NTNU

BRU21
Better Resource Utilization in the 21st century

# **BRU21:** Research and Innovation Program in Digital and Automation Solutions for Oil and Gas Industry

Prof. Alexey Pavlov – BRU21 program manager

NTNU TechnipFMC Lundin Norway equinor AkerBP OKEA wintershall dea GASSCO NEPTUNE ENERGY OLJEDIREKTORATET PETROBRAS

# BRU21 origin

**41 Fact finding meetings with the industry & authorities: 2016-2017**

- ❑ What are the major challenges for the O&G industry?
- ❑ What are “break-through technologies” for oil prices at 30 $?
- ❑ How can NTNU contribute to deliver future technologies & education in O&G?


**BRU21 Report – NTNU Strategy for Oil & Gas** [www.ntnu.edu/bru21](http://www.ntnu.edu/bru21)

# BRU21 vision, mission and goal

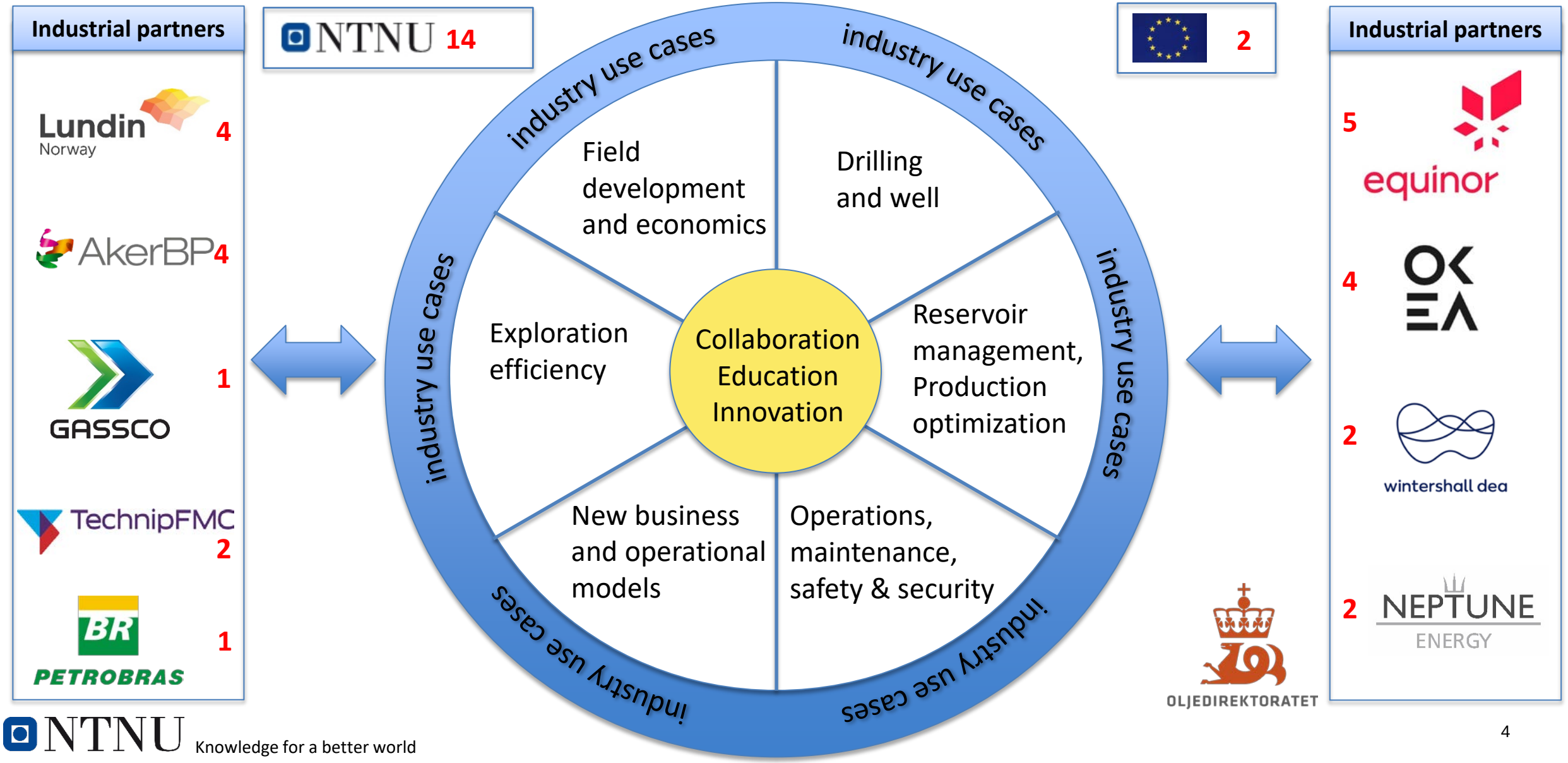
**BRU21 vision**
Enable higher efficiency, safety and reduced environmental footprint of oil and gas production through digital and automation technologies

