The 4th Industrial Revolution

February 25, 2020
Disclaimer

This presentation may contain certain forward-looking statements with respect to Saudi Aramco’s (the “Company”) financial position, results of operations and business, and certain of the Company’s plans, intentions, expectations, assumptions, goals and beliefs. These statements include all matters that are not historical fact and generally, but not always, may be identified by the use of words such as “believes”, “expects”, “are expected to”, “anticipates”, “intends”, “estimates”, “should”, “will”, “shall”, “may”, “is likely to”, “plans” or similar expressions, including variations and the negatives thereof or comparable terminology.

You should be aware that forward-looking statements are not guarantees of future performance and that the Company’s actual financial position, results of operations and business, and the development of the industries in which it operates may differ materially from those made in or suggested by such forward-looking statements. Factors that could cause actual results to differ materially from the Company’s expectations are contained in cautionary statements in the Company’s Prospectus filed with the Saudi Arabian Capital Markets Authority and available at https://cma.org.sa/en/Market/Prospectuses/Pages/default.aspx (the “Prospectus”) and include, among other things, the following:

• (1) oil and gas supply, demand and price fluctuations; (2) global economic market conditions; (3) competition in the industries in which the Company operates; (4) conditions affecting the transportation of products; (5) operational risk and hazards common in the oil and gas, refining and petrochemicals industries; (6) the cyclical nature of the oil and gas, refining and petrochemicals industries; (7) weather conditions; (8) political and social instability and unrest and actual or potential armed conflicts in the MENA region and other areas; (9) managing the Company’s growth; (10) risks in connection with projects under development and recent and future acquisitions and joint ventures, including with respect to SABIC; (11) managing the Company’s subsidiaries, joint operations, joint ventures, associates and entities in which it holds a minority interest; (12) the Company’s exposure to interest rate risk and foreign exchange risk; (13) risks related to operating in a regulated industry and changes to oil, gas, environmental or other regulations that impact the industries in which the Company operates; and (14) international trade litigation, disputes or agreements.

The Prospectus contains a more complete discussion of the factors that could affect the Company’s future performance and the industries in which it operates. The Company undertakes no obligation to update or revise any forward-looking statements, whether as a result of new information, future events or otherwise. All subsequent written and oral forward-looking statements attributable to the Company or to persons acting on its behalf are expressly qualified in their entirety by the cautionary statements referred to above.
Localization is Supported by a Comprehensive Ecosystem

**National Transformation Program**
- Create an **incubator environment** to attract digital investment, establish digital businesses, and promote innovation and digital security
- Accelerate the implementation of primary and **digital infrastructure projects**
- Promote innovation through R&D, supporting the leadership of local digital companies

**Saudi Vision 2030**
- Goal to transform into a **global hub connecting 3 continents**
- Increase investments in **digital economy** and build a developed digital infrastructure
- Encourage presence of SMEs and entrepreneurs

**Saudi Aramco Digital Transformation Program**
- Optimize operations and provide end-to-end value chain visibility to improve margin
- Lead the industry in technology innovation, and build partnerships with global digital hubs
- Upskill workforce in digital
- Maximize local content required to support digital program

**MCIT ICT Strategy**
- Grow IT and emerging tech market within KSA
- Increase the **IR4.0 and ICT sector’s contribution** to KSA GDP
- Support **technology localization** efforts in the Kingdom
- Attract **foreign investments**

**IKTVA**
- Increase amount of **goods and services procured in the Kingdom**
- Drive **supply-chain efficiency** and value across operations
- Encourage **development of a diverse, sustainable, and globally competitive energy sector** in the Kingdom

© Saudi Arabian Oil Company, 2020
Localization is a Focus for the KSA – Saudi Aramco’s IKTVA Program Aims to Achieve 70% Local Content

- Drives domestic value creation by working with suppliers for mutual benefits
- Envisions to improve investment, and maximize long term economic growth and diversification
- Focuses on delivering quality jobs, advancing innovation and enhancing global competitiveness

IKTVA is designed to reward Saudi Aramco’s suppliers for the use and development of local labor and sub-suppliers
IR 4.0 Workshop Outline

