

# MReBooks

## Mixed Reality Handbooks for Mining Education



This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation

Hanno Bertignoll / Manuel Ortega / 27.03.2019

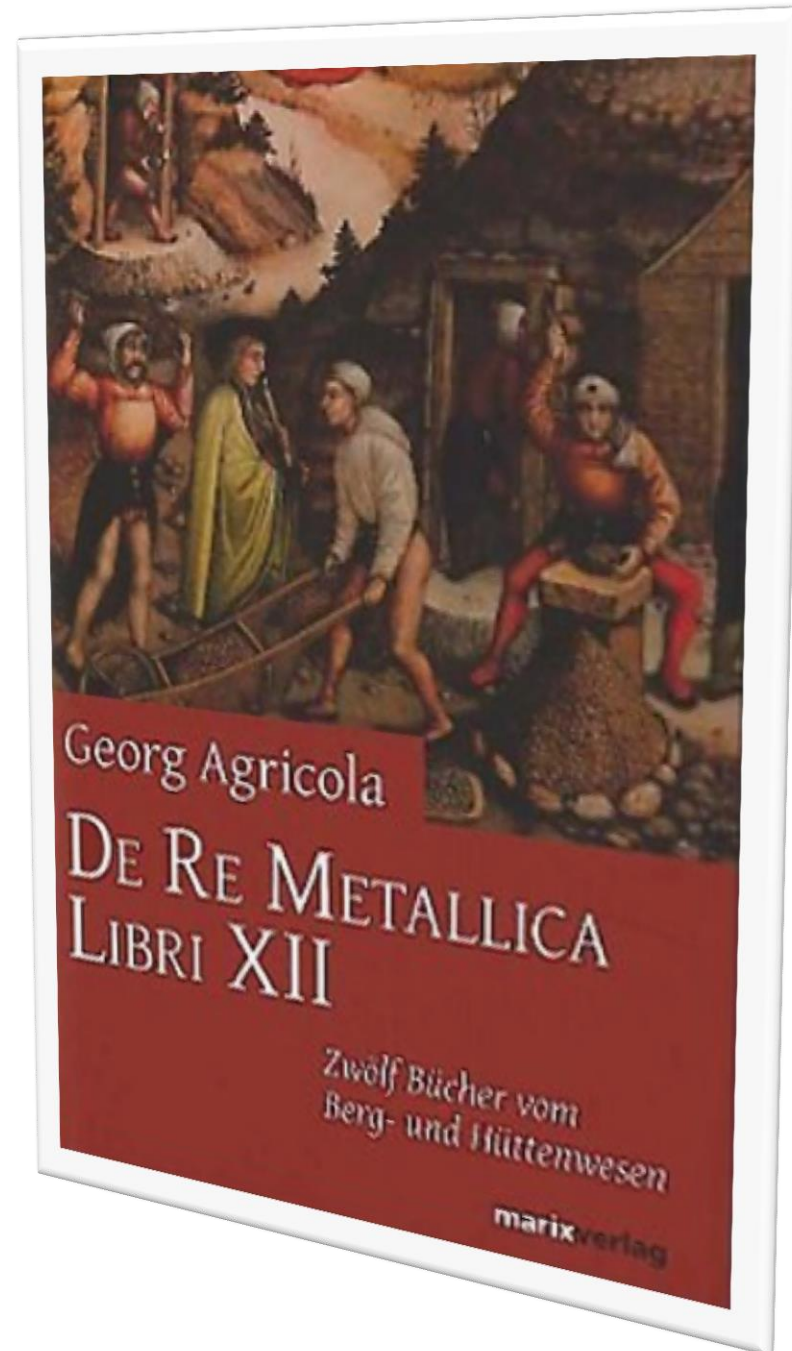
# CONTENT

- Why
- Challenge
- Solution
- How
- Outlook

Why

Poor knowledge is a traditional problem in mining

(Agricola, 1556)