+ support the industry transition to sustainable energy future

**BRU21 mission**
Mobilize multidisciplinary expertise across NTNU and, in cooperation with industrial partners, produce research results for novel technological and organizational solutions

**BRU21 goal**
Deliver new knowledge, technologies, innovations and multidisciplinary specialists for the digital transformation of the Oil and Gas industry and for the Norwegian society

# BRU21: Industry – NTNU collaboration: 39 (+2) projects



BRU21

Better Resource Utilization in the 21st century

# BRU21 project matrix: 39(+2) projects

| 6 | 11 | 7 | 4 (+2) | 5 | 6 |
|---|---|---|---|---|---|
| **Drilling and Well** | **Reservoir management and Production optimization** | **Operations, Maintenance, Safety and Security** | **New business and operational models** | **Exploration efficiency** | **Field development and economics** |
| Safe drilling in karstified carbonates (Lundin Norway) | A hybrid data-driven and mechanistic model for production optimization in the oil and gas industry (Lundin Norway) | Maintenance in remote operations (AkerBP) | Digital relations and new business models (TechnipFMC) | Does well data quality affect machine learning performance? (AkerBP) | Improved planning methods for more energy efficient and environmentally friendly fields in the Barents Sea (AkerBP) |
| Intelligent data analytics for offshore well integrity and life cycle management (PETROBRAS) | Production optimization strategies for offshore production systems with water processing constraints (OKEA) | Predictive maintenance (Lundin Norway) | Collaboration and digital tools in early stage design of offshore facilities (TechnipFMC) | Automated Seismic Reconstruction of Missing Section (NEPTUNE ENERGY) | Cost effective development of (small) discoveries on the NCS (OKEA) |
| Automatic real-time surveillance of drill-string vibrations (NTNU) | Improved technology for production optimization, with focus on gas lift allocation (wintershall dea) | Predictive Maintenance and Remaining Useful Lifetime (OKEA) | From idea to discovery: information sharing and cooperation in the exploration value chain (NEPTUNE ENERGY) | Automated facies classification through applying machine-learning to pre-stack seismic data (wintershall dea) | Automated methodologies for decision support in field development (Lundin Norway) |
| Digitalization/automation of life-cycle well integrity (NTNU) | Assisted history matching for petroleum reservoirs (equinor) | Risk-based maintenance (equinor) | Remote operations and future operating models (equinor) | Automated lithology classification of whole core CT scans (equinor) | Optimizing the operation of natural gas infrastructure (GASSCO) |
| Drilling data analytics (NTNU) | Assisted history matching, reservoir model update and optimization (equinor) | Industry 4.0 and smart predictive maintenance (NTNU) | Design, operation and maintenance of offshore energy hubs | Machine learning-based generic well log depth matching (AkerBP) | PoDecs: valuation under uncertainty (OKEA) |
| Real time fault and symptoms detection in drilling operation with wired pipe (NTNU) | Optimization of production, reservoir and field development (NTNU) | Safety and security in design and operation of ICS systems (NTNU) | AI for safety-critical remote operations | | Real options-based valuation for environmentally friendly O&G production (NTNU) |
| | Optimization across time-scales in oil- and gas production (NTNU) | Detection and localization of subsea leakages (NTNU) | | | |
| | Data-driven reservoir modelling (NTNU) | | | | |
| | Integrated Reservoir Tool/FieldOpt (NTNU) | | | | |
| | Machine learning-based production optimization (NTNU) | | | | |
| | (NTNU) | | | | |

