

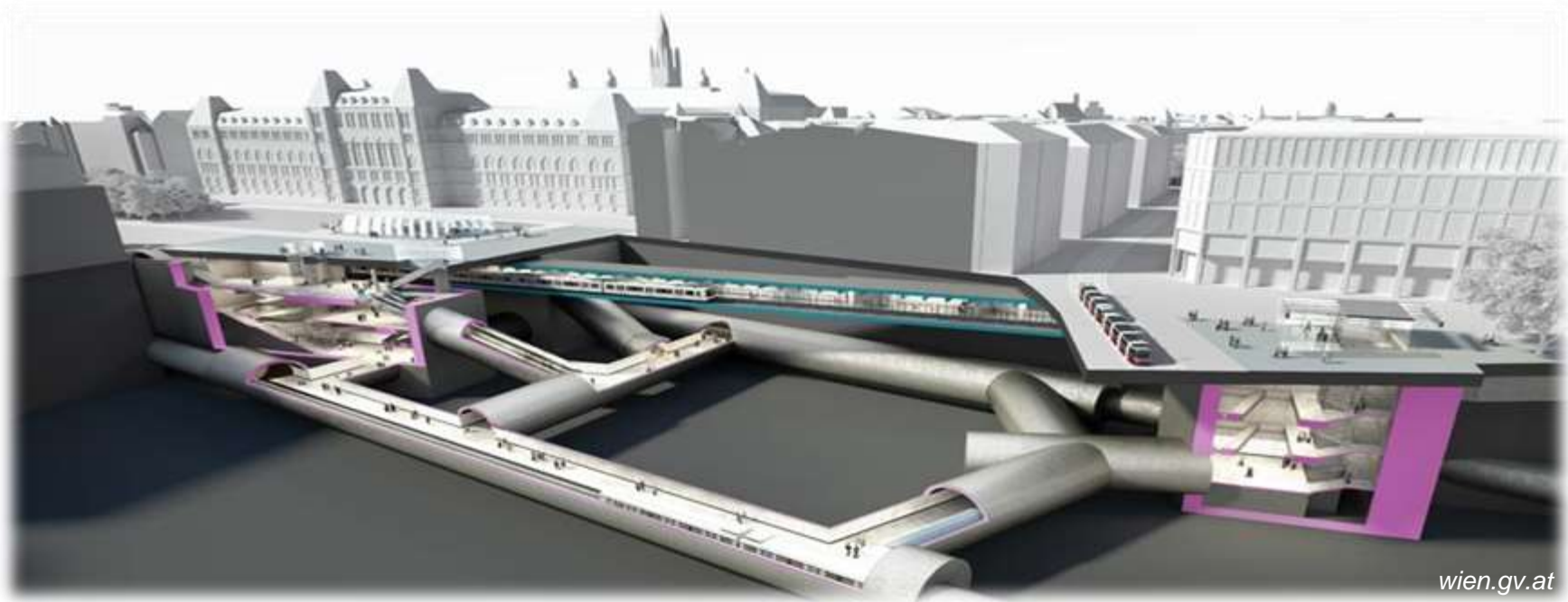
# Modelling & Simulation for Underground Operations