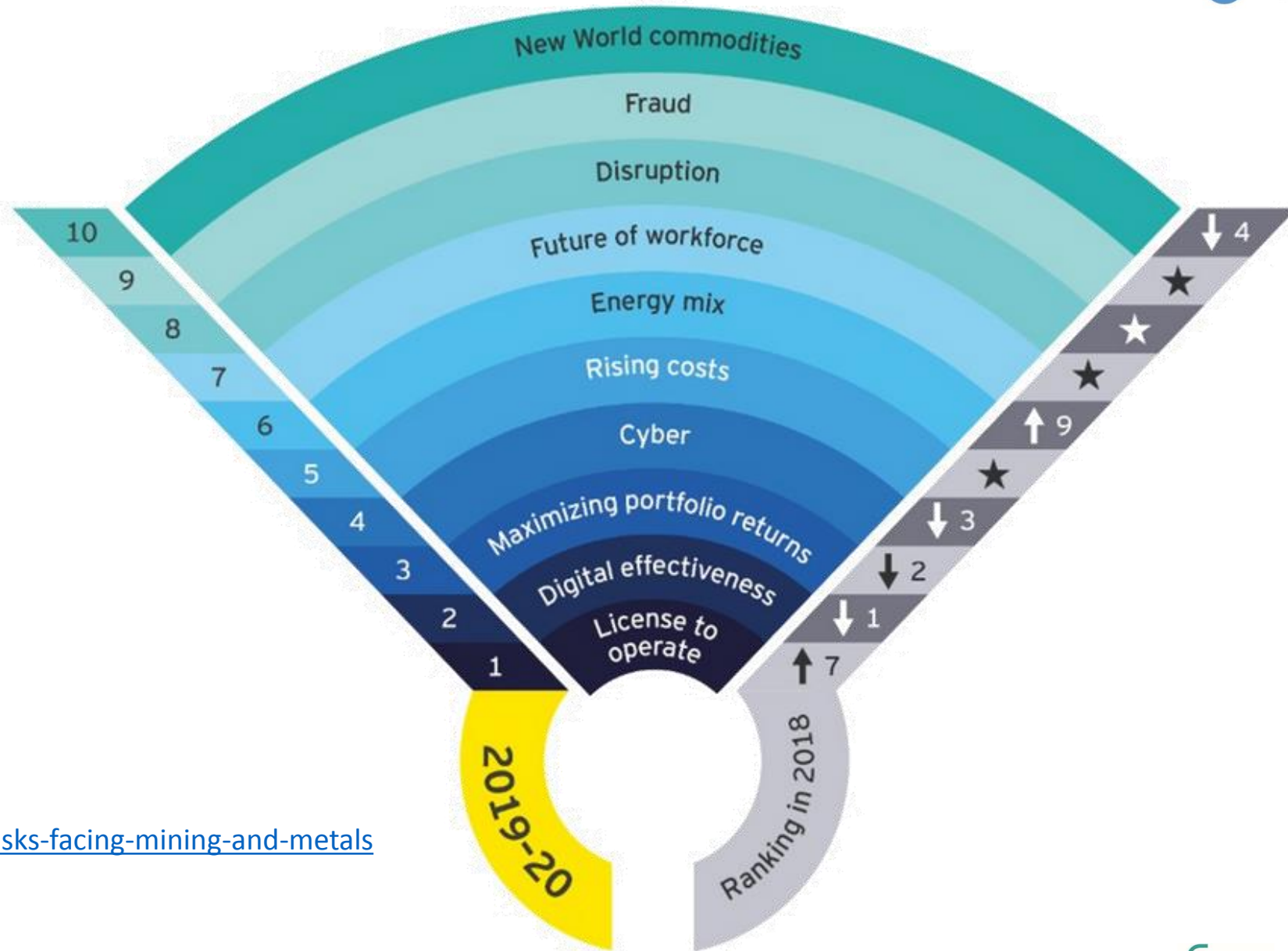


Why

# Future of workforce is one of top ten business risks to mining

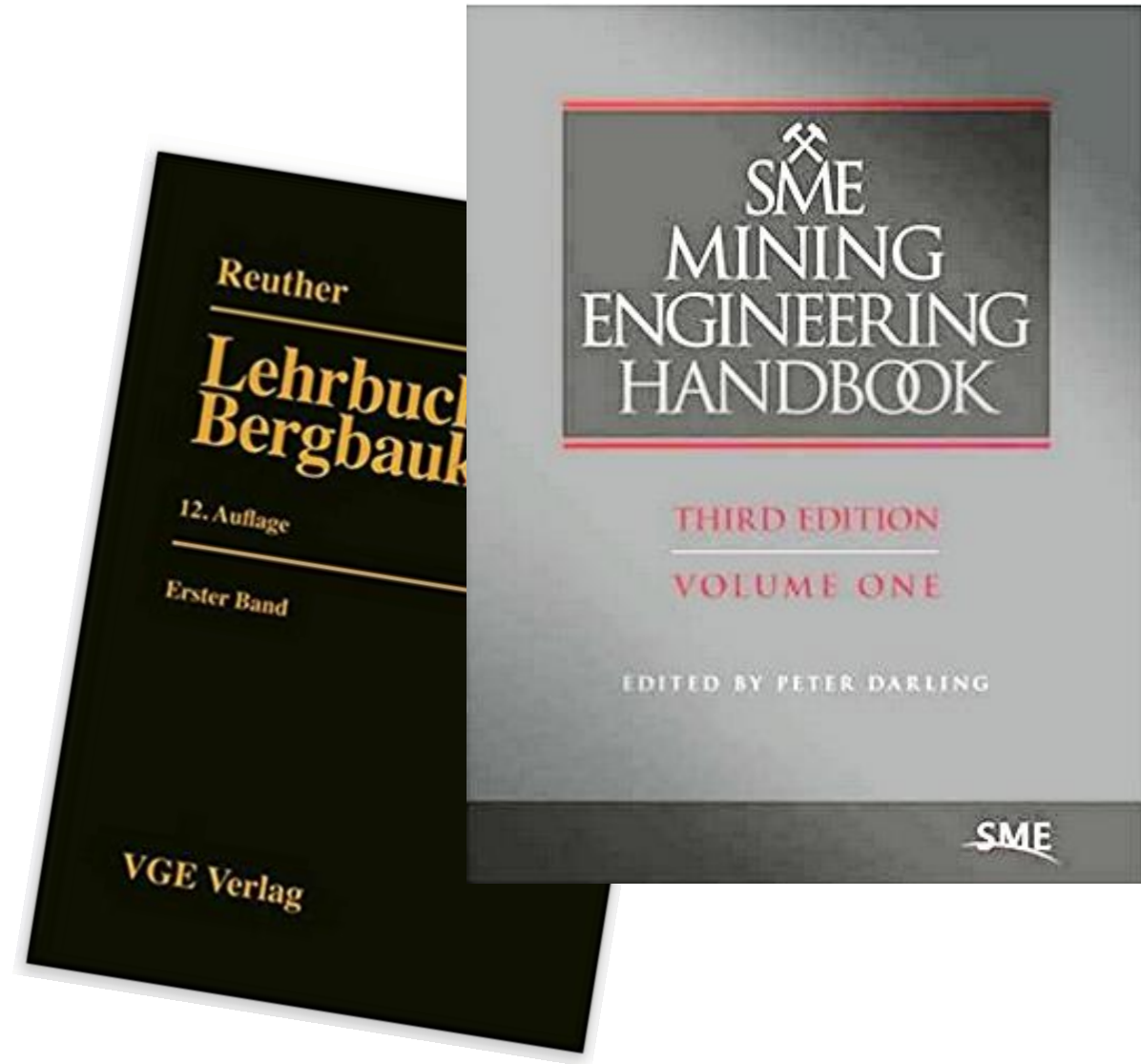
(Ernst&Young, 2019)

[www.ey.com/en\\_gl/mining-metals/10-business-risks-facing-mining-and-metals](http://www.ey.com/en_gl/mining-metals/10-business-risks-facing-mining-and-metals)



# The Challenge

- Mining education is based on mostly old material / paper based
- Students experience difficulties understanding 3D concepts
- Virtual Reality (VR) offers easy ways to gain field trip experience
- VR offers safe ways to experience hazardous situations
- Education material for digital native students



