European Mine Rescue
-
Research Results of the I²Mine Project

Dipl.-Wirt.-Ing. **Felix Lehnen**

RWTH Aachen University,
Institute of Mining Engineering I

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The I²Mine Project

Innovative Technologies and Concepts for the Intelligent Deep Mine of the Future

SEVENTH FRAMEWORK PROGRAMME

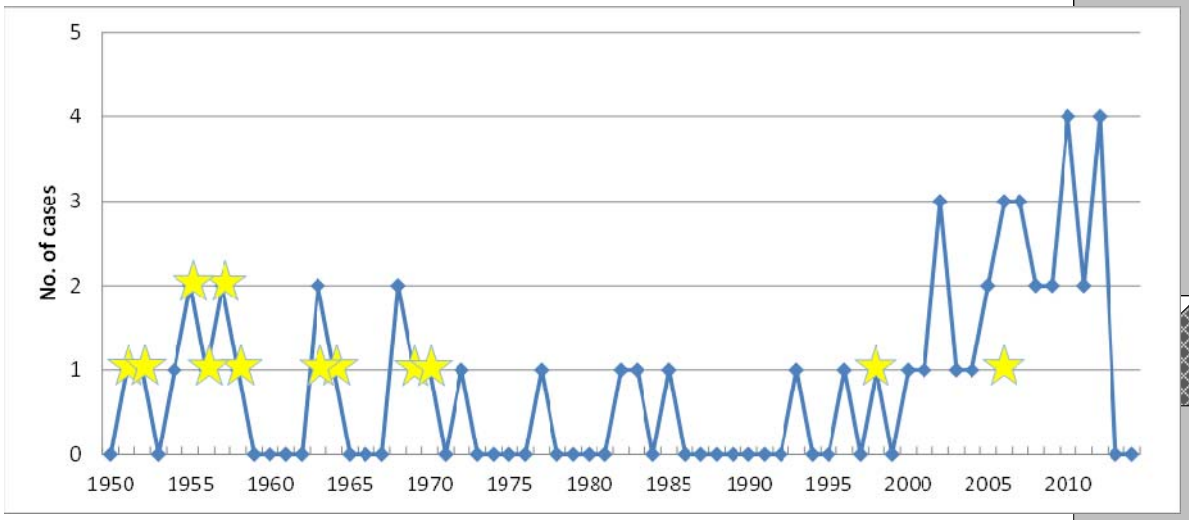
- **European Mining at Great Depths**
- **4 Year Project, 26 Million Euro Budget**
- **27 Partners from 10 EU-Countries, e.g.:**

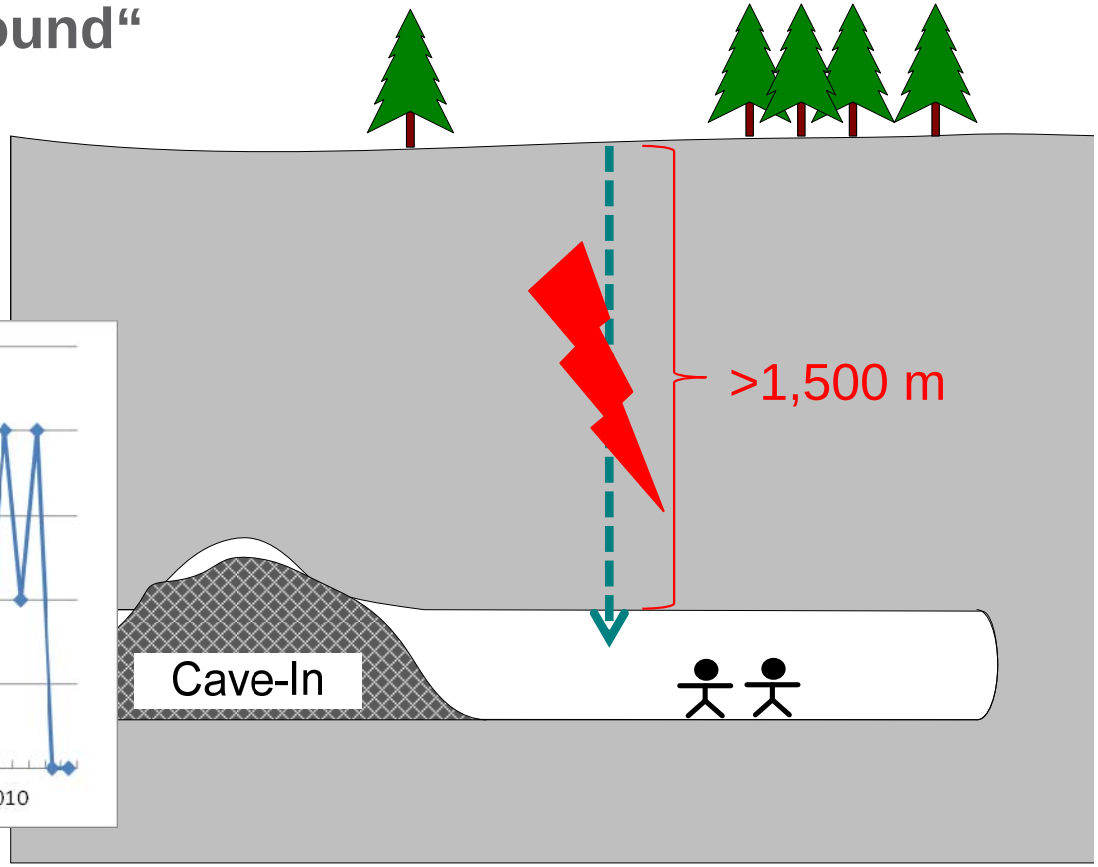
SANDVIK · RWTH AACHEN UNIVERSITY · LKAB · A! · Dräger · KGHM Cuprum · K+S · NEW BOLIDEN · DMT · Luleå University of Technology · CATERPILLAR · TOMRA Sorting Solutions · Kompania Węglowa S.A. · ABB

