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## INTEGRATED RESERVOIR MANAGEMENT OF OIL, GAS AND CONDENSATE FIELDS: BEST PRACTICES



Integrated engineering today and tomorrow

System (Integrated) Engineering: essential tool for complexity management System Engineering at Gazprom Neft

System (Integrated) Engineering: essential tool for complexity management

## What is System/ Integrated Engineering?



A great success is made up of many foreseen and carefully considered details

V.O. Klyuchevsky

**System Engineering (SE)** is a cross-disciplinary engineering science that provides methodology and tools for the holistic **modeling**, **design**, **creation and exploitation** of complex natural, technological and organizational objects.

SE integrates the approaches and algorithms developed in such areas as:



## **System Engineering at field level**



### Integrated models assembly:

- » Integrity
- » Interaction between models
- » Multi-parametric economic optimization

## System Engineering at oil company level



## Interdisciplinarity – the spirit of System Engineering

- » The Peril of Expertise Silos of isolated functions
- » The imperative of the time synergistic integration of these Silos by unified:
  - Information
  - Algorithms
  - Tools
  - Procedures and methodology



## Key milestones of contemporary System Engineering



### (Large-scale) systems theory: Philosophical basis for System Engineering



## The complexity of engineering objects keeps growing



### Volumes of information increase on daily basis



The drivers for SE relevance growth: the era of new major projects in Russia



The drivers for SE relevance growth: shifting to an unstable world



# The drivers for SE relevance growth: radical efficiency increase is required



#### Possible opportunities:

cognitive technologies	accessibility of	sensors a	and gadgets	design chemistry
smart materials	new techno	logies	ІТ сара	acity growth
	3D printing	agile	digitalization	

## System Engineering at Gazprom Neft

# GPN-Electronic Asset Development program (ERA<sup>™</sup>) is the digital foundation of System Engineering at Gazprom Neft



EXPLORATION ERA:GeoMate (Geologists digital workspace)



#### DEVELOPMENT

ERA:GRAD reservoir engineer digital workbenches

Search for analogue fields



#### **KNOWLEDGE SHARING**

Knowledge management system with cognitive search engine



- » iAdviser systems
- » Digital workbenches for all functions
- » Modular architecture



#### DRILLING

One window to monitor drilling process



#### **PRODUCTION**

ERA:Shakhmatka (Well real time data and forecast), ERA:Mekhfond (Optimization of well design, mobile operator)



#### CAPITAL CONSTRUCTION

3D-augmented reality, aero-monitoring



#### **CONCEPT ENGINEERING**

Integrated engineering, ERA:ISKRA (Optimal development concept accounting for interdependencies within the "reservoir-well-infrastructure-costeconomics")



## **ERA:ISKRA** is an integrated cross-functional platform













## Benefits of using cost engineering at GPN



**Bank of cost models** 

#### Improved cost estimates at early stages 54% 52% As per cost model 42% 40% As per DED\*

Onsite

infrastructure

±15% Accuracy of estimate based on cost model ±50% Standard accuracy at "Appraise" stage ±30% Standard accuracy at "Select" stage

## **4** days

Linear infrastructure

Calculation time using cost modeling

**2** months

Calculation time using DED

6%

1111

Other

infrastructure

6%



#### 20

### SE application at early stages: **Remote Field Group**

**REGIONAL MODEL** development stage allows to: Principles of HC generation and migration **>> GEOLOGICAL MODEL** Facial, structural and tectonic **>>** model, trap geometrization, identification of zonal and **》** geological trends **BUSINESS CASE** pipeline diameter Optimization of technological solutions and Exploration **>>** program accounting for EMV, DETAILED **RATIONALE OF** PREREQUISITES Probability estimate of resources and risks PRELIMINARY **INFRASTRUCTURE** +30% EMV growth due to the application of integrated approach CONCEPT **RATIONALE FOR** Probability estimate of **RESERVOIR MODEL** 

production profiles using 3D models, well pad distribution

VOI

Probability estimate of production profiles using 3D models, well pad distribution

- Integrated project concept at early
  - Identify the range of optimized technical and management solutions
  - Design and plan of further studies
- Structure the Exploration program for the timely selection of the optimal
- Business Case management from initiation through to realization

+10% Growth in project profitability

Profitability of project with integrated model



#### The Integrated model allows to:

- » Identify bottlenecks in the well network and to optimize its operation;
- » Estimate potential production opportunity and analyze risks;
- » Optimize gas re-injection;
- » Justify large infrastructure objects.

Integrated modeling is a key step towards a "digital oilfield"

## **40.5** MMT

Potential additional oil production from integrated modeling including 11 GPN fields until 2030

Selecting a suitable project portfolio



#### **Technology projects KPI:**

Year	Description	Targets	Target CAPEX/ha
2017	Opt. design of wells	-30 MM/well	1.05
2020	Long HWs	L=2 km	0.9
2020	Long multilateral HWs	2 HWs, 2 km long	0.85

#### Portfolio 2: new technology



#### Portfolio 1: existing technology