# The Solution

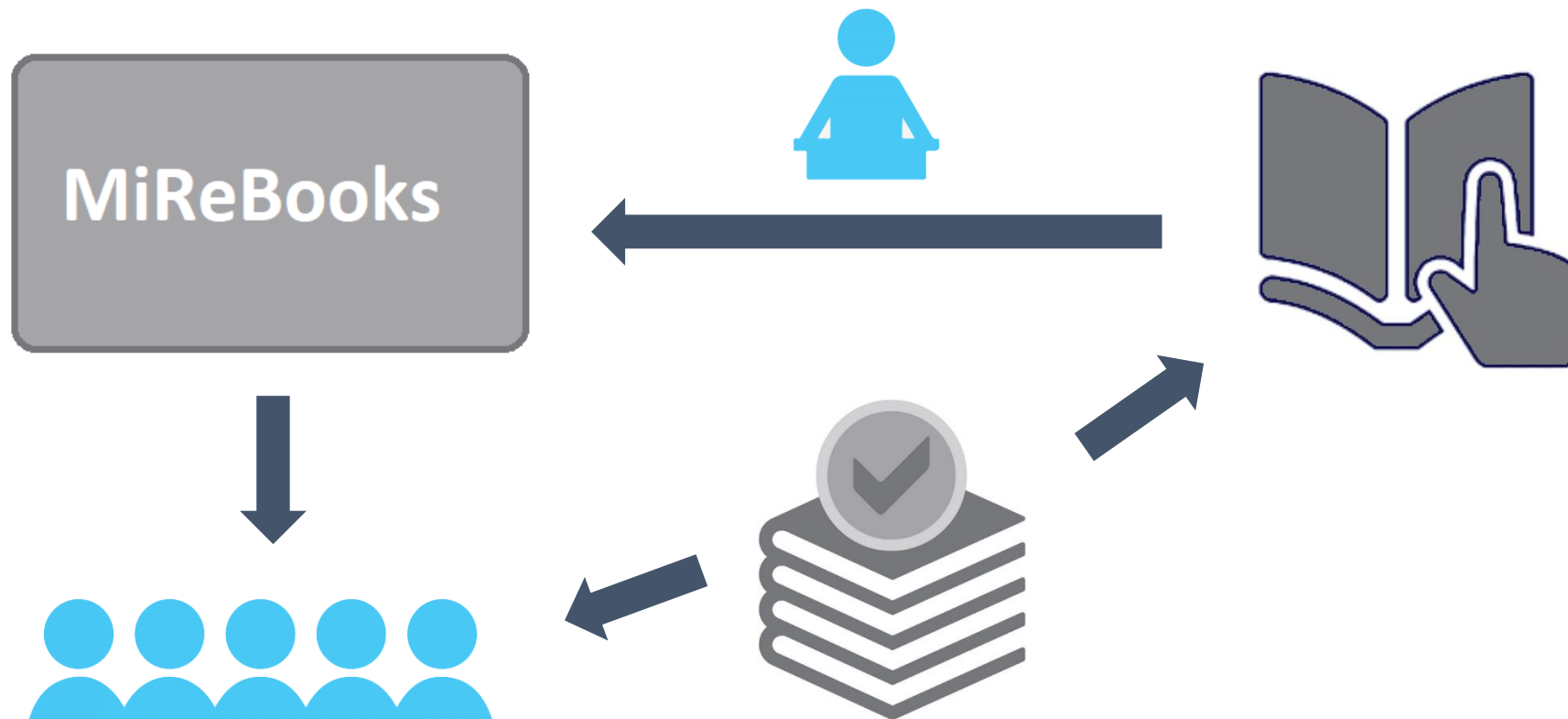
- Partnership of mining universities & industry
- New pedagogic / didactic concept
- Enhance education with digital material





# MiReBooks Concept

- Users
  - Lecturer
  - Students
- Handbooks
  - Content
  - Text/ARVR
- Lecture
  - Digital m.
  - Editing tool
- Lecturer guide
  - What
  - How



