Digital transformation of JOGMEC and Japanese oil and gas industry

Kenji Akiyoshi

Advisor Oil and Gas Upstream Business Unit

DG Digital Transformation Group

Japan Oil, Gas and Metals National Corporation

Agenda

- JOGMEC's E&P activities

- Government policy and JOGMEC's DX strategy

- Current DX activities

- Challenges in DX in Japan

- Way forward

- Conclusions

JOGMEC's Activities

- JOGMEC;
  - is a governmental agency under Ministry of Economy, Trade and Industry (METI)
  - has 6 business areas for energy and mineral resources

Oil & Gas	Metals	Coal	Geothermal Energy	Stockpiling	Mine Pollution Control
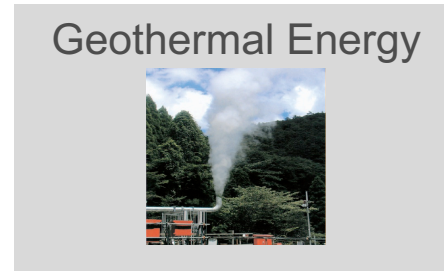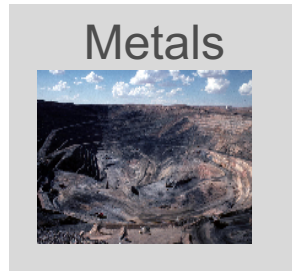
- has been working in Oil and Gas E&P projects at home and abroad for more than 50years

- for securing energy resources to Japan by supporting E&P activities of Japanese private sector

- by providing equity capital, liability guarantee, technology assistance, intelligence gathering, and HRD opportunities and

- by strengthening relations with oil and gas producing countries through various cooperative activities

JOGMEC's E&P Sector

- JOGMEC's core projects are in Abu-Dhabi, Mozambique, Russia, Indonesia, Australia and other countries in Middle East, Central Asia and North America
- Frontier exploration in Kenya and Russia
- Domestic offshore survey for about 5,000km^2 of 3D seismic data acquisition every year
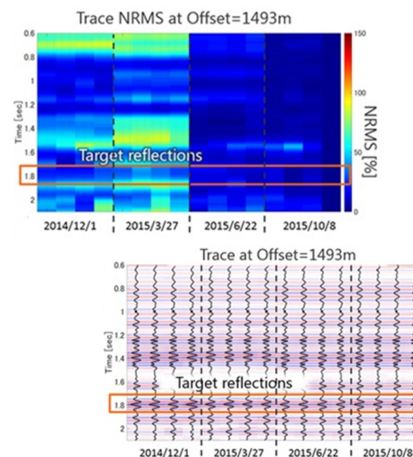- R&D on EOR, shale development, exploitation of gas hydrate and so on by Technology Research Center

As of June 2019 ○ Equity Capital ○ Liability Guarantee
○ Geological Survey (ongoing)

Facility of Technology Research Center (left)
Reservoir monitoring at CCS project site (right)

3D seismic vessel for domestic offshore survey

Government Policy

- "Growth Strategy 2018" by Japanese Cabinet
  - Japanese cabinet mapped out this new economic policy in 2018
  - Utilization of digital technology in various industries for realization of "Society 5.0"
  - Energy and resources development is one of the key issues.

- New Policy for resources development based on the Growth Strategy 2018
  - Accelerate utilization of digital technologies in E&P sector for strengthening Japanese E&P industry for increasing production and reducing costs by AI, IoT and other digital technologies
  - METI and JOGMEC are actively involved in the development of technologies, secure and foster advanced IT human resources, utilize data owned by the government and promote cross-industrial cooperation

JOGMEC's Digital Transformation (DX) Strategy

- A study group reviewed the current situation of DX and suggested a strategy for JOGMEC and E&P industry

