Agile Hydrographic Survey Operations: A Focus on Saudi Aramco

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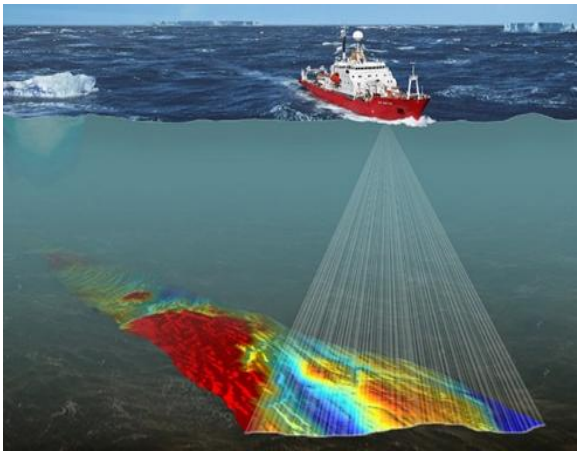
Saudi Aramco, one of the world's leading energy companies, is renowned for its vast operations in the exploration, production, and distribution of oil and gas. Given its prominence, Saudi Aramco's projects span a wide range of environments, from offshore oil fields to shallow marine regions, necessitating precise and efficient hydrographic survey operations. Saudi Aramco's offshore operations are supported by an extensive infrastructure network, including approximately 100 offshore platforms, six offshore gas-oil separation plants, and hundreds of kilometers of subsea pipelines and cables. This infrastructure is continually expanded and upgraded to maintain field potential and replace aging components. The ability to remain agile and adaptable in this highly dynamic field is critical, especially in regions where environmental conditions and technological advancements rapidly evolve. This article explores how adopting agile principles can enhance hydrographic survey operations within Saudi Aramco, ensuring precision, safety, and innovation.

I. WHY AGILITY IS CRUCIAL FOR SAUDI ARAMCO'S HYDROGRAPHIC SURVEYS

1. Diverse and Challenging Environments



Saudi Aramco's offshore operations are conducted in challenging environments and spanning the kingdom's coastline from the Arabian Gulf to the Red Sea. These areas are subject to rapid changes in weather, tides, and underwater topography, making traditional, rigid survey methodologies less effective. In particular, the shifting nature of sediment, coral reefs, and underwater geological formations in the Arabian Gulf necessitates flexibility in survey approaches.

Agility in hydrographic surveys enables Saudi Aramco to respond swiftly to unforeseen challenges in real time. As an example: scouting uncharted areas is a must prior to start of the survey, allowing a correct survey method and equipment type to be deployed. A few cases in the northern fields of the company's concession areas, a mixed survey operation between the mother vessel and her survey launch were carried out to mitigate challenging nature of the survey areas. When underkeep clearance becomes a safety concern but deploying a small boat was not an option, modifying the survey line patterns, or re-focusing the area of interest for data acquisition has proven to be effective in achieving the survey objectives. Another example, if survey teams encounter unexpected shallow water or varying currents, an agile approach allows them to pivot quickly, alter survey methodologies, or deploy modern technologies to ensure accurate results. This adaptability is crucial to ensure that operations continue smoothly without delays, thus optimizing Saudi Aramco's offshore exploration, infrastructure development, and environmental monitoring efforts.

2. Technological Integration and Innovation

As Saudi Aramco continues to leverage cutting-edge technologies in its hydrographic surveying operations, remaining flexible becomes crucial. The company uses advanced tools such as autonomous underwater

vehicles (AUVs), multibeam sonar systems, and real-time data processing software to gather critical information about the seafloor and marine ecosystems. To remain competitive in a fast-evolving technological landscape, Saudi Aramco's survey team embraces adaptability by integrating innovative technologies quickly and efficiently. This allows them to diversify data acquisition tools considering location requirements, enhance their survey accuracy, reduce operational costs, and minimize risks. Capitalizing on AI technology, the company is undertaking intensive digital transformations on all fields including the offshore. A dynamic approach also enables the company to be proactive in testing and adopting new methods such as Artificial Intelligence (AI) for data analysis and automatic seabed identifications & classifications, Machine Learning (ML) to predict seabed conditions, and bathymetric lidars for location assessments.

3. Operational Efficiency and Cost-Effectiveness

The scale of Saudi Aramco's projects means that hydrographic surveys often involve large teams and resources. However, traditional survey methodologies and team