# HOW – STEP 1

- New pedagogic / didactic concept
  - Create digital material
  - Pedagogic Possibilities
- Technical evaluation
- Perform test lectures
  - Collect feedback





# Pedagogic Concept

- RWTH created storybook

360° Multi-Point Video

Animated 3D Model

Annotations

Traditional Material

Loading and Hauling in Mining with VR assistance - test lecture							
pic	Principles of loading and hauling in an open-pit mine						
aiming	At the end of the lecture, the students know the basic principles of loading and hauling in an open-pit mine.						
setting	Presence						
duration	90 Minutes						
number of	up to 30 (as there is no group work planned) (depends on available virtual reality devices)						
Previous structure of the lecture						Integration of new technology (AR/VR)	
Time	Content do I want to convey	Which learning goal taxonomy corresponds to the goal of this unit?	Which media do I use to communicate this?	Format	Method	How do you imagine the use of AR/VR in this unit? (please specify!)	Is there already any existing AR/VR material (please specify)
2-20min	Introduction into loading and hauling in mining	(1) Knowledge + (2) Comprehension: Students can describe the principles and purpose of the loading and hauling process in mining.	(B) Presentation (F) AR/VR	PPT	(1) communication of contents (2) interactive presentation	short clip of loading a truck by a wheel loader from an outside position	yes, 360degree videos
20-50min	Wheel loader: operation, machinery, technical data etc.	(1) Knowledge + (2) Comprehension: Students can describe the basic elements of a rigid frame truck and summarize operational issues from a operators point of view	(B) Presentation (F) AR/VR (D) Blackboard	PPT	(1) communication of contents (2) interactive presentation	several video clips of a truck by a wheel loader. Different camera positions (outside, operator wheel loader, shovel loader). The material will be used to explain basic features of operating a wheel loader and showing technical details of the machinery.	yes, 360degree videos
50-80min	Haulage truck: operation, machinery, technical data etc.	(1) Knowledge + (2) Comprehension: Students can describe the basic elements of a rigid frame truck and summarize operational issues from a operators point of view	(B) Presentation (F) AR/VR (D) Blackboard	PPT	(1) communication of contents (2) interactive presentation	several video clips of loading and driving a truck. Different camera positions (outside, operator truck, drone/air). The material will be used to explain basic features of operating a truck and showing technical details of the machinery.	yes, 360degree videos
30-90min	Summary and discussion/questions	(1) Knowledge + (2) Comprehension: Students can recap the lecture and have the	(B) Presentation (D) Blackboard	PPT	(1) communication of contents (2) interactive presentation	none	---

# Create Test Lectures

- Montanuniversität Leoben
  - Loading and Hauling in Mining
- Tallinn Technical University
  - Open Pit Bench Blast Design
- Luleå Technical University
  - Underground Mine Tunnel Development
- TU Bergakademie Freiberg
  - Surface Mining





# Digital Material – VR Example

- Filmed mining processes @ open pit mine
  - Blasting
  - Loading
  - Hauling





# Digital Material

- TU Graz – Filming and rendering
  - 360° videos (multi point of view)
  - Drone videos
- Epiroc – Underground mining machines 3D models
  - For use in VR or AR environment
- KGHM – Mining environment animation
  - 3D blasting animation for VR or AR environment