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| | Integrated Reservoir Tool/FieldOpt – NTNU | | | | |
| | Machine learning-based production optimization – NTNU | | | | |
| | – NTNU | | | | |

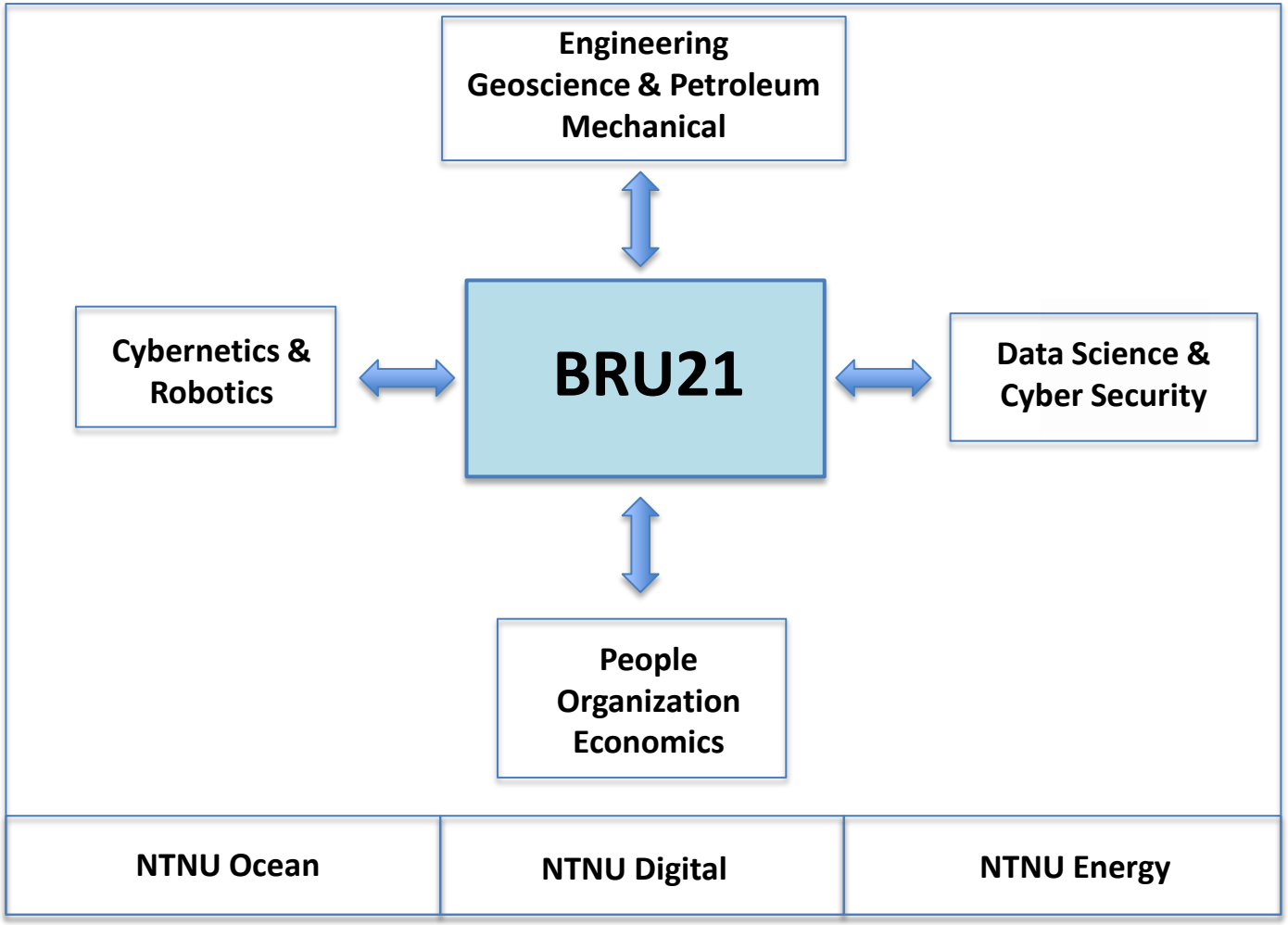
**Contribution to reduced environmental footprint**

