Competitiveness of Deepwater Technology Roundtable
The E & P Innovation Chain Of The Future

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The E&P Innovation Chain Of The Future
Disruptive – Incentives, Risks, Ideas

• RSB background

• RSB R,D&I challenges

• RSB R,D&I initiatives (some of them)
Repsol Sinopec Brasil is a company leader in exploration and production of hydrocarbons in Brazil. Repsol Brasil, initiated its activities in Brazil in 1997, and proceeded to carry out a capital increase in December 2010, totally subscribed by Sinopec.

Strategic position in areas with a higher potential of presalt region and exploratory activities in Santos Basin.
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RSB background: major player in presalt basin

Current approximate production ca. 80.000 boe/d (3rd producer in the country). Strategic positioning in presalt higher potential areas.

<table>
<thead>
<tr>
<th>Area</th>
<th>Phase</th>
<th>Operator</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albacora Leste</td>
<td>Production</td>
<td>Petrobras</td>
<td>10%</td>
</tr>
<tr>
<td>Sapinhoá</td>
<td>Development</td>
<td>Petrobras</td>
<td>25%</td>
</tr>
<tr>
<td>Lapa</td>
<td>Development</td>
<td>Petrobras</td>
<td>25%</td>
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<tr>
<td>BM-C-33</td>
<td>Appraisal</td>
<td>Statoil</td>
<td>35%</td>
</tr>
<tr>
<td>BM-S-50</td>
<td>Appraisal</td>
<td>Petrobras</td>
<td>20%</td>
</tr>
<tr>
<td>BM-S-51</td>
<td>Exploration</td>
<td>Petrobras</td>
<td>20%</td>
</tr>
<tr>
<td>BM-ES-21</td>
<td>Exploration</td>
<td>Petrobras</td>
<td>11.1%</td>
</tr>
</tbody>
</table>
Wells drilled in BM-C-33 with RSB as operator are amongst the more complex drilled to date in ultra deepwater.

Wells drilled have 2.800 metres of water column and are located 200 km away from the shore. Flow assurance issues (fluid: condensate gas, highly paraffinic and with risks of hydrate formation).

Besides needing to drill the salt layer, rock in the reservoir is of extreme hardness and non conventional (silicified carbonate with volcanic intrusions).
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R&D strategic goal: offshore deepwater competitive at 40 $/bbl

R&D goal: develop next generation of technologies associated to development, operation and decommissioning of offshore oil basins.

Breakeven per play

Source: Deloitte O&G Reality Check 2015
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Challenges of our strategic plan

RSB R&D CHALLENGES

KEY TECHNOLOGY AREAS

Well Technology

Offshore Operations

Materials and Corrosion

Fluid-Rock Characterisation

Enhanced Oil Recovery

Subsurface Illumination

INCREASE RATE OF PERFORATION (ROP)
REDUCE NON PRODUCING TIME
PLUG & ABANDONMENT
INTEGRITY MONITORING
INCREASE WATER DEPTH
NEW FIELD DEVELOPMENT STRATEGIES
INCREASE STEP OUTS
WHILE DRILLING CHARACTERISATION
INCREASE RESERVOIR PRODUCTIVITY
INCREASE RECOVERY
IMPROVE ILLUMINATION OF COMPLEX RESERVOIRS
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R&D Portfolio defined with collaboration of partners

53 technical meetings during the months of March and April in 2015

- In-house
- Operators
- Service companies and equipment manufacturers
- Small & Medium sized technology companies
- Universities and Research Institutes
- Qualificators and facilitators

Total number of ideas identified: 219
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RSB R&D investment plan 2014-18

85% of resources invested in Brazilian universities and/or companies

• Internal resources
  • Creation of local research hub, in collaboration with shareholders research centres.

• Subsurface Illumination
  • Goal: improve illumination of complex reservoirs and reduce drilling costs

• Rock and Fluid Characterisation + EOR
  • Goal: development of monitoring tools for flow assurance and design of new strategies for enhanced oil recovery.

• Offshore Technology and Materials
  • Monitoring of integrity and oil spills detection, new technologies for deepwater and long tiebacks.