"Deep Mine Rescue"

- **Work Package 6: "Health and safety and environmental aspects in future deep mining"**
- **Task 6.6: "Deep Mine Rescue"**
- **<u>Scenario</u>: „Miners trapped underground"**

➔ **Entrapments > 3 Days:**

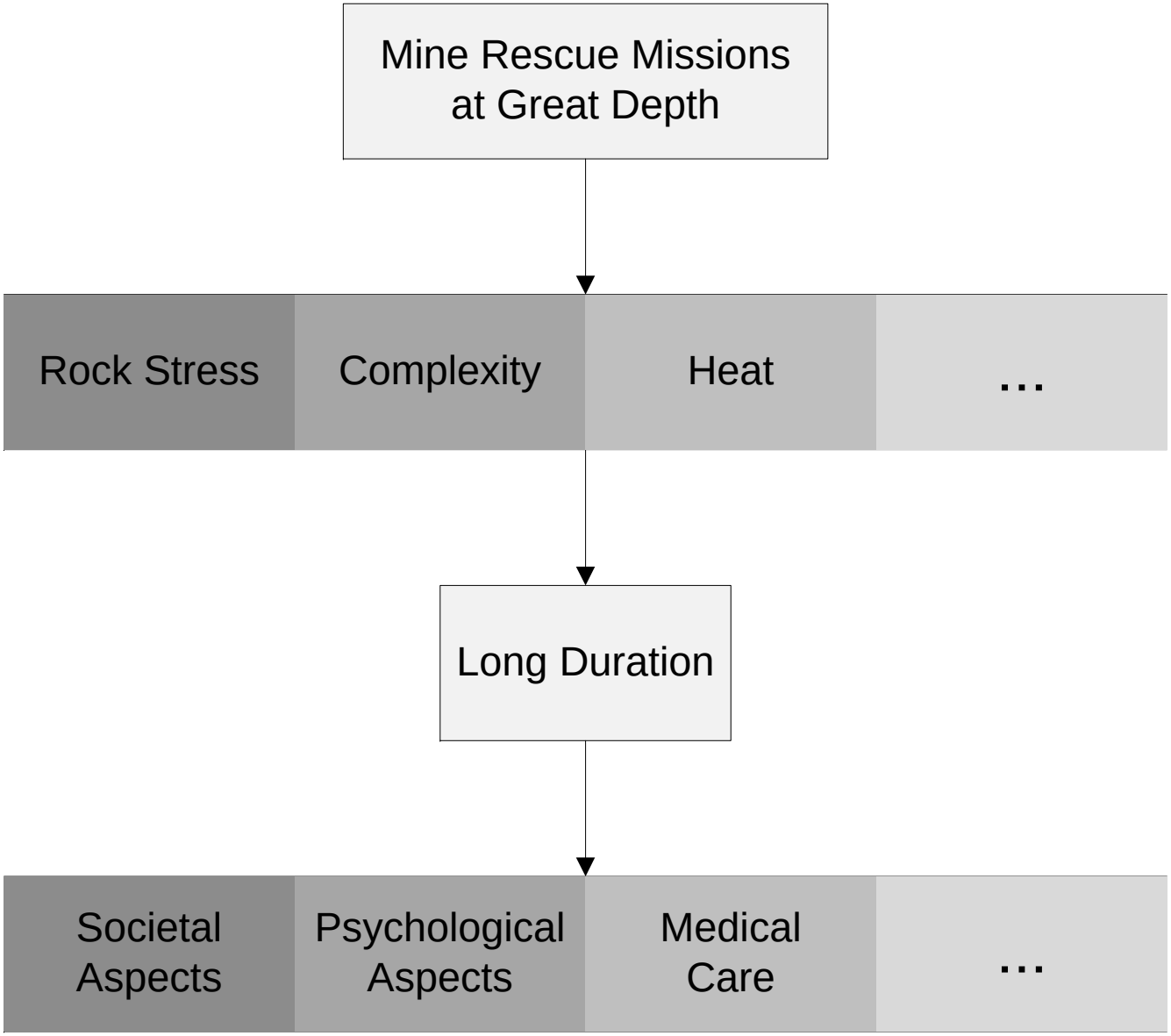




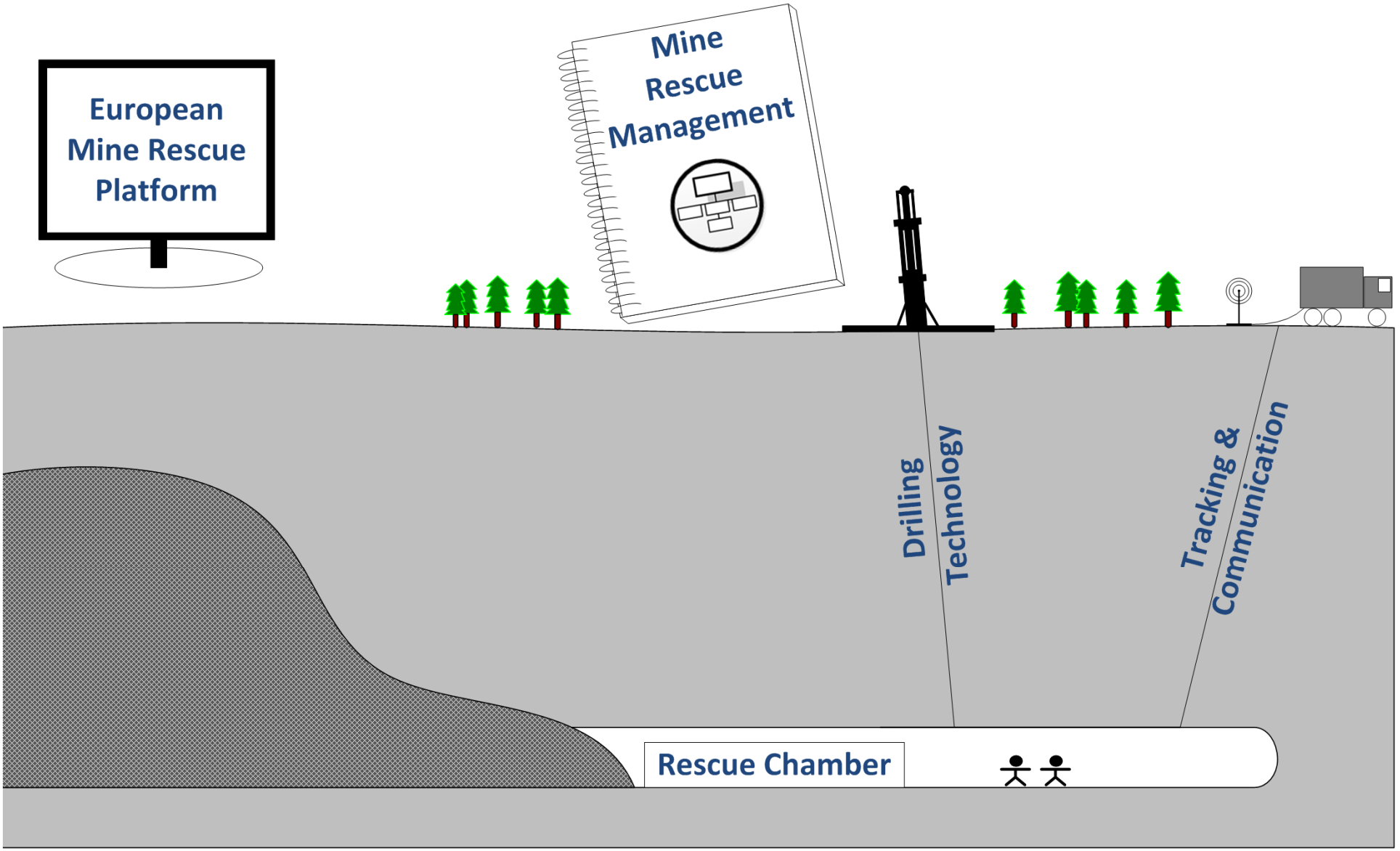
Mine Rescue at Great Depths

- **Great depths can lead to long-lasting missions and further challenges for mine rescue teams.**

- **Long duration leads to new dimensions for mine rescue.**



Overview of Results



European Mine Rescue today

- Private vs. Governmental Structures
- Company-owned Mine Rescue Teams vs. civil Fire-Fighters
- Bilateral Cooperation instead of international Networks
- European Directives vs. National Mining Laws and Standards