# BRU21 model:

## Collaboration Research Education Innovation

# BRU21 Multidisciplinary collaboration across NTNU

## 8 departments / 4 faculties at NTNU

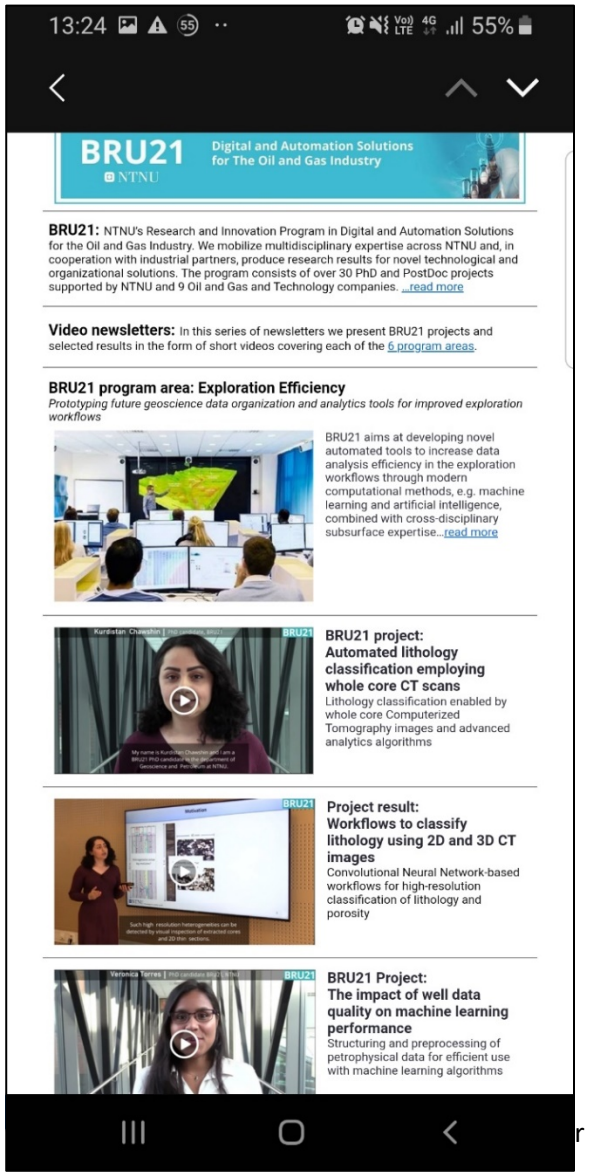



# BRU21 Research

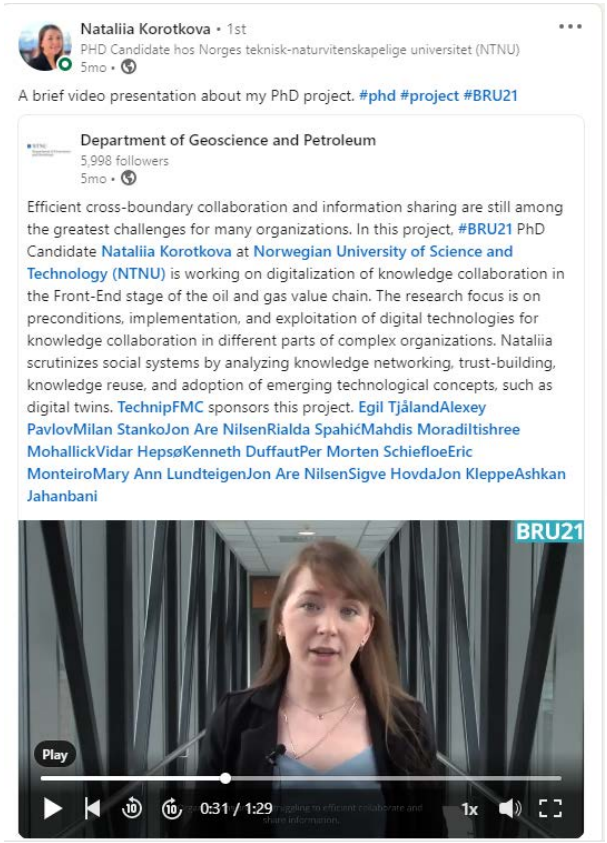

NTNU

# Research dissemination

## Video Newsletters




## LinkedIn




## Video reports

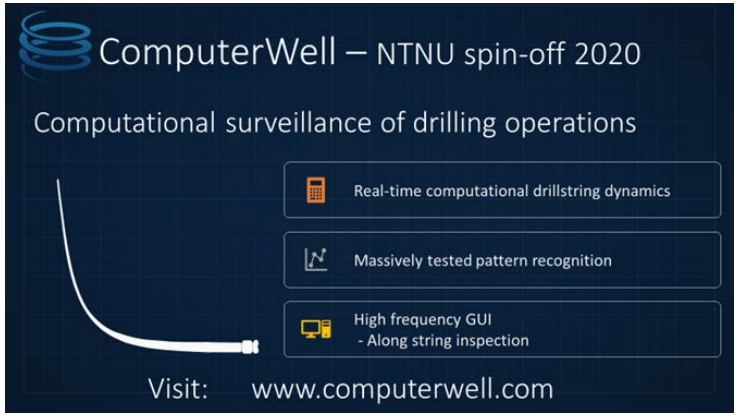

**Innovative dissemination strategy**

- 55+ videos on projects and project results
- In total 2+ hours of videos
- Training in business communication