Executive Summary

The Opportunity

The Business Case

Sectors
9

Worth of business opportunities
$7.5bn

Examples of use cases
24

Anticipated Market Size

Localization Potential

© Saudi Arabian Oil Company, 2020
# Agenda

<table>
<thead>
<tr>
<th>Session</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening</td>
<td>Sultan Alotaibi</td>
</tr>
<tr>
<td>Overview of Saudi Aramco’s Digital Transformation Program</td>
<td>Hiba Alajeeb</td>
</tr>
<tr>
<td><strong>IR 4.0 Technologies: KSA Market Trends, Localization Potential, and Use Cases</strong></td>
<td></td>
</tr>
<tr>
<td>Cybersecurity</td>
<td>Ali Asseri</td>
</tr>
<tr>
<td>Cloud Computing</td>
<td>Nora AlShaikh</td>
</tr>
<tr>
<td>IOT and Smart Devices</td>
<td>Abdulaziz AlGhamdi</td>
</tr>
<tr>
<td>Artificial Intelligence &amp; Big Data Analytics</td>
<td>Basim Al-Dossary, Talal Altook</td>
</tr>
<tr>
<td>Mobility</td>
<td>Meshal Al Hazmi</td>
</tr>
<tr>
<td>Industrial Robotics</td>
<td>Abdullah Khder</td>
</tr>
<tr>
<td>Additive Manufacturing (3D printing)</td>
<td>Omar Abuhabaya</td>
</tr>
<tr>
<td>AR/VR</td>
<td>Rakan Maghribi</td>
</tr>
<tr>
<td>Closing</td>
<td>Sultan Alotaibi</td>
</tr>
</tbody>
</table>
Saudi Aramco’s Digital Transformation Program

A Forward Looking Innovation Hub to Foster 4IR Solutions

Saudi Aramco Digital Vision

In 2022, Saudi Aramco is the world’s leading digitalized energy corporation, maximizing shareholder value and spearheading digital innovation in energy globally.

Digital Mission

- Improve the Margin
- Innovate with Technology
- Revenue Diversification
- Develop the Digital Workforce
- Maximize Localization

© Saudi Arabian Oil Company, 2020
The Building Blocks of Saudi Aramco’s Digital Transformation Program

Technology Tracks
- Cloud
- Modeling
- Analytics
- AI: RPA...
- IoT
- AR/VR
- 3D Printing
- Mobility
- Robotics
- Blockchain

Business Domains
- Subsurface
- Upstream Processing
- Business Units (eg. GO, U/S, D/S)

Operating Model
- Acquisitions & agile Delivery Model
- Funding & Procurement
- Innovation Centers (IR4.0, Ventures, etc)

Digital Foundations
- Culture
- Talent
- Processes
- Enterprise & Data Architecture
- Security
- Data Governance

Partnerships
- Industry Peers
- System Integrators
- Digital Labs
- Cybersecurity Bodies
- Connectivity & Hardware Providers
- Innovation Partners

© Saudi Arabian Oil Company, 2020
Market Trends, and Localization Potential in KSA
Cyber Security
Vision 2030 calls for a greater ‘knowledge economy’ - this growth is highly digital, driven by innovation in big data, cloud services, and smart technology.
Key Observations & Takeaways

- Spend increase is directly correlated to increase in Attempted cyberattacks by 33% between 2018 and 2019, reaching 160 million attempts per year with almost a 15% success rate.
- Cybersecurity spend in KSA represents ~50% of total spend in IR4.0, representing more than half of total cybersecurity spend in MENA.
- O&G industry is the primary target of cyberattacks, followed by government, financial services and telecommunications.
- 26% of spend in 2019 was on cybersecurity services with the remaining on cybersecurity products.
Cybersecurity Represents an Attractive Localization Opportunity Given the Current Gap and Expected Demand Growth

The opportunity

Newly established **minimal cybersecurity control regulations** kingdom-wide.
New mandate applies to all **NCI companies** including Oil and Gas industry.

The business case

1. Current KSA demand for cybersecurity is estimated at ~ $3.5b (2020)
2. Forecasted ~ 16% annual growth in the **Cybersecurity** market through 2025
3. Access to thousands of companies
Localization Potential of Cybersecurity

**Hardware**
- Data Diodes
- Firewalls
- Intrusion Prevention Systems
- Intrusion Detection Systems
- Web Proxies
- Sandboxing Email Gateways
- Web Application Firewalls

**Connectivity & system integration**
- Mobile Security
- IoT Security
- IT/OT Security
- Security Architecture
- Cloud Security

**Software/Platform**
- Application Security
- Vulnerability Management
- Identity and Access Management
- eGRC Platform

**Services**
- Risk Assessments
- Penetration Testing
- Compliance Assessments
- Maturity Assessments
- Incident Response & Forensics
- Security Monitoring
- Awareness Services
- Training & Staff Development
A Win-Win Opportunity

Cybersecurity expertise has great potential and has applications both in oil and gas and several other industries in KSA (e.g. military).

The kingdom has established the National Cybersecurity Authority a government body to establish and mandate cybersecurity requirements.

The KSA is moving towards the adoption of digital technologies, increased internet penetration, use of IoT and cloud, and these are the factors contributing to the growth of the cybersecurity market.