Potentials →

- more collaborative Approach
- European Mine Rescue Platform

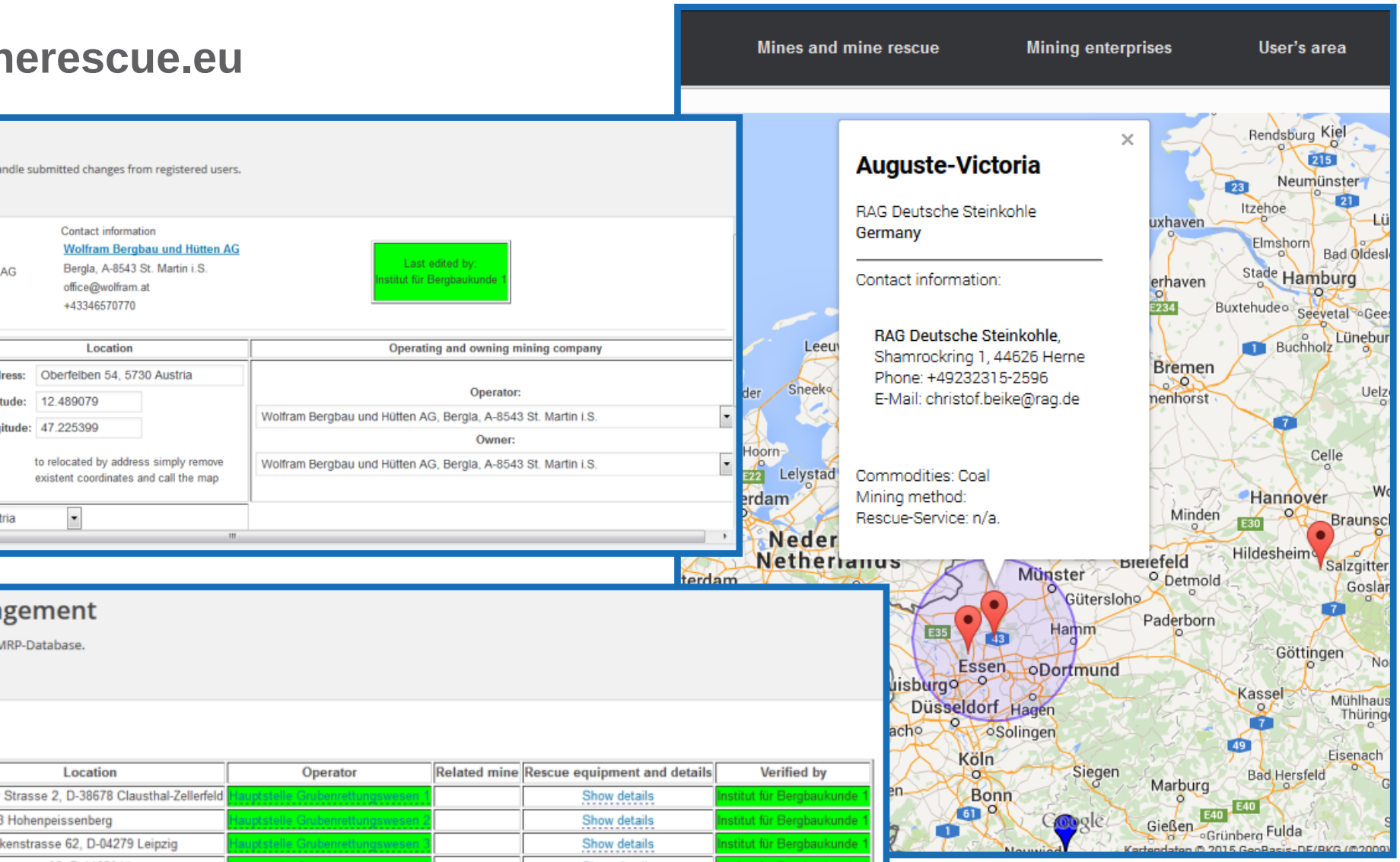
European Mine Rescue Platform

- **Build-Up of a web-based European Mine Rescue Platform (EMRP)**
  - ➔ Database of Capacities, Experts and Equipment
  - ➔ Currently on the Agenda of the EU Standing Working Party on Mine Safety, Luxemburg.