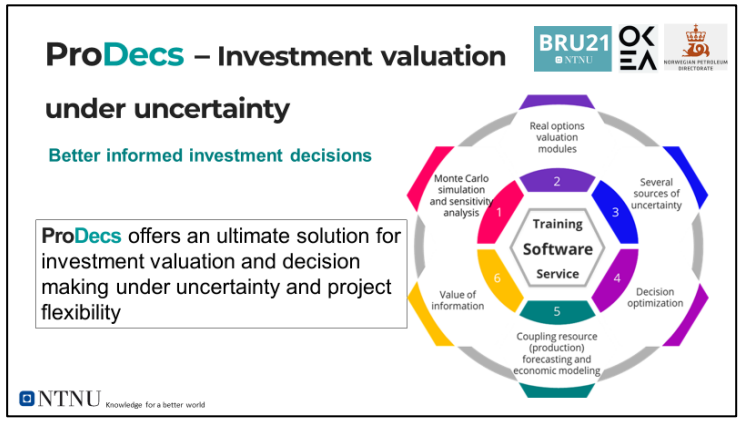
r world

# BRU21 Innovation

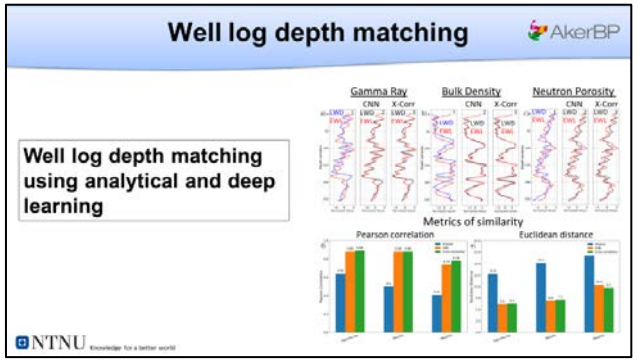
Equinor & Techstars Energy Accelerator

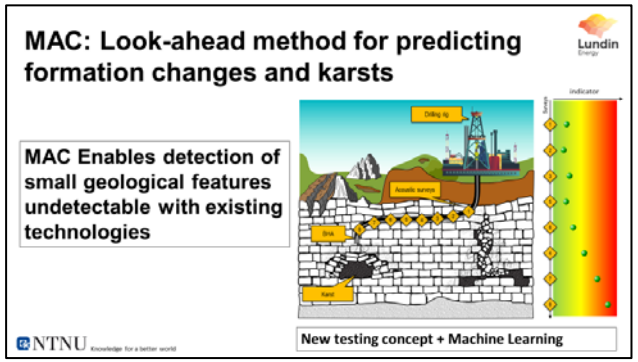


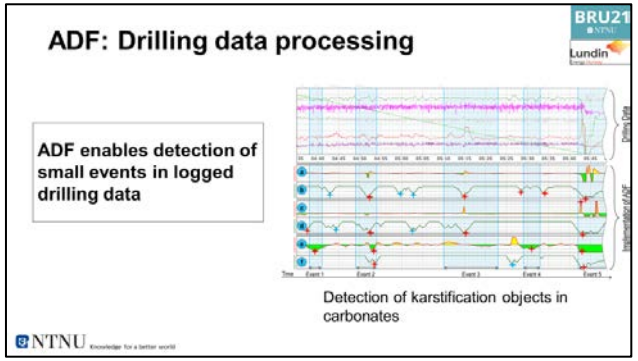

KONGSBERG HOW

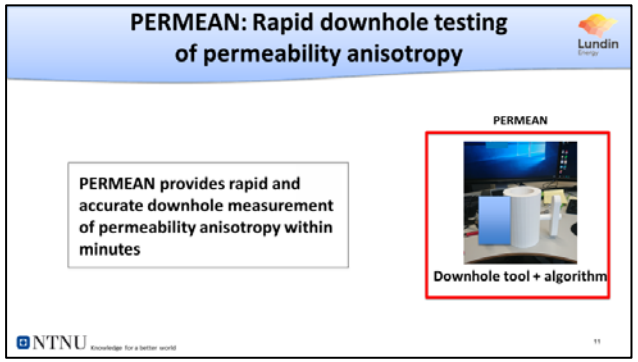