*Maj Christian Resch*

*Federal Ministry of Defence Austria*

*Science, Research and Development Division*

# The other 3<sup>rd</sup> Dimension



*complex emergencies underground*

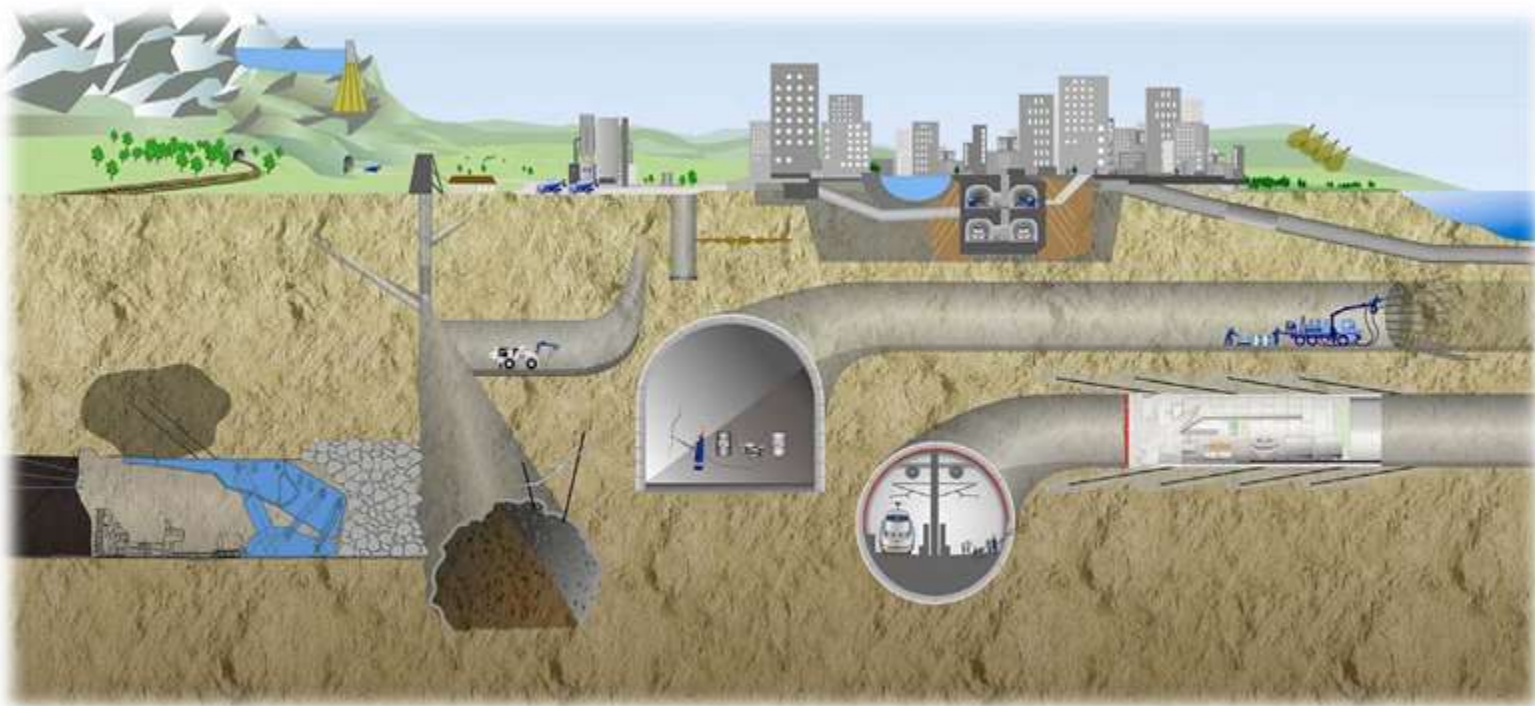
# Tokyo (1995)



source:

Okumura T, Takasu N, Ishimatsu S, Miyanoki S, Mitsuhashi A, Kumada K, Tanaka K, Hinohara S: Report on 640 victims of the Tokyo subway [sarin](#) attack. *Ann Emerg Med* August 1996;28:129-135.

# Hybride Threats



## Underground constructions:

*railways, metro, tunnels, canalisation, parking, shopping malls, event halls, mining facilities,...*

# Status Quo

## *underground constructions in Europe*

Country	Road tunnels (km)	Train tunnels (km)	Metro tunnels (km)
<b>Germany</b>	69	382	367
<b>France</b>	133	256	304
<b>Norway</b>	522	126	119
<b>UK</b>	13	114	519
<b>Italy</b>	340	734	106

Source: [BASf]