Access

National Priority

Outlook
Cloud Computing
Types of Cloud

- **IaaS**
  - Applications
  - Security
  - App Servers
  - Database
  - O/S
  - Virtualization
  - Servers
  - Storage
  - Networking
  - Datacenter

- **PaaS**
  - Applications
  - Security
  - AI/ML
  - Block Chain
  - Analytics
  - PaaS
  - Virtualization
  - Servers
  - Storage
  - Networking
  - Datacenter

- **SaaS**
  - Applications
  - Security
  - AI/ML
  - Block Chain
  - Analytics
  - SaaS
  - Provider
  - Cloud Provider
  - Cloud Provider
  - Cloud Provider
Cloud Represents an Untapped IR4.0 Opportunity for KSA

KSA Projected Spend in Cloud
USD Millions

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>700</td>
<td>1000</td>
<td>1300</td>
<td>1800</td>
</tr>
</tbody>
</table>

Key Observations & Takeaways

- Cloud spend is forecasted to approximately double every 2 years in KSA.
- Cloud represents an untapped technology in the Kingdom.
- Compared to global spend placing it the highest among IR4.0 technologies.
- In KSA, the majority of spending has been on subscriptions to software as a service (SaaS) out of kingdom.
- Cloud-first policy of KSA government entities is expected to drive major growth.
Current Cloud Services Market

International Cloud Provider

• Offer a rich catalogue of Cloud services and solutions including Software as a Service.

Local Cloud Provider

• Cloud companies located in Saudi Arabia offering mainly infrastructure as a service (IaaS) and very limited (SaaS)
National Cybersecurity Authority (NCA)

National Cybersecurity Authority Control (ECC - 1 : 2018)

4-2-3-3 Organization’s information hosting and storage must be inside the Kingdom of Saudi Arabia.
Gaps Cloud Services Market in the Kingdom

- Limited SaaS availability
- Dependency on international cloud
- Limited Open Source Software use
- Lack of digital transformation solutions
Localization Potential Cloud Computing

- **Hardware**
  - Strong potential for the manufacturing of servers and storage systems in KSA.

- **Cloud and System integration**
  - Potential to capitalize on cloud to cloud integration services.

- **Software Development / Platform**
  - Build critical SaaS solutions for Saudi market.

- **Services**
  - Migration to Cloud
  - Cloud security services
  - Develop Software solutions to be provided by local Cloud providers.
IoT & Smart Devices
IoT has the Highest Spend Among Manufactured IR 4.0 Tech

KSA Projected Spend in IoT

USD Millions (% per year)

- IoT spend in KSA has been focused on products, representing 65% of spend with the remaining being spent on IoT services.
- Within IoT spend on products, 55% is on hardware, 30% is on software and 15% was on connectivity.
- Largest growth in IoT spend in KSA is forecasted to be in manufacturing and transportation; thus, Industrial IoT (IIoT) is expected to have the highest growth among IoT types.

Key Observations & Takeaways

Sources: Accenture Research, Accenture Analysis, IDC KSA IoT Market Forecast 2019-2023, Gartner
Examples of Smart City Solutions Deployment
Vision 2030 aims to apply Smart Cities’ concepts

In the KSA, several large diversification projects are rapidly catalyzing the uptake of smart city solutions and services.

Key projects include the Riyadh Rapid Bus Transit System, Riyadh Metro, Amaala, NEOM, Qiddiya and the Red Sea Project.

The Ministry of Municipal and Rural Affairs (MOMRA) launched the smart cities program - an ambitious initiative by the government to apply the concept of smart cities in Saudi cities to enter the digital age as part of the National Transformation Program.
### Localization Potential of IoT and Smart Devices

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Connectivity &amp; system integration</th>
<th>Software/Platform</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Limited capacity for sensor manufacturing locally.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Very limited local manufacturers of intelligent devices in KSA - strong potential for local manufacturing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• limited manufacturing of boards, modules or processors in KSA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Includes network access (wireless, fiber, satellite, etc.) used to connect a smart device/sensor to a network</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Includes applications that transform collected data into actionable insights</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Open software platform has high potential to be localized</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Covers technology and processes related to IoT solutions such as solutions management, support and deployment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Limited presence of players Intelligent Devices &amp; Smart Sensor services in KSA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
AI and Big Data Analytics
AI and Advance Analytics are Forecasted to be the Main Driver of IR 4.0 Tech Spend

KSA Projected Spend in AI, Big Data Analytics and Modeling

USD Millions (% per year)

- Artificial Intelligence and Advanced Analytics is set to become the technology domain in Aramco with the second highest spend by 2025
- AI will also boost growth across all IR4.0 technologies with the increase in AI adoption growing spend on cloud, IoT, robotics, etc.

Sources: Accenture Research, IDC KSA IT Spend 2019
Truck Hauling Optimization

Description

- The system provides the recommended number of trucks that Saudi Aramco needs to dispatch between the bulk plants.
- It looks into the historical data of sales hauling, waiting times, inventory levels, and in-transit trucks to predict the volume of sales and the expected trucks waiting time.