## Innovation projects towards implementation/licensing



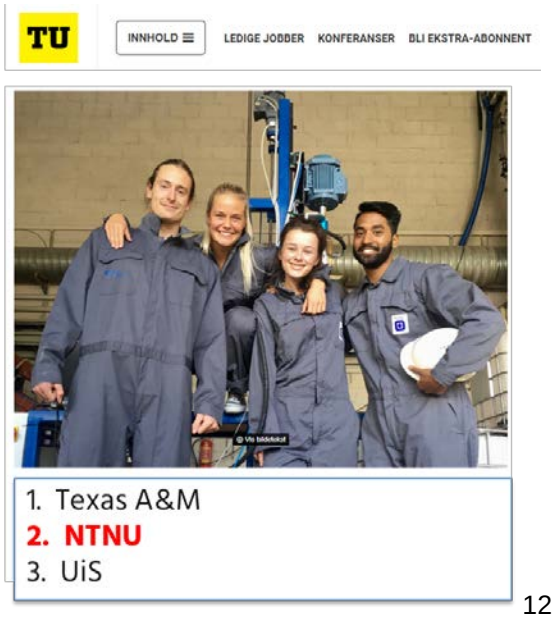



# BRU21 Education


2018


1. **NTNU**
2. OU
3. A&M

2017




1. Texas A&M
2. **NTNU**
3. UiS

# BRU21 Academy: courses for the industry

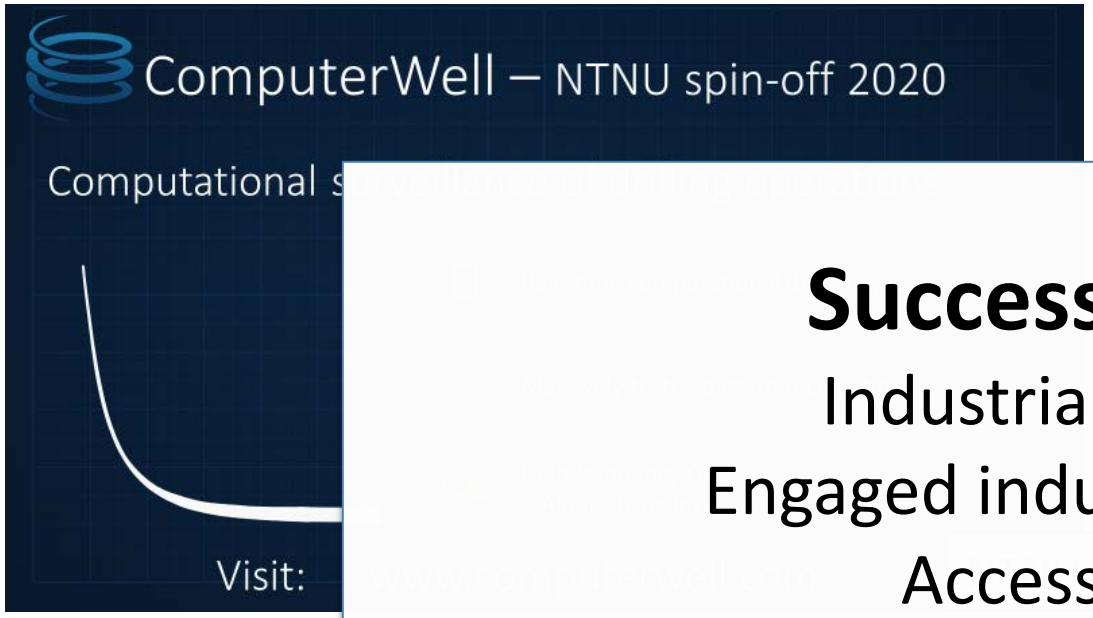
**Petroleum Cybernetics for Engineers and Managers**
(A. Pavlov, M. Stanko)