  - Creation of a platform for digitalization
    - Scheme for Joint POCs
    - Support by AI/ICT expert and domain expert
    - HRD
    - Utilization of proprietary data of METI / JOGMEC
    - Trend survey and dissemination of information
  - Collaboration with other industries and academia
    - Planning of open competitions and workshops
    - International collaboration utilizing the relationships with the government of other countries
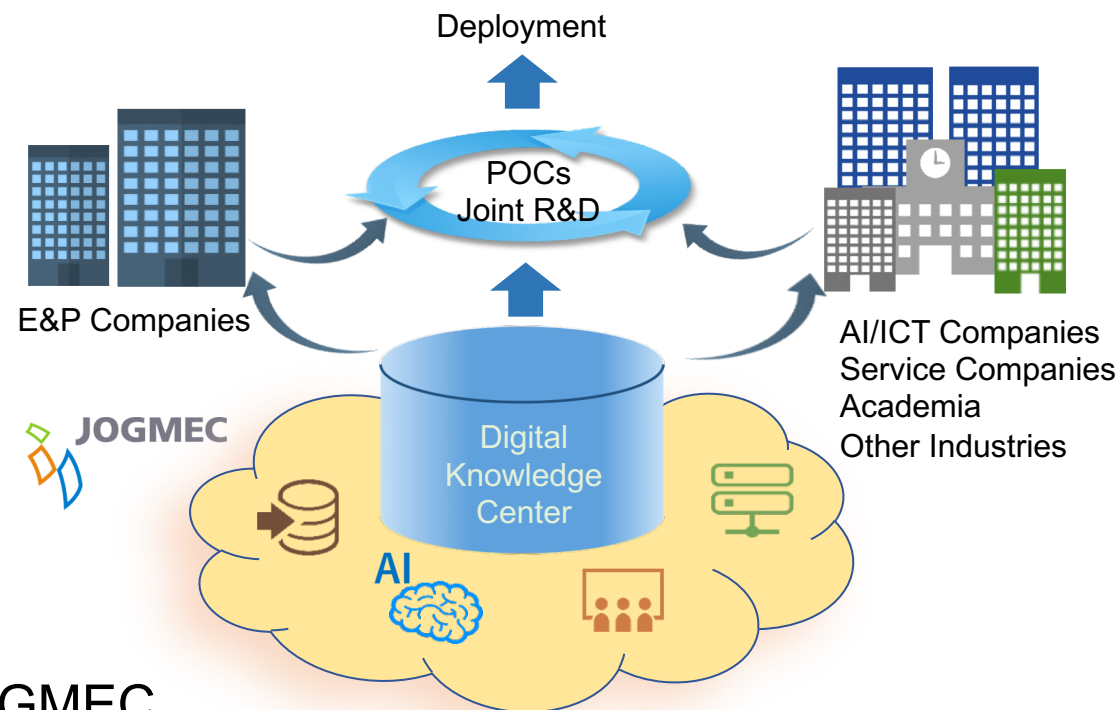
JOGMEC's Digital Transformation (DX) Strategy

- Core areas of digitalization

  - Success of exploration

  - Optimization of development plan

  - Control over development cost

  - Maximization of recovery factor

  - Reduction of OPEX

  - Optimization of LNG value chain

- Digitalization of JOGMEC's work flow

  - Renovation of NDR, other legacy databases and application environment

  - More focus on subsurface data

Criteria of priority evaluation map

- Value
- Scalability
- Frequency
- Delivery time
- Feasibility
- Data volume
- Technology maturity

Priority Map

Feasibility

Value
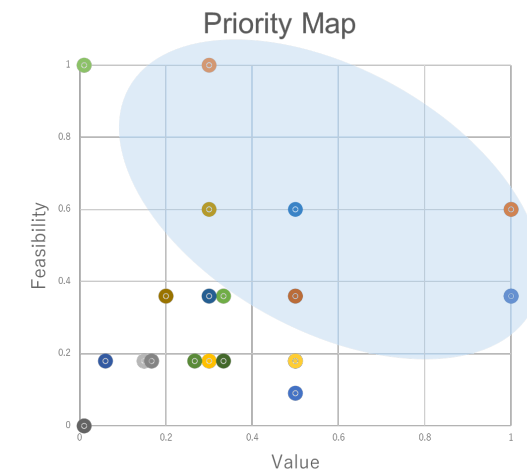
Well and seismic data management and well log data QC

- Challenges
  - Extract reliable data from unsorted dataset and archives
  - Quickly identify well log data that needs to be reviewed

  ➤ Data organization and integration in the DELFI environment
  ➤ Well log data QC using Schlumberger's ML algorithm