Key Benefits

- Reduce Demurrage Charges
- Automate Manual Work
- Minimize Waiting Time
- Improve Customer Relations

Key Users

- Planner
- Operator

Key Technologies

- Intel. Sensing
- Analytics
- AI
Equipment Lifetime Analytics

Description

• To determine the optimal beyond-economy-repair point. That is, when should we stop maintaining equipment and should start planning for a replacement.

• A cost prediction model solution based on the maintenance history and the age of the equipment then the solution will recommend replace/repair decisions and highlighting the outliers.

Key Benefits

• Optimize Maintenance Strategy
• Optimize the Total Cost Of Ownership

Key Technologies

Analytics
AI

Key Users

Engineer
Planner
Operator
Supplier Delivery Date Prediction

Description

• Predicting the delivery date of purchase orders based on 20 attributes. For example: vendor, material type, quantity of materials, supplier location (in kingdom or out)

• In order for the buyer to determine when to expect the materials to arrive, it needs a predictive model. This is especially important when the item is needed urgent and an emergency PO is considered.

Key Benefits

• Provide buyers with improved forecasts of delivery date
• Minimize the number of emergency POs for which Saudi Aramco pays a premium.

Key Users

Planer
Buyer

Key Technologies

Analytics
AI
Shipping Optimization

**Description**

- Optimizes ship terminal operations by building an intelligent planner, which extracts trends from historical data and uses both historical trends as well operational requirements to optimize the monthly lifting schedule and four-day berthing assignment for crude oil exports.

- Uses both Machine Learning and Mathematical Optimization. Incorporated weather, GPS tracking and a simulator to improve the accuracy or the optimizer and run different scenarios.

**Key Benefits**

- Minimize the ship waiting time
- Avoid demurrage charges.
- Optimize the terminal operations

**Key Technologies**

- Analytics
- AI

**Key Users**

- Engineer
- Planner
- Operator
Satellite/Aerial Image Analytics

**Description**

- Automate Satellite/Aerial analysis process using Big Data platform and Deep Learning techniques

- land-use change detection including object boundary identification and classification.

- Land encroachment detection is a process that takes nearly an entire year with an assistance of the software; however, it also requires manual intervention.

**Key Benefits**

- Accurately Automate land encroachment detection
- Image analysis can be executed more frequently.
- Over 25,000 of man-hours per year can be saved

**Key Users**

- Engineer
- Planner

**Key Technologies**

- Analytics
- AI
Asset Failure Predictor: Accurately predicts equipment failure before a costly downtime

**Description**

- An analytics-driven solution which predicts equipment failure.

- Consists of an analytics engine running on top of operational data captured through sensors connected to the equipment.

- Runs various analysis on the data to predict the probability of asset failure with a high degree of accuracy.

- Enables the plant technicians to align maintenance schedules to planned downtimes and turnaround cycles.

**Key Benefits**

- Improve Asset Lifetime and Utilization
- Increase Plant Profitability
- Improve Maintenance Efficiency

**Key Users**

- Engineer
- Maintenance Technician
- Operator

**Key Technologies**

- Intel. Sensing
- Analytics
- AI
Soft Sensing: Create real-time virtual sensors by inferring from other parameters

**Description**

- Real-time virtual sensors based on analytics-driven solution and first principles models.
- Pulls in data from multiple data sources (e.g. DCS, Historian, LIMS, etc.) and utilizes machine learning to develop correlations for inferring parameters.
- Acts as a second layer to validate instrument and analyzer readings.

**Key Benefits**

- Improve Operations real-time Performance and Productivity
- Improve Maintenance Efficiency

**Key Technologies**

- Intel. Sensing
- Analytics
- Modeling
- AI

**Key Users**

- Engineer
- Maintenance Technician
- Operator
Column Analytics: Predicts a process upset in a column prior to occurrence

**Column Analytics**

**Description**

- An analytics-driven solution that is used to identify precursors to a given event (e.g. process upset).

- Pulls in data from multiple data sources (e.g. DCS, Historian, LIMS, etc.)

- An Analytics software is used to develop the model to identify underlying root causes through pattern recognition and correlation development.

- Serves as a predictive advisory tool to anticipate process upsets and proactive corrective actions.

**Key Benefits**

- Predict process upsets
- Improve Operations Performance

**Key Users**

- Engineer
- Operator

**Key Technologies**

- Intel. Sensing
- Analytics
- Modeling
Prescriptive Analytics for Process Optimization: Optimizes process performance and reduces process variability

Process Optimization

Description

• An analytics-driven solution which optimizes the process performance and reduces the process variability.