# Challenges

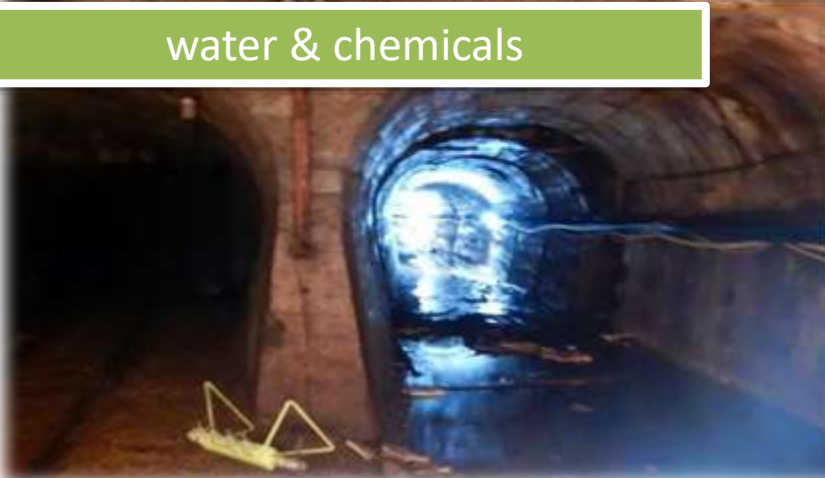
geology & construction



limitations in effects of actions



water & chemicals



Operations under extreme conditions:  
movement, TTPs, darkness, obstacles,  
logistics, communication,...



# Challenges

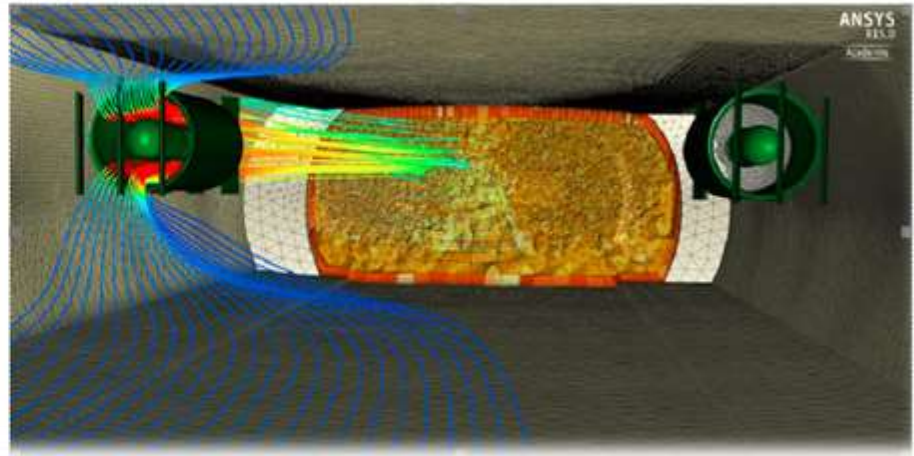
interoperability





# Modelling & Simulation for underground operations

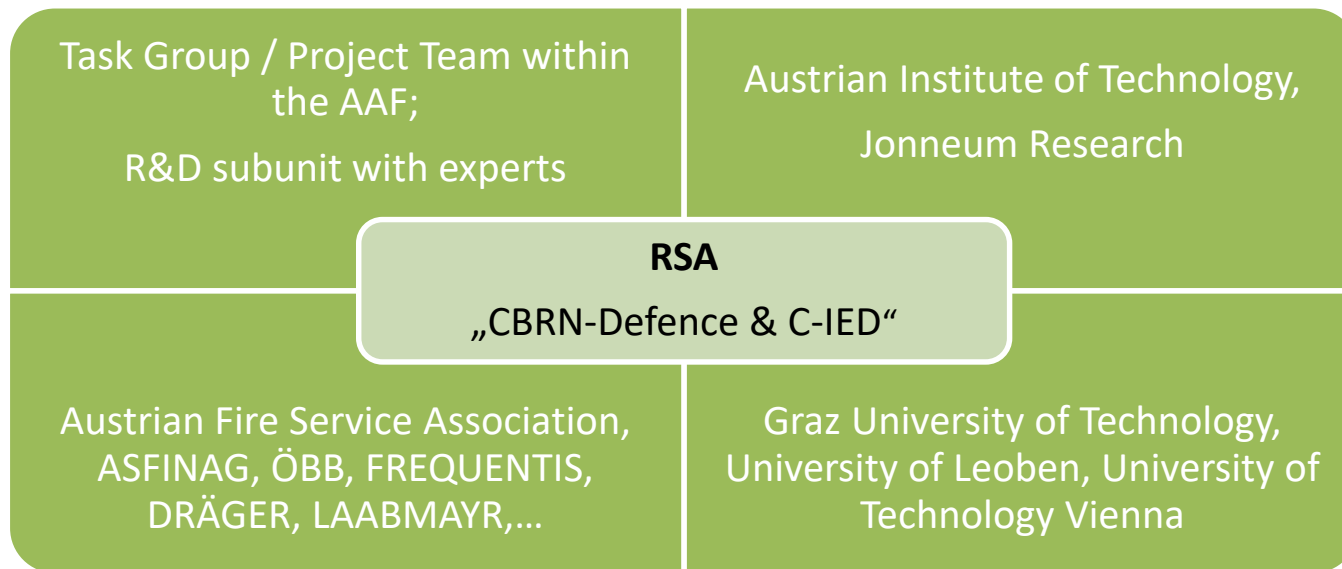
- air conditioning
- substance transfer & source term recognition (GRAMM/GRAL)
- fire & explosion (CFD effects of pressure and temperature)
- infrastructure impact (inside & outside)
- risk modelling