  - ➔ Increase Preparedness and European Standards in H&S and Mine Rescue

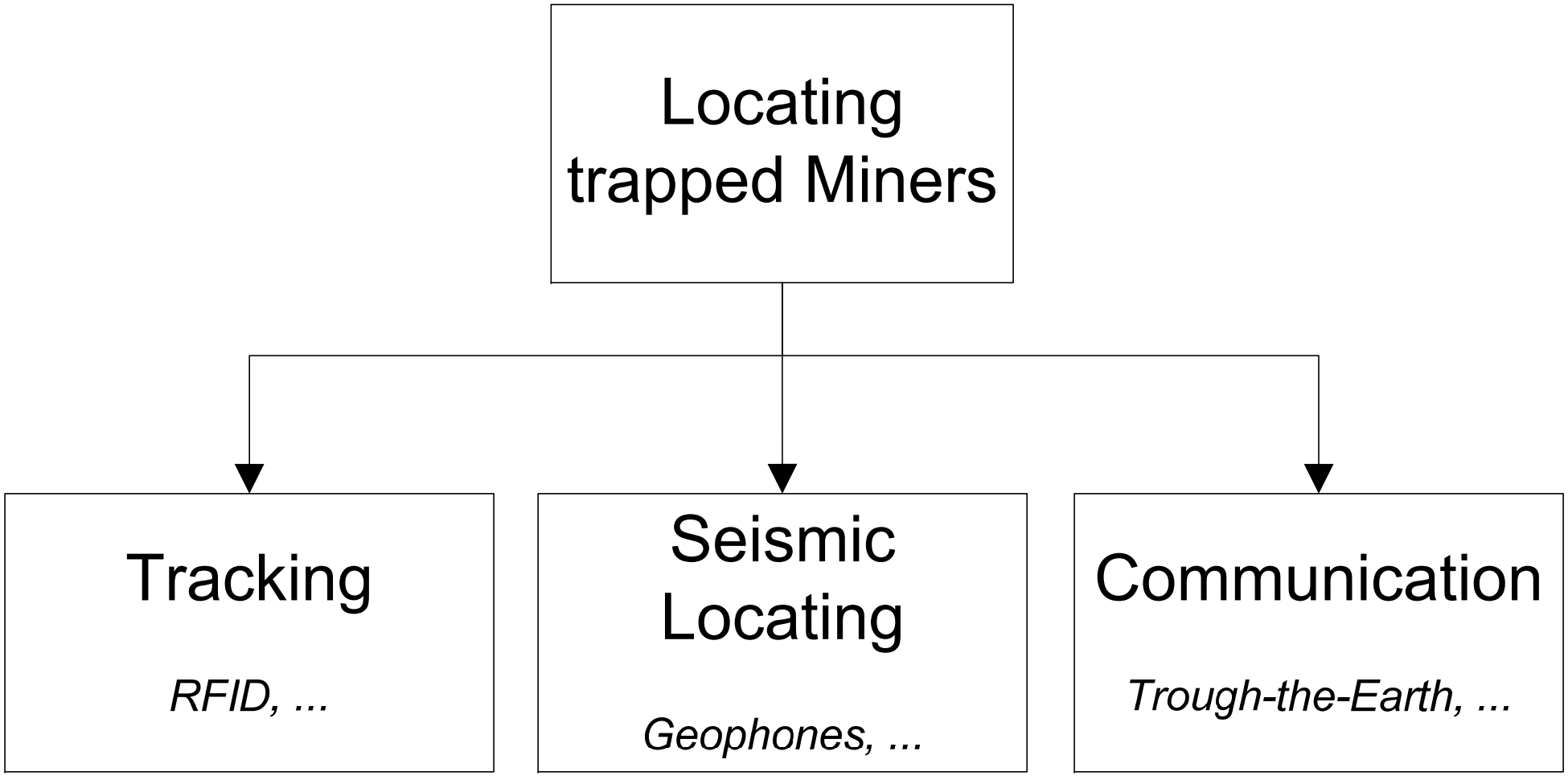
	# underground mines	# central mine rescue stations	# mine rescue teams	# mine rescu personnel
	20	6	16	n/a
	6	15	n/a	1285
	1	2	12	60
	24	4	200	1000
	4	4	8	40
	36	4	1230*	6150
	7	7	n/a	n/a
	26	4	12	60
	22	4	86	43