• Pulls in data from multiple data sources (e.g. DCS, Historian, LIMS, etc.) and leverages prescriptive analytics to suggest best actions by considering multiple optimization scenarios (e.g. maximize production, quality, yield).

• Enables the process control philosophy to move from reactive management to proactive and forecast-driven intervention.

Key Benefits

• Improve Asset Utilization
• Increase Plant Profitability
• Improve Operations Performance and Productivity

Key Users

• Engineer
• Operator

Key Technologies

• Intel. Sensing
• Analytics
• Modeling
Product Demand Forecasting: Uses advanced analytics and modeling to analyze the factors impacting product demand

**Description**

- An AI-driven forecasting solution which uses advanced analytics and modeling to analyze the factors impacting product demand (e.g. weather, market price, historical sales, etc.) and simulates multiple demand scenarios.

- The solution generates a forecasted plan months in advance.

- Leads to optimized production plans for the forecasted products.

**Key Benefits**

- Improve Demand Visibility
- Improve Planning
- Increase Profitability

**Key Users**

- Planner
- Marketing Representative

**Key Technologies**

- Intel. Sensing
- Analytics
- Modeling
Plant Safety Monitoring: Leverages the monitoring applications to enforce safety discipline in the plant

**Description**

- An integrated solution which leverages the monitoring applications to enforce safety discipline in the plant.
- Comprises of video cameras installed in fixed positions with the aim to monitor the movement of personnel and machinery in the plant.
- The real-time video feed is integrated with an analytics engine that autonomously detects and reports safety risks (e.g. Proper PPE)

**Key Benefits**

- Improve Compliance
- Improve Response Time and Issue Resolution

**Key Users**

- Safety Officer
- Industrial Services Rep.

**Key Technologies**

- RPA
- AI
- Analytics
- Intel. Sensing
Localization Potential of AI & Big Data

- **Hardware**
  - Servers
  - Storage units
  - Sensors
  - High Performance Computing (HPC)
  - Graphics Processing Units (GPU)

- **Connectivity & system integration**
  - System integration
  - System connectivity and networks

- **Software/Platform**
  - Advanced Analytics and AI Software and Platforms.
  - Computer Vision Solutions.
  - Edge AI

- **Services**
  - Development and deployment of advanced data analytics solutions
Localization Potential of AI and Big Data

Support/Maintenance/Training Services

• Provide on-site support to ensure solutions/applications/systems integrity and health
• Provide needed maintenance and fine-tuning services to models, solutions, and systems
• Provide standard and customized training
• Develop user capabilities to utilize the solutions
Mobility
Market for Mobility in KSA is expected to grow at ~11% to reach a value of $780MM by 2025

KSA Projected Spend in Mobility
USD Millions
(% per year)

<table>
<thead>
<tr>
<th>Year</th>
<th>Spend (USD Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>414</td>
</tr>
<tr>
<td>2020</td>
<td>460</td>
</tr>
<tr>
<td>2021</td>
<td>512</td>
</tr>
<tr>
<td>2022</td>
<td>569</td>
</tr>
<tr>
<td>2023</td>
<td>633</td>
</tr>
<tr>
<td>2024</td>
<td>704</td>
</tr>
<tr>
<td>2025</td>
<td>783</td>
</tr>
</tbody>
</table>

Source: Aramco Team
Mobile Solutions Have Several Applications Within Oil And Gas

Enterprise Apps

BYOD & Company-Owned

- Industrial Security
- Supply Chain
- Training
- IT
- Finance
- HR

Field Apps

Intrinsically Safe Devices

- Plant Maintenance
- Truck Inspection
- Oil & Gas Operations
- Navigator for ArcGIS
- Marine Inspection
- Safety

© Saudi Arabian Oil Company, 2020
Customer Portal: Serves as a primary point of information exchange between Saudi Aramco and its customers

**Application Description**

- A collaborative application which serves as a primary point of information exchange between Saudi Aramco and its customers.
- Allows customers to access their profile and view the details of their requested products and services (e.g. orders placed, lifting schedule).
- Allows partners and third party providers to quickly respond to business opportunities.

**Key Benefits**

- Enhanced Collaboration
- Improved Order Placement Efficiency

**Key Users**

- Customers
- Sales Representative
- Marketing Representative

**Key Technologies**

- Mobility
- RPA
Automate Mobile Development: Transforms the Traditional mobile applications development life cycle

**Automate Mobile Development**

**Description**

- A solution which allow customers to develop their own mobile applications without requiring the technical skills
- Automate mobile development can be applied across the business, especially in operations and maintenance where engineers are required to fill standard forms and submit the data to a centralized server.
- Availing this capability will transform the business and produce great productivity solutions with minimum time-to-market (TTM)

**Key Benefits**

- Enhanced time to market (TTM)

**Key Users**

- All Employees

**Key Technologies**

- AI
- Mobility
- Modeling
Digital Permit: Automates the work permit generation and approval workflows

**Digital Permit**

**Description**

- An electronic application which automates the work permit generation and approval workflows.
- Enables the field technician to raise a work permit request after providing all the required details (e.g. location, operating area, type of work to be performed).
- Using predefined workflows, the solution routs the permit to the designated personnel for approval using a connected device.

