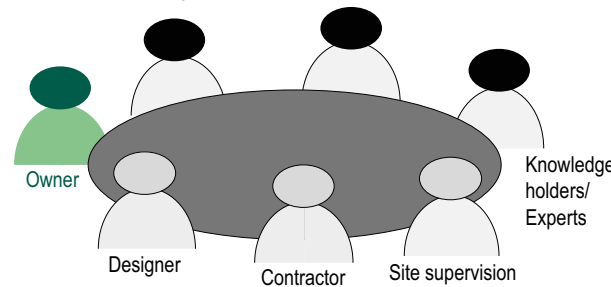
## Control risk events

Control events by using prepared mitigation measures and gradually ramp up normal operation again.



## The owner is the initiator and driver

The owner initializes the risk management process and implements it as a team task with the involvement of all key project partners, knowledge holders and experts throughout the entire duration of the project.



Risk management only works in a corporate and project culture in which openness and transparency prevail.



## Recommendations for Project Risk Management in Underground Construction



### German Tunnelling Committee

c/o STUVA e.V.  
 Mathias-Brüggen-Straße 41  
 50827 Cologne, Germany  
 Phone: +49 (221) 597950  
 E-Mail: info@daub-ita.de

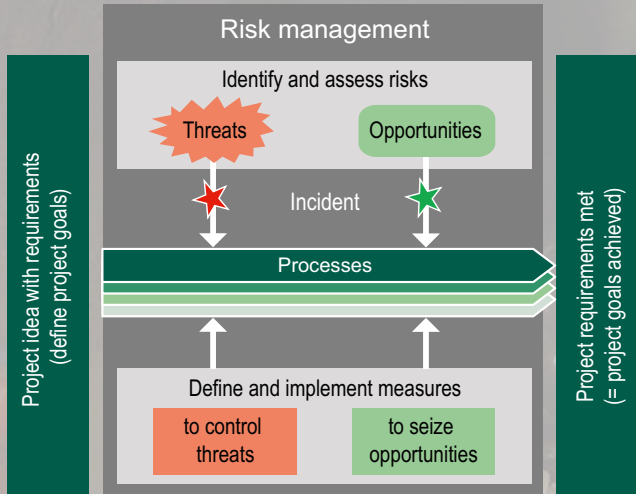


## „No construction project is risk free.

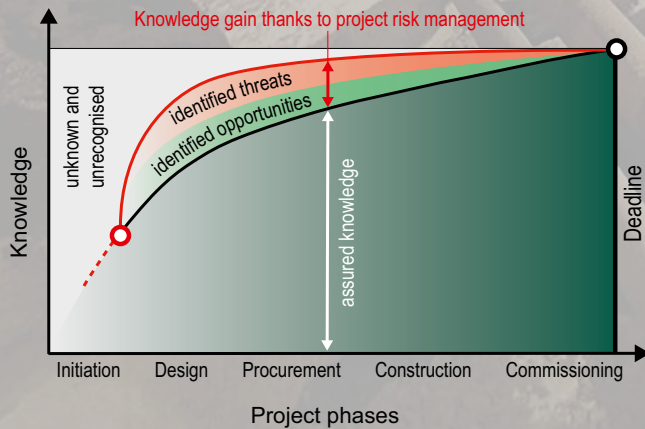
... Risk can be managed, minimised, shared, transferred, or accepted. It cannot be ignored.“

(Sir Michael Latham, 1994)

## Risk management helps to control threats and seize opportunities



## The proportion of the unknown and unrecognized is greatly reduced at an early stage



## Risk events are not coincidences –

they have a cause and concrete effects on the achievement of the project goals (quality, functionality, deadlines, costs).



## Possible cause categories

- Ground conditions, existing structures (major risk cause in underground construction)
- Legal framework and subsequent changes
- Procedures (planning permission, contract award, land acquisition)
- Financing
- Politics, economy
- Design, project preparation
- Execution
- Construction supervision
- Changes and variations
- Contractual risks
- Interfaces
- Operation of nearby facilities
- Natural hazards
- Accidents, incidents
- Force majeure

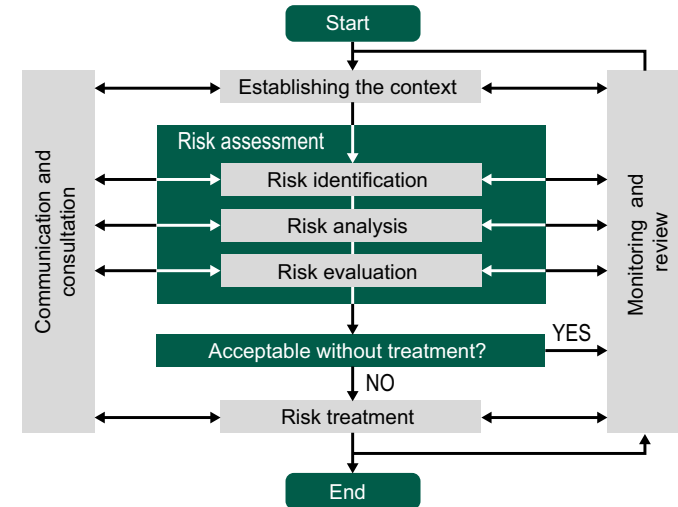
## Possible Project requirements

- Functionality, quality
- Occupational health, safety
- Protection of the environment, sustainability
- Public acceptance
- Protection of property and rights of third parties
- Efficient organisation, processes
- Deadlines
- Costs



## DAUB Recommendations for Project Risk Management in Underground Construction

The **standard process from ISO 31010** is also used for underground construction. This process must be repeated continuously during all project phases until the end of the project.



## Risk register as a management tool

The risk register is the key instrument for risk identification, action planning and implementation control.

Risk evaluation			Action planning		Responsibilities/ Verification		
ID Nr.	Risk description	Risk value P I R	Measures/ Actions	Residual risk P I R	Respon- sible	Date	Note of completion
Risk category (grouped by cause category)							
Risk number and designation		Action catalogue		Target date/ responsibilities, verification/ notice of completion			
Initial risk value (Impact on requirements)				Residual risk value (after implementation of the measures)			

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