# Modelling & Simulation for underground operations

- **MULTIPLE IMPACT:**
  - Hazard & Risk & Vulnerability Assessment
  - IPE
  - Protection technologies
  - CONOPS
  - Infrastructure protection / enhancement
  - Emergency planning
  - VR/AR training
  - Awareness

## Management Cluster (e.g. Underground Operations)



# Science & Research in AUSTRIA

- AUSTRIA as a country of researchers with a current research quota of 3.18% (No. 2 in the EU)
- Variety of thematic research programs and actors
- Defence research as a "new" term



## Science & Research in the AAF

- Research in the AAF is gaining new insights in a verifiable and repeatable manner using scientific methods, to ensure a **knowledge & evidence-based input** for the further development of the armed forces for the best possible military task fulfillment
- In the AAF primarily applied research is carried out, but also experimental development and testing and - to the extent absolutely necessary - also basic research

# R&D landscape

**In-House  
Research**  
(MOD research  
projects)

**National  
Defence  
Research  
Program  
„FORTE“**  
(from 2018)

**National  
Security  
Research  
Program**  
(KIRAS, ASAP,  
TakeOff, IKtdZ)

**EDA R&D**  
**European  
Defence Fund**  
(PADR, EDRP,  
EDIDP)

**H2020,  
UCPM,  
ISF**

EDA... European Defence Agency

PADR... preparatory action on defence research

EDRP... European defence research program

EDIDIP... European defence industrial development program

UCPM... Union Civil Protection mechanism

ISF... Internal Security Fund

### Defence Research: what are we talking about?



Source: European Defence Agency definitions used for R&T and R&D expenditure

For one success, a lot of dead-ends have to be explored.

# THANK YOU FOR YOUR ATTENTION

*“the less you spend on armed forces, the more you will have to spend on defence research to ensure operational leverage into the reduced forces“*





## module 0

### orientation seminar for underground operations



# module 1

## introduction to complex underground emergencies



## module 2

### individual training basic training



## module 3 inter-agency training



# module 4 tactics



## module 5 Full Scale Exercises



## module 6 Train the Trainer

# ...food for thoughts

- Peter Hofer: Coping with Complexity. The Development of Comprehensive SubSurface Training Standards from a Military Perspective. In: Berg- und Hüttenmännische Monatshefte 12/2019 (zur Veröffentlichung angenommen).
- BMLV: Unser Heer 2030. Wien 2019
- Sean Monaghan, Patrick J. Cullen, Njord Wegge: MCDC Countering Hybrid Warfare Project. Countering Hybrid Warfare.  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/784299/concepts\\_mcdc\\_countering\\_hybrid\\_warfare.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/784299/concepts_mcdc_countering_hybrid_warfare.pdf) [13.10.2019]
- Peter Hofer: Security unter Tage. Eine Fähigkeitslücke im Wirkungsverband der Anspruchsgruppen. In: Berg- und Hüttenmännische Monatshefte 12/2018, S. 540-544
- Peter Hofer: Dynamischer Schutz. Embrasive Leadership im Rahmen der experimentellen Fähigkeitsentwicklung der Landstreitkräfte. In: Österreichische Militärische Zeitschrift 4/2018, S. 451-461
- Peter Hofer, Peter Vorhofer: Strategisch denken und handeln im sicherheitspolitischen Aktionsfenster. In: Österreichische Militärische Zeitschrift 2/2016, S. 188–196