**Key Benefits**

- Faster Work Permit Processing
- Improved Work Permit Execution

**Key Users**

- Engineer
- Maintenance Technician
- Operator

**Key Technologies**

- Mobility
- RPA
Digital Library: Links all operational documentation such as procedures, OEM manuals, standards and others in digital format

**Digital Library**

**Description**

- An online repository which links all operational documentation such as procedures, OEM manuals, standards and others in digital format.

- Creates a standardized taxonomy across all assets to allow for easy and secure browsing, edits, and change management.

- Constitutes the basis for building smart recommendation engines that correlate knowledge assets with real-life events, and is exposed through a variety of channels from mobile, to AR/VR headsets, and PCs.

**Key Benefits**

- Improved Compliance
- Better Knowledge Transfer

**Key users**

- All Employees

**Key Technologies**

- VR / AR
- Mobility
# Digital Learning: Unified eLearning application across Saudi Aramco accessible by all employees and contractors

## Description

- A unified eLearning application across Saudi Aramco which is accessible by all employees and contractors.

- With a single point of access, users can enroll and complete their required trainings and courses (e.g. plant operators access trainings dedicated to the use of machines - HSE employees access safety trainings).

- The eLearning system stores all the content in a centralized location and keeps track of individual progress through personalized reports.

## Key Benefits

- Better Knowledge Transfer
- Improved Training Effectiveness

## Key Users

- All Employees

## Key Technologies

- Cloud
- Mobility
Gaps in Mobility Services in Kingdom

- Field & Productivity Apps
- Cloud for Mobility
- Testing & Analytics Tools
- Development Expertise
- Training
- Mobile Management
- Industrial Network
Localization Potential of Mobility

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Connectivity &amp; system integration</th>
<th>Software/Platform</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>No local manufacturer of mobile devices. There is some potential for local manufacturing.</td>
<td>Configuring mobile applications and integrating with existing systems and data sources can be done locally.</td>
<td>Potential for building field/industrial and enterprise mobile apps</td>
<td>High potential for localizing the development of mobile applications</td>
</tr>
<tr>
<td>Potential in localizing the network and wireless infrastructure.</td>
<td>Potential to enhance services to cater to analytics applications</td>
<td>Potential for customizing mobile platforms in KSA</td>
<td>Support for mobile hardware and software can be done in KSA</td>
</tr>
<tr>
<td></td>
<td>Potential expansion of Cellular and Wifi coverage for field operations</td>
<td>Potential for building mobile apps testing software</td>
<td>High potential for localizing training of mobile application development</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Potential for localizing mobility solutions UX and UI design</td>
</tr>
</tbody>
</table>

© Saudi Arabian Oil Company, 2020
Robotics & UAV
UAV & Robotics Spend is Projected to Double Every 3 Years

KSA Projected Spend in UAV & Robotics
USD Millions (% per year)

- Smart city initiatives, such as NEOM, will drive the growth of robotics at 30% CAGR, compared to 20% globally.
- Robotics are expected to increase in spend, especially with advancements in AI.
- Healthcare has been a leader in adopting robotics in KSA, from surgical to physiotherapy applications. Manufacturing is expected to drive growth to enable digital workforce.

Sources: Accenture Research, IDC KSA IT Spend 2019
Focus Areas

- Robotics
- Quad Copter
- Fixed-Wing
- Subsea
- ROV/Swimmer
- AUV
- Ground
- Crawler/Cleaner
- Legged

Saudi Aramco: Public
© Saudi Arabian Oil Company, 2020
Applications

- Environment Monitoring
  - Gas detection | Wild life | Agriculture

- Enhance Safety & Security
  - Emergency Responses | Confined spaces

- Operational Efficiency
  - Inspection | surveillance | Automation

Robotics Solutions

Resolve Challenges and Create Opportunities
# Remote Ground Robot: Autonomously Scout Operating Facilities and Communicate Data wirelessly

## Remote Ground Robot

**Description**

- A robot-based solution which autonomously scout operating facilities.
- Autonomous robots can communicate data wirelessly and send alerts.
- Ground robots are capable of identifying issues such as leaks, overheating, structure damage.