- Results
  - Reduction of data preparation time by 75%
  - Easy and quick creation of user interface for data organization using design thinking process
  - Detection of outliers in well log data and previous interpretation results
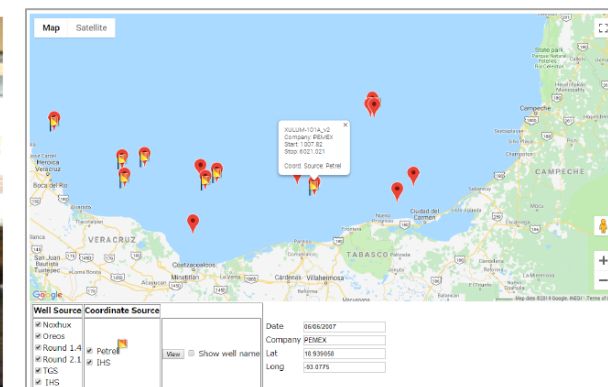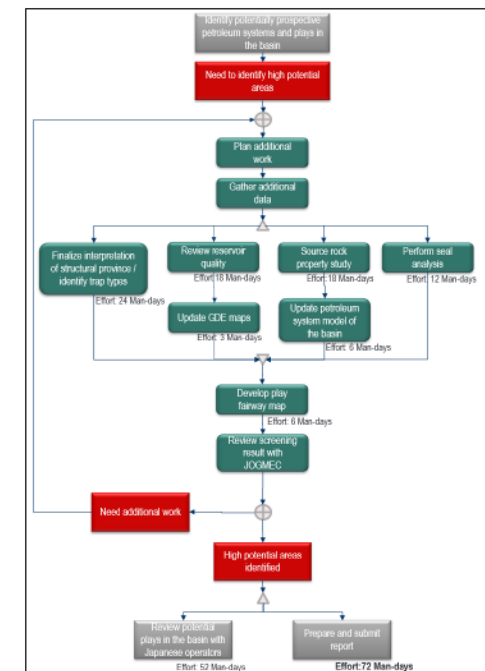
Operation Efficiency Enhancement Study

- Study for operation efficiency enhancement in oil fields
  - Target: 20% reduction of OPEX by introducing digital technologies and KAIZEN method
    - KAIZEN method involves all employees and improves standardized processes throughout the whole business areas
  - Results:
    - Identified areas to improve are efficiency of workers' behavior on P/F and ESP failure
  - Way forward:
    - Continuous efficiency enhancement with combination of digital technology and KAIZEN culture
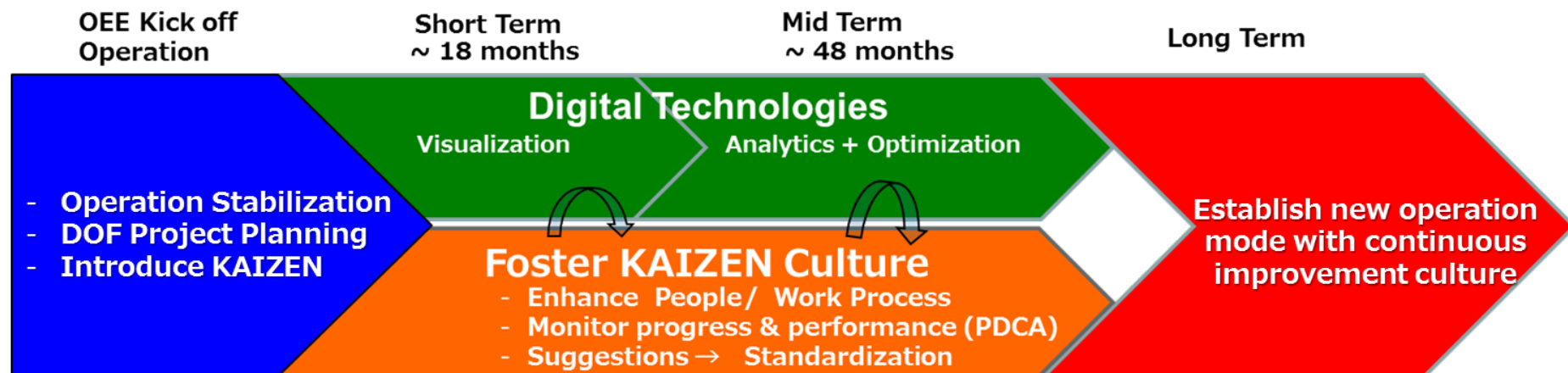
Digitalization of Laboratory Works

- Utilization of AI to our lab operations
  - Challenge: Technology transfer and reduction of human errors
  - Method: Assessment by reviewing lab data and interviewing to JOGMEC technicians
  - Results: Automated leakage prediction in core flooding system and interpretation of wave velocity measurement

    "At first, I suspected the AI solutions because trouble detection requires additional sensors. However, it was a new insight for me that conventional datasets have a big potential."
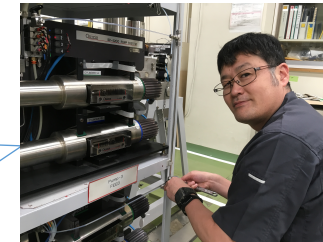
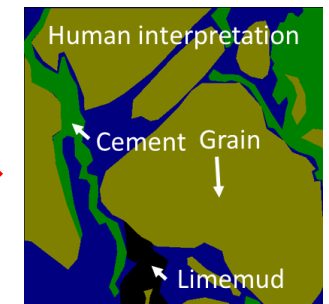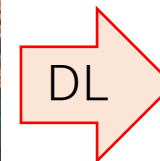| Lab items reviewed |
| --- |
| Core flooding |
| PVT test |
| Synthetic oil mixture |
| Slim tube |
| Wave velocity |
| Tri-axial compression |
| Biomarker analysis |