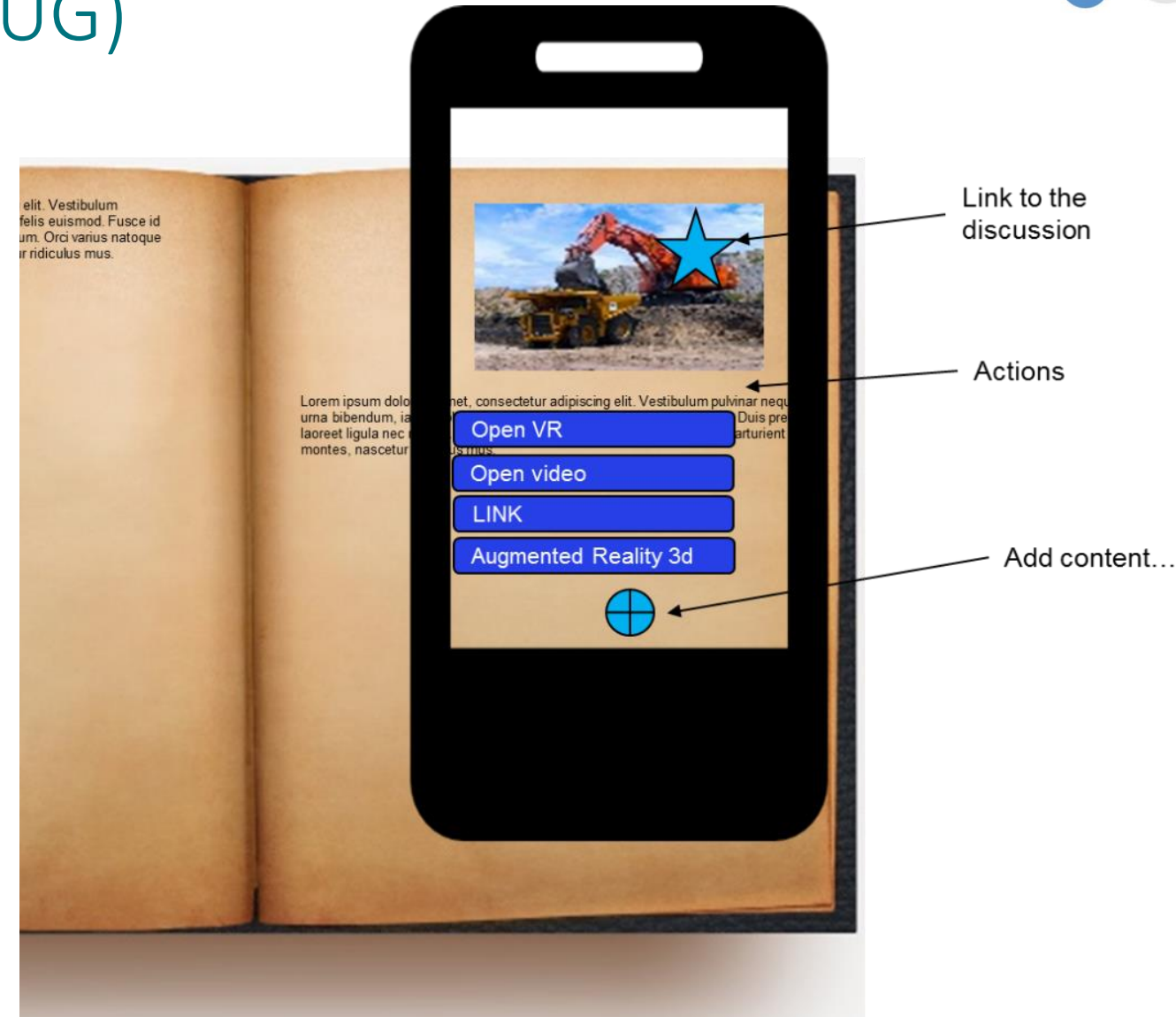


# Digital Material – AR (VTT & TUG)

AR enables linking a physical object (book) with digital materials.