## Key Benefits

- Improve Asset Integrity
- Enhance Safety Health and Environment
- Optimize Facilities Operations

## Key Technologies

- Intel. Sensing
- Robotics
- AI

## Key Users

- Environment Coordinator
- Plant Inspector

© Saudi Arabian Oil Company, 2020
UAV-Based Ultrasonic Testing: Measures Metallic Structure Thickness Using UAV

**Description**

- A UAV-based solution which conducts UT for elevated structures.
- UT-UAV allows for safer and faster NDT by eliminating the need for scaffolding.
- UT-UAV enables inspectors to conduct the UT testing as required by international standards.

**Key Benefits**

- Enhance safety of Inspectors
- Optimize Inspection Activities

**Key Users**

- NDT Coordinator
- Plant Inspector

**Key Technologies**

- Intel. Sensing
- Robotics
Hydrocarbon In-service Tanks Inspection Robot: Inspects Tanks Bottom Plate While It is still in-service

**In-Service Tank Inspection Robot**

**Description**

- A robot-based solution which is intrinsically safe and can conduct NDT for bottom plates for hydrocarbon tanks.
- Capable of navigating around the tanks bottom plate through hydrocarbon products.
- This Robot eliminates shutdowns that are required to conduct inspection activities.

**Key Benefits**

- Optimize T&I Activities
- Enhance Operation Efficiency
- Improve Environmental Protection

**Key Users**

- NDT Coordinator
- Plant Inspector

**Key Technologies**

- Intel. Sensing
- Robotics
### Localization Potential of Industrial Robotics and Automation

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Connectivity &amp; system integration</th>
<th>Software/Platform</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Very limited local manufacturers of Drone and Robotics in KSA. Strong potential for local manufacturing.</td>
<td>• local companies provide system integration in Robotics.</td>
<td>• Potential to localize software developer in KSA. Open software platform such as robotic operating system (ROS) and associated platforms has high potential to be localized.</td>
<td>• Limited presence of players offering Drone and Robotics services in KSA.</td>
</tr>
<tr>
<td>• Potential growth of Anti-Drone development and manufacturing.</td>
<td>• local companies manufacture/integrate Anti-Drone systems.</td>
<td>• Potential growth of AI for Drone/Robotics solutions.</td>
<td>• local training and certifications for industrial users.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• local repair &amp; maintenance for Drone and Robotics</td>
</tr>
</tbody>
</table>
Additive Manufacturing
3D Printing is a Strategic Tech for Integrated Supply Chain

KSA Projected Spend in 3D Printing
USD Millions
(% per year)

Key Observations & Takeaways

- 3D Printing will play a key strategic role in building an integrated supply chain for the energy industry
- Aramco expected to account for more than 50% from KSA Projected Spending.

Sources: Accenture Research, IDC KSA IT Spend 2019
The 3D Printing Ecosystem Consists of Several Aspects Including Scanning, Software, and Service Bureaus

3D Ecosystem

3D scanning facilitates customization and reverse engineering by generating CAD files from physical objects.

Service bureaus enable organizations to 3D print with minimal risk and no capital investments on hardware.

Includes part design, print optimization, and digital simulation software.

Provides open-source and paid access to design files developed by hobbyist and design engineers.
Spare Parts Printing: Sources asset spare parts internally by leveraging 3D Printing technologies

**Description**

- An advanced 3D printing solution which allows Saudi Aramco to digitalize spare parts to outsourced to certified AM manufacturer. Leveraging OEM or local design offices to develop 3D CAD asset models, spare parts can be ordered for 3D printing, reducing lead time to avail demand.

- While 3D printing can help reduce turnaround times and reduce overall procurement material costs, it also unlocks advanced engineering design capabilities, otherwise unachievable through traditional manufacturing procedures.

**Key Benefits**

- Improve Procurement Performance
- Improve Asset Lifetime and Utilization
- Reduce Inventory
- Improve Machine Performance and Efficiency

**Key Users**

- Engineer
- Procurement Representative

**Key Technologies**

- Modeling
Localization Potential for Additive Manufacturing

- Limited near term potential as designs would usually be done by a small central team overseas.
- No manufacturing of metal powders anywhere in the Middle East.
- Limited availability of high performance polymers such as PEEK.
- No manufacturing of 3D printers exists today in KSA or the Middle East.
- Potential to enhance existing connectivity to meet 3D printing requirements.
- No manufacturing is capable to validate and test metallic and nonmetallic printed parts in KSA.
- Limited presence of players manufacturing 3D printed products or offering 3D printing services in KSA.
- All services providers currently are limited to plastic and prototyping capabilities.

Source: Desktop research, Saudi Aramco analysis
Focus Areas
Market for AR/VR is expected to grow at ~25% to reach a value of $700MM by 2025

**KSA Projected Spend in AR/VR**

*USD Millions (% per year)*

<table>
<thead>
<tr>
<th>Year</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>150</td>
<td>200</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>600</td>
<td>700</td>
</tr>
</tbody>
</table>

**Key Observations & Takeaways**

- AR/VR spend has been driven by entertainment, training applications, and manufacturing.
- AR/VR is expected to help O&G and manufacturing companies enhance personnel safety through remote maintenance operations, remote emergency management, and enhanced training to ensure high skill levels.