- Carbonate lithology identification from thin sections
  - Target: Automated identification of lithology
  - Method: Semantic segmentation and classification using CNN
  - Results: 90% accuracy or more

POCs Just Getting Started

LNG value chain analysis

- Target: Optimization of LNG shipping in Southeast Asian gas market
- Method: Combinational Optimization using data of a LNG production site and 10 to 20 consumer sites where demand and prices change

Gas Demand

Consumer Site

LNG Plant

LNG Production
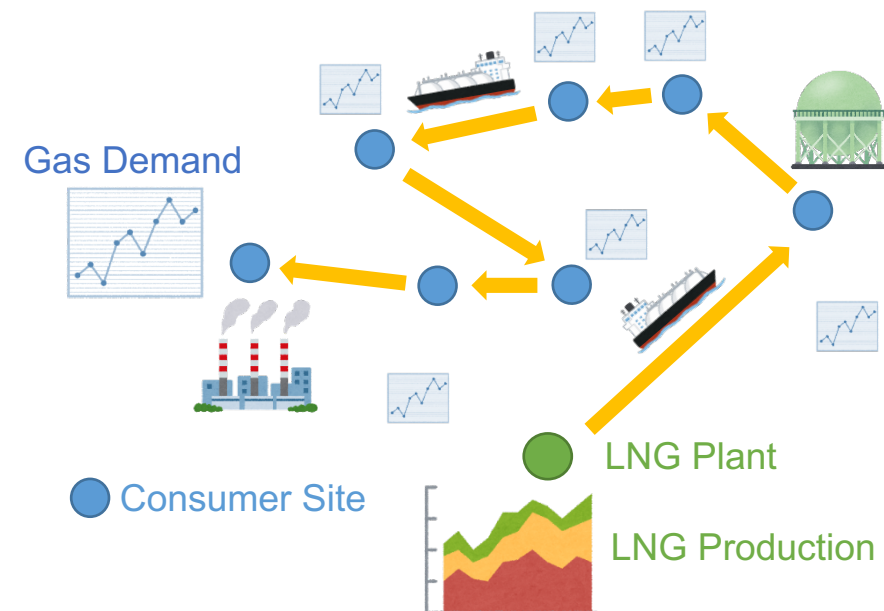
Drilling Analysis Consortium

- Target: predicting stuck and lost circulation with ML
- Method: Labeling of drilling problems on various data, and recognizing anomalous patterns by CNN

Data Sharing & Data Analyses Algorithm Developments

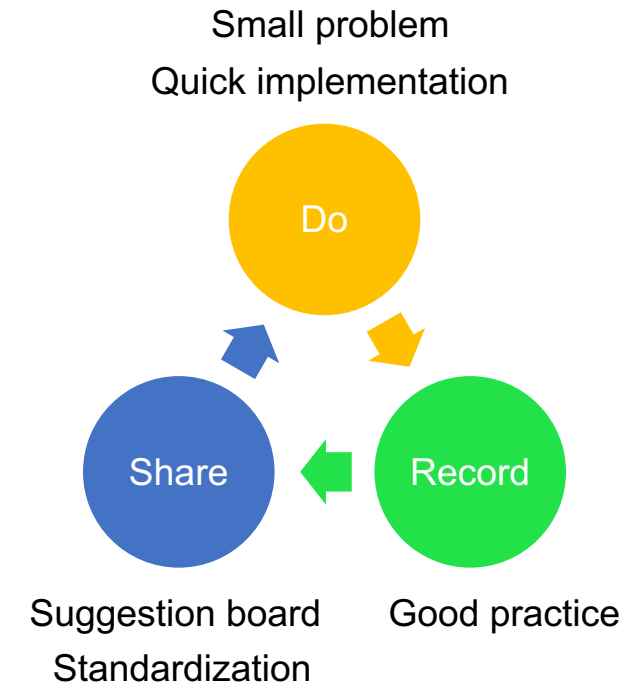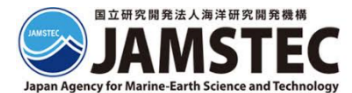|	
JOGMEC	JAMSTEC
INPEX	JAPEX
U. Edinburgh	U. Tokyo