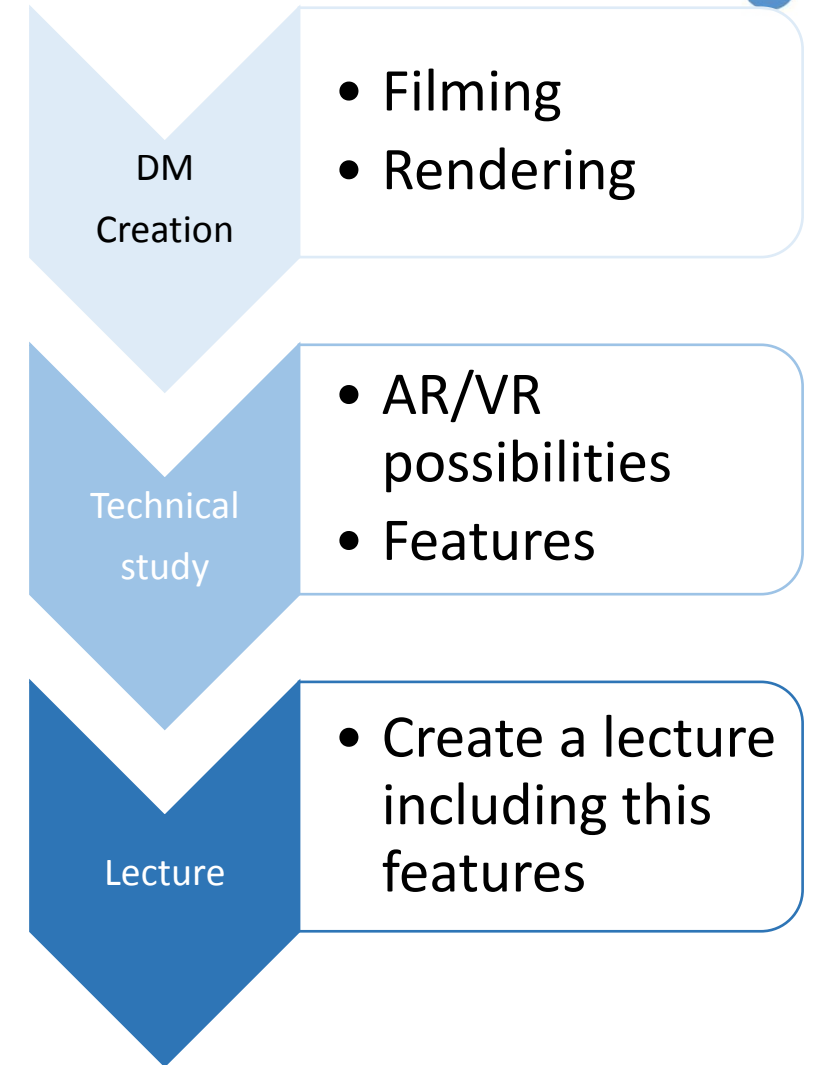
An image in a book serves as a link to digital materials / functionalities.

The image can provide access to e.g. discussion board, VR application, animations, 360° videos and URL



# Pedagogic Possibilities

- Lecturer may not be familiar with the possibilities that AR and VR can offer
- New approach:
  - possibilities that the digital material offers
  - → lecturer to implement in the lecture





# Technical Evaluation – VR

- Oculus GO VR headset
- Low-cost option
- Data stored in cloud
- Internet connection required



# Technical Evaluation – VR

- HTC Vive VR headset
- High-quality option
- Data stored in powerful gaming spec computer
- No internet connection required
- Cable connection to computer required → no mobility



# Technical Evaluation – VR

- Samsung Gear VR headset
- High-mobility option for classroom
- Data stored in smartphone
- No internet connection required





# Technical Evaluation – AR

Test:

Picture triggers AR

- Move / rotate / zoom



# Perform test lectures

- MUL (Tobias Ladinig)
  - 4 lectures performed
- TTU (Michael Hitch)
  - 4 lectures performed
- LTU (Adrian Halim)
  - 3 lectures performed
- TUBAF (Taras Shepel)
  - To be performed



# Collect Feedback

- Instant feedback
  - Improve features of AR/VR material
    - Annotation and highlighting on 360° videos and 3D model
    - Lecturer/attendants synchronization
- Feedback questionnaires
  - TUBAF
  - RWTH

**Evaluation - MiRebooks test lecture**

Date: 19.03.2018

Topic of the test lecture: Testvorlesung Loaden / Fördern

I am a.. ☒ ...student ☐ ...teacher ☐ other: .....