Sources: Accenture Research, IDC KSA IT Spend 2019
Connected Assistance: Connects field workers to their supervisors or to AI-enabled bots

**Description**

- A solution which connects field workers, seeking assistance with specific activities, to their supervisors or to AI-enabled bots.

- Enables the assisting party to have a real-time video feed of the situation on the ground, and the assisted party to interact and obtain instructions via voice and/or video over a hands-free medium such as smart glasses.

**Key Benefits**

- Improve Operations Performance and Productivity
- Better Error Avoidance
- Better Knowledge Transfer

**Key Users**

- Engineer
- Maintenance Technician
- Operator
- Safety Officer
- Security Officer

**Key Technologies**

- Mobility
- AR/VR
- AI

© Saudi Arabian Oil Company, 2020
Warehouse Digital Guide: Assists warehouse operators in locating and retrieving material on the floor more effectively

**Description**

- A mobility-based solution which assists warehouse operators in locating and retrieving material on the floor more effectively.

- GPS-enabled augmented reality devices, integrated with warehouse databases (e.g. material properties, storage location, quantities), guide users to the material’s location and allow them to scan tags and obtain more information directly.

- Based on AR glasses, this handsfree environment increases the warehouse operator’s agility and productivity

**Key Benefits**

- Enhance Collaboration
- Better Error Avoidance

**Key Users**

- Logistics Coordinator
- Warehouse Operator

**Key Technologies**

- Mobility
- VR / AR
Virtual Training: Offers interactive trainings that are built in a virtual environment

**Virtual Training**

**Description**

- A VR-driven solution which offers interactive trainings that are built in a virtual environment and allows for a 3D visualization of events and real-time reaction to user input.

- Virtual training scenarios are built for different trainings across departments and unlock 2 key benefits:
  1. Lower cost of recreating scenarios with physical space;
  2. Higher effectiveness of training due to superior visualization effects and interactive technology

**Key Benefits**

- Improve Training Effectiveness

**Key Users**

- All Employees

**Key Technologies**

- VR/AR
- Modeling
Digital Twin: Simulates every plant asset in real-time within a virtual environment

**Description**

- A dynamic digital replica of the plant where every asset is simulated in real-time in a virtual environment.
- Allows the visualization and analysis of different scenarios without interrupting the ongoing plant operations.
- All changes done on the physical plant are reflected in its digital replica in real-time.
- Acts as an innovation testing bed within a risk-free environment.

**Key Benefits**

- Improve Maintenance Efficiency
- Improve Operations Performance and Productivity

**Key Users**

- Engineer
- Maintenance Technician
- Operator

**Key Technologies**

- Intel. Sensing
- Analytics
- Modeling
Saudi Aramco: Public

Localization Potential of Mobility

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Connectivity &amp; system integration</th>
<th>Software/Platform</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>• No local manufacturer of AR/VR devices. There is some potential for local manufacturing.</td>
<td>• Configuring mobile applications and integrating with existing systems and data sources can be done locally. • Potential to enhance services to cater to analytics applications • Potential expansion of Cellular and Wifi coverage for field operations</td>
<td>• Potential for building field/industrial and enterprise immersive apps • Potential for customizing virtual reality platforms in KSA • Potential for building AR/VR apps testing software</td>
<td>• High potential for localizing the development of AR/VR applications • Support for AR/VR hardware and software can be done in KSA • High potential for localizing training of AR/VR application development • Potential for localizing AR/VR solutions UX and UI design</td>
</tr>
</tbody>
</table>
iktva Support
iktva Program Provides Various Support to Investors

**Investment Screening**
- Evaluate, screen, and assess investment against Saudi Aramco iktva requirements.
- Provide support on localization plans.

**Business Plan Development**
- Guide and support the investor’s business plan with technical expertise, demand information, industrial land, funding referrals

**Due Diligence**
Support investors in commercial licenses and technical qualifications, such as:
- Investment license
- Industrial license
- Acquisition of funds
- Acquisition of land
For More Details

Contact the IR 4.0 Localization Team:

Ahmed A Al-Faleh
Industrial Development & Strategic Supply Department
Saudi Aramco
Falehaa@aramco.com

Hiba A Alajeeb
Industrial Development & Strategic Supply Department
Saudi Aramco
Hiba.Alajeeb.1@aramco.com

Sultan F Alotaibi
Industrial Development & Strategic Supply Department
Saudi Aramco
Sultan.Otaibi.33@aramco.com

We invite you to engage with us and send us your Expression of Interest via https://iktva.sa/opportunities