EMRP Prototype

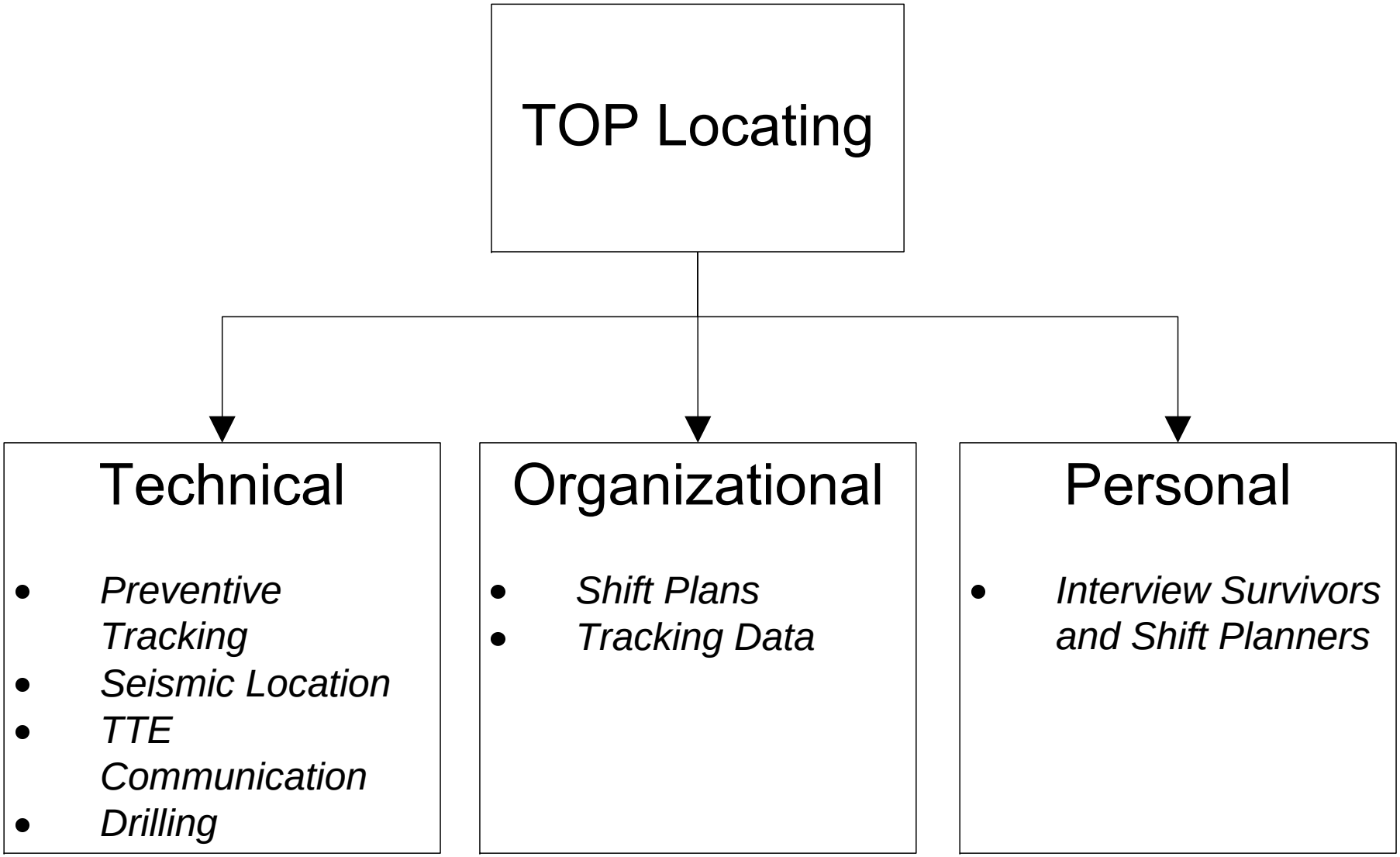
- www.minerescue.eu



Locating Trapped Miners



Locating Trapped Miners



Drilling Technology

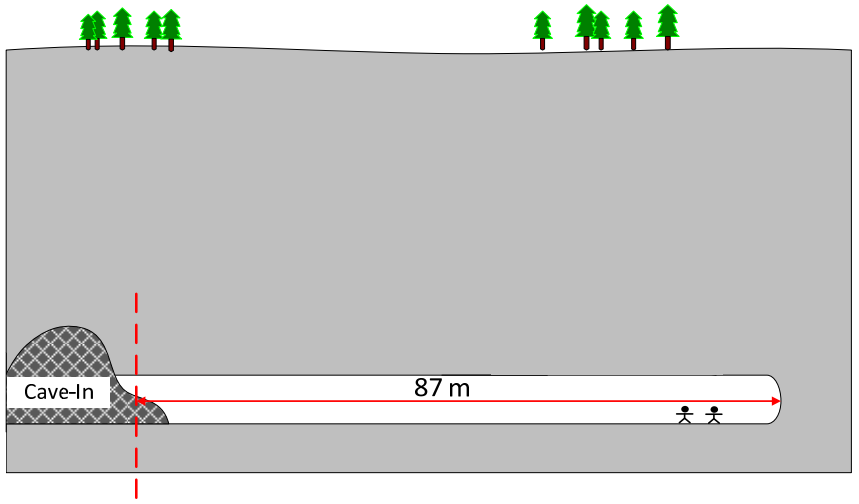
- **Rescue Drilling from Surface as the Worst-Case Scenario**
- **1st Step: Pilot Drill Hole**
  - ➔ Small diameter (< 10 cm) to locate, contact and supply the trapped Miners
  - ➔ Life-critical drilling time, Transfer of Chile (2010; 700 m) to 2000 m: 49 Days
- **2nd Step: Rescue Drill Hole**
  - ➔ Large Diameter (> 40 cm) for the actual Rescue of the trapped Miners
  - ➔ Mission-defining drilling time, Transfer of Chile: another 97 Days
- **Great Depths**
  - ➔ Drilling deeper than 2000 m is technically feasible.
  - ➔ Drilling is life-critical and should be top Priority during the Rescue Mission.
  - ➔ Redundant and parallel Strategies are highly recommended.

Rescue Chamber Design

- **4-Month Design Study at Lulea University, Sweden**
  - ➔ Mobile, slim Chamber with Service Cart
  - ➔ Hammocks and removable Seats
- **Synthesis of Isolation Studies**
  - ➔ Valuable Know-How in Space Flight, Antarctic Missions, …
  - ➔ Psychological Considerations
  - ➔ Habitable Furniture
  - ➔ Food and Medical Rations
- **Requirements in Mining**
  - ➔ Stability during regular Blasting
  - ➔ Max. 4 Persons in Road-Heading