JOGMEC

Challenges in DX in Japan

- Weaknesses in Management Practices
    - ◆ Agility of companies, Use of big data and analytics

        (IMD World Competitiveness Yearbook 2019)

    - ➢ Capacity building for data science
        - Certificate for deep learning <u>Generalist</u>

            (Determines the ability to make appropriate decisions and

            use Deep Learning in a business situation - JDLA)

    - ➢ KAIZEN method
        - Encourage small changes for improvement

            at individual level and propagate it to corporate level

    - ◆ Many challenges with the tasks involving

   complex processes like subsurface studies

Small problem
Quick implementation

Do

Share   Record

Suggestion board   Good practice
Standardization

Challenges in DX in Japan

- Strengths in Scientific & Technological Infrastructure

  ✓ Expenditure on R&D, R&D personnel, Patent grants, Computers in use, High-tech exports, etc.   (IMD World Competitiveness Yearbook 2019)

  ✓ HPCs are available – ABCI of AIST

  ✓ AI ventures, ICT companies, academia, engineering companies and E&P companies collaborate in oil & gas areas

- Plenty of room for improvement by

  changing our management practices
  and full use of our advanced resources

Akita University

THE UNIVERSITY OF TOKYO

AIST

FUJITSU

INPEX

JAMSTEC
Japan Agency for Marine-Earth Science and Technology

TOYO ENGINEERING

JAPEX

HITACHI
Inspire the Next

CHIYODA CORPORATION

MITSUBISHI HEAVY INDUSTRIES

Way forward

- Openness to accelerate DX

    - Collaboration and Competition

    - Tell the outside of the industry about the attractiveness and challenges of E&P technologies

    - More openness of subsurface data – but gradually

- Data driven approach and Knowledge driven approach

    - Subsurface is highly uncertain world

    - Data driven approach may not be enough for decision making

    - Knowledge driven approach must not be only replication of human activities
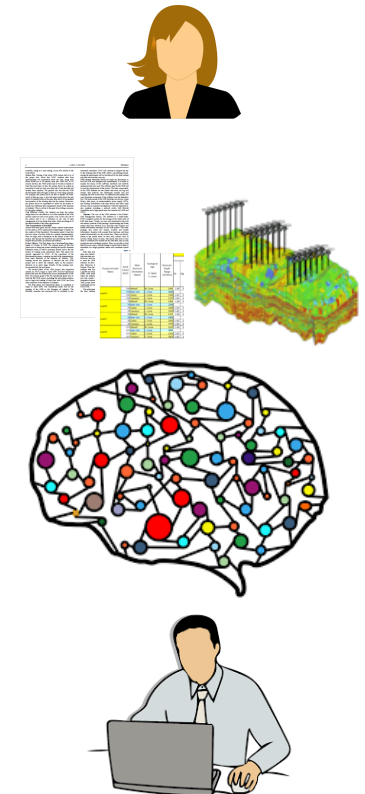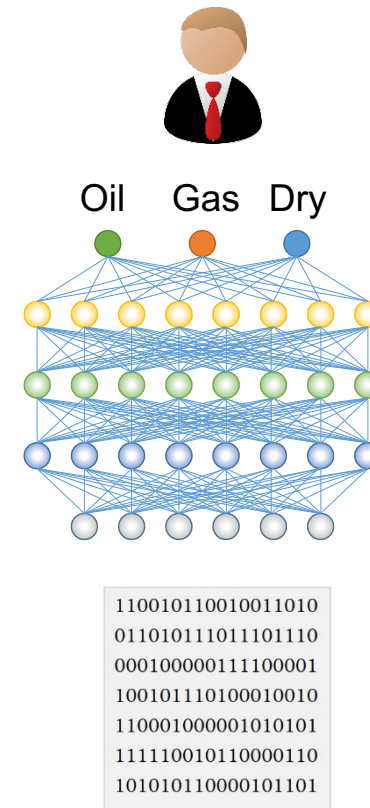
Oil   Gas   Dry

Conclusions

- JOGMEC is accelerating DX based on the new policy of the government and METI

- Several POCs are conducted in collaboration with Japanese E&P, ICT and engineering companies and academia utilizing the data and knowledge acquired through decades of activities.

- Major challenge is management practices but more bottom-up process together with full use of our advanced resources would benefit Japanese industry

- JOGMEC aims to be a data knowledge center that provides our industry with the resources for digitalization and data science including data, experts and HRD opportunities

- Openness and integration of data-driven and knowledge-driven processes are the key to future success of DX