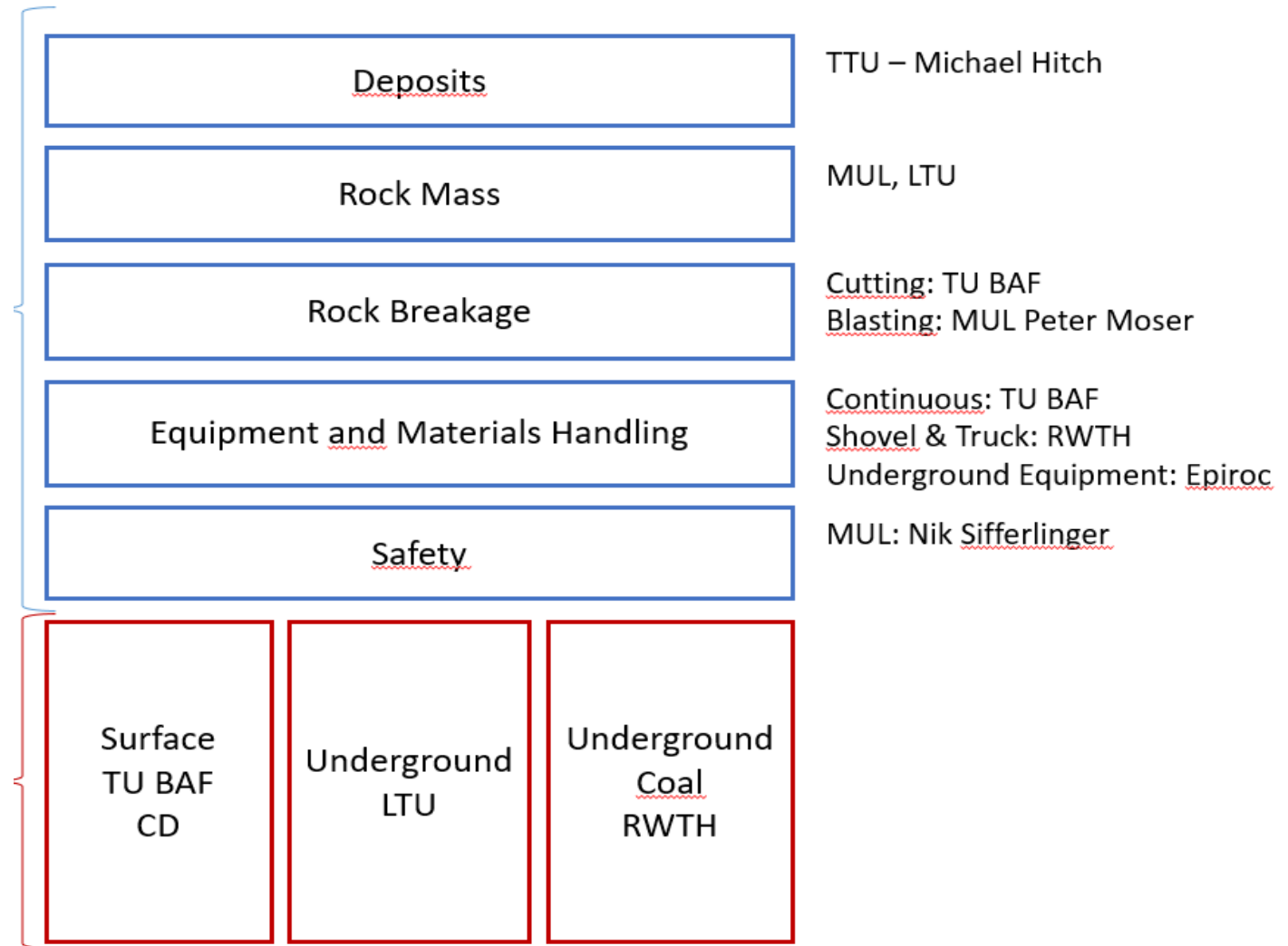
**How often do you use the following devices?**

	Frequency							
	daily	3-4x per week	1-2x per week	3-4x per month	1-2x per month	3-4x per year	1-2x per year	never
desktop-pc	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
laptop	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
smartphone	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
tablet	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
gaming console	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Microsoft HoloLens	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Oculus Rift/HTC vive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>



# Outlook

- Evaluate feedback
  - Apply user input
- Create the book's structure
- Create lecture editing tool
- Create manual how to use the book
- Books ready end 2021



Supported by:



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