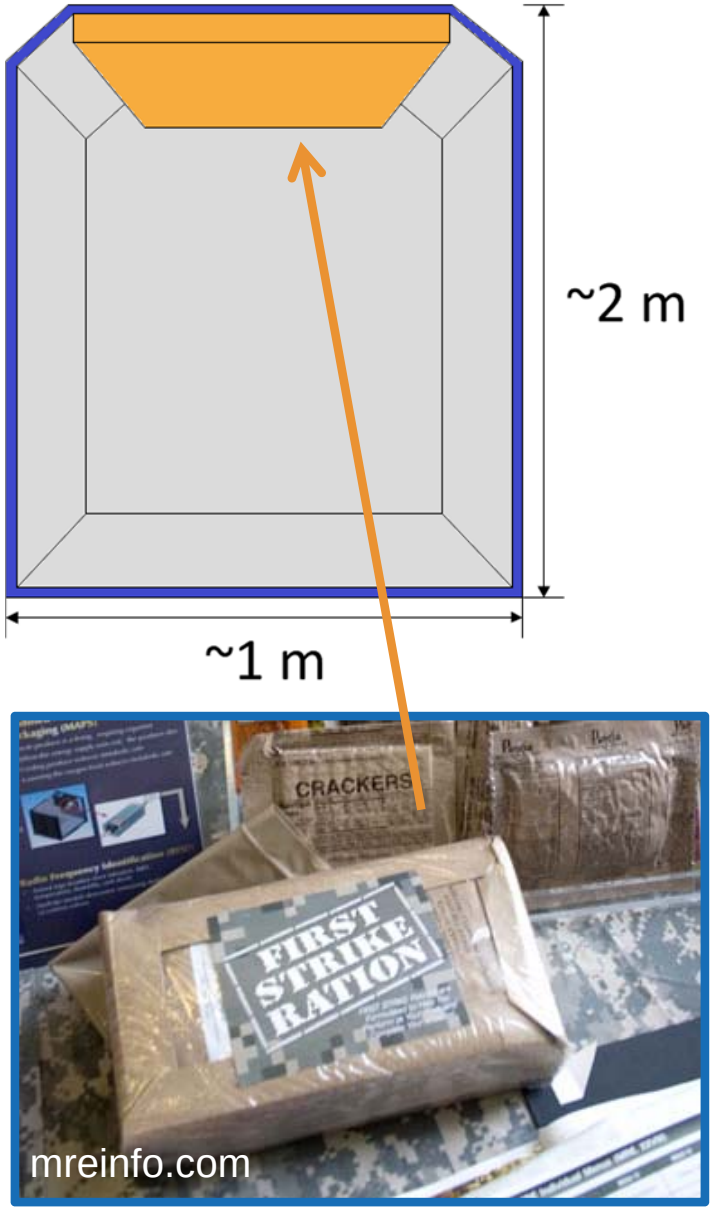
Example: Air Supply

- **Calculated Demand**
  - ➔ High Stress, Low Motion: 0.75 m³ of Air per Person and Hour
  - ➔ 4 Miners trapped for 30 Days: 2,160 m³ of Air in total
- **Ambient Air available**
  - ➔ Rockfall or Inundation Scenario: no hazardous Gases
  - ➔ Typical Cross-Section of 5x5 m
  - ➔ 87 m of open Drift would be sufficient.
- **Worse Case Scenario**
  - ➔ Insufficient Fresh Air
  - ➔ 86,400 Liters of pure Oxygen needed
  - ➔ 9x 50-Liter-Bottles of pure Oxygen @ 200 bar



Example: Nutrition

- **Demand of Water**
  - ➔ 2 Liters per Miner and Day
  - ➔ 240 Liters of Water in total
- **Alternative Storage**
  - ➔ e.g. between 2-Layer Walls
  - ➔ 5 cm in a 1x2x3 m Chamber: 1,000 Liters
- **Demand of Food**
  - ➔ 1,800 kCal per Miner and Day → 216,000 kCal
- **Military Solution**
  - ➔ “First Strike Ration” (FSR™)
  - ➔ Each FSR: 2,900 kCal, 1.1 kg, 3.1 Liters
  - ➔ Demand: 75 FSR, 1,000 €, 2-Year Shelf-Life



Outlook

- **Best Practice Guide**
  - ➔ Implementation of all prior Findings
  - ➔ Preventive Measures and Emergency Technologies
  - ➔ Preparedness by European Cooperation
  - ➔ Implementation of Disaster Management Principles
- **Ph.D. Thesis**
  - ➔ Scenario Definition
  - ➔ Database of Mine Rescue Missions and Statistical Evaluation
  - ➔ Qualitative Case Study Research
  - ➔ Transfer of Disaster Management Principles
  - ➔ **Mine Rescue Management** Concept

Thank you!

Dipl.-Wirt.-Ing. Felix Lehnen

Lehnen@bbk1.rwth-aachen.de

www.bbk1.rwth-aachen.de

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