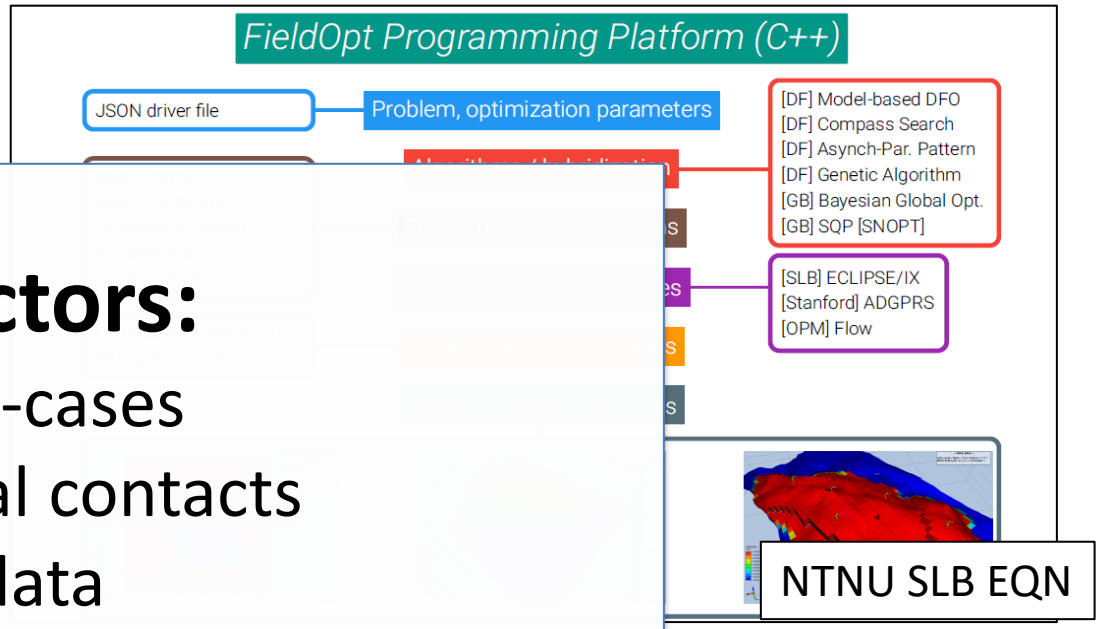

**Digital solutions for planning and optimization of maintenance**
(J. Vatn)


**Digital Twins for Managing Safety and Reliability of Systems**
(J. Vatn)

**Remote operations**
(V. Hepsø)

# BRU21 success factors




NTNU SLB EQN

## Success factors:

Industrial use-cases

Engaged industrial contacts

Access to data

Access to industrial expertise

Capable & experienced PhDs/PostDocs

NTNU expertise + supervision

Focus on Innovation

Thiago Lima Silva
PostDoc

Across 5 BRU21 projects

NTNU

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**ty anisotropy**

scholarship from
Engineering

Lundin

# BRU21

2021
2022

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in Digital and Automation Solutions
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NTNU