• Drilling Technology
  • New technologies for hard rock drilling and cementing.

Execution model in partnership with other oil companies and our shareholder research centres.

We expect that these partnerships will bring additional 60% funding to our projects.
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RSB network of Brazilian universities and research institutes

21 universities and research institutes from 13 different states.
23 completed or active projects in 9 different universities (13 additional under evaluation).
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Industry Partners: cost and risk sharing

Partnership with other operators.
Execution of activities with participation of Brazilian industry.

Operators
- Statoil
- BR Petrobras
- Shell
- BG Group
- Petrogal
- Total
- Sinochem
- Chevron
- Queiroz Galvão

Service and Equipment Suppliers and Qualifiers
- Baker Hughes
- GE
- Vallourec
- FMC
- Halliburton
- OneSubsea
- Technip
- Aker Solutions
- ABB
- Kongsberg
- Subsea 7
- PGS
- Bureau Veritas
- Tenaris
- DNV-GL
- CGG
- GeoImaging Solutions
- ikon Science
- OILFINDER
- PIBUTO
- ALIS
- Souza Brasil
- PETREC
- INGRAIN Brasil
- ESSS

Small and Medium Enterprises
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International cooperation coordinated through our shareholders

Partnership with shareholders (SINOPEC e REPSOL) research centres located in China and Spain. More than 2,000 researchers and state-of-the-art laboratory facilities.
Cooperation is useful in pre-competitive projects (low TRL levels), but it is essential to successfully execute latest stages of technology development (high TRLs, prototyping and field demonstration).

Partnerships with other Oil Operators (+40% additional resources and expertise)

Public funding also available: EMBRAPPII and other FINEP initiatives, BNDES, international funding initiatives (Norway-NRC, Spain-CDTI, EU-Horizon)

RSB shareholders also partners in some projects that generate synergies between portfolios.
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Subsurface Illumination: research programme SPEED

Development of prototype and optimisation of high performance computing usage.
HPC research facility that needed private and public funding for its construction.

Project in partnership between a technology based company (GIS) and a research institute (SENAI-CIMATEC).

Public funding through EMBRAPII-FINEP.
Development of oil spill detection system for floating applications
International cooperation with industrial partner Indra (Spain)

HEADS is an Hydrocarbon Early Automatic Detection System, based on the combination of two different sensors (radar and IR camera) that are assisted by meteorological sensors and managed by smart algorithms.

Currently, the System has to be installed on fixed sites: fixed platforms or onshore.

The objective of this project is to adapt HEADS to enable the detection of spills from mobile sites (e.g. mobile platforms or FPSO).

Existing technology for fixed platforms that needs to be adapted to floating production systems.

Project in partnership with REPSOL R&D and INDRA Spain. Two universities and one start-up company executing activities in Brazil.
Why an Open Innovation Programme?

- Specific programme focused on encouraging Academia to propose disruptive solutions to Industry Challenges
- Enabling technologies (Breakthroughs, High Risk, High Reward) at a Proof of Concept stage
- Aiming to bring innovation opportunities from other industry sectors (out of the box), capturing talent from university departments that are not amongst our typical network (non O&G departments)
- Focus on developing entrepreneurship, aligned with our Corporate Social Responsibility Objectives

Universia

- Network with 24 Universities located in 7 Iberoamerican Countries (4 in Brazil)
- RedEmprendia Solutions is part of Universia
  - 7 Universities participated (Brazil-1, Spain-1, Portugal-2, Chile-1, Mexico-1, Colombia-1)
  - Launched the first Call in cooperation with Repsol (2015)
Drilling over ~10 times faster than conventional drilling.

Lasers can be used in various ways for destroying rock but two of them have become attractive for deep drilling:

- Rock weakening with further application of mechanical tools
- Direct rock destruction via ablation (spalling, fusing or vaporizing).

Laser Enhanced Drilling (PDC+Laser)

- A test hole drilled 12' deep in dolomite rock
- A prototype of laser and PDC-hybrid bits. (Zediker et al., 2012)
THANK YOU!
OBRIGADO!
谢谢！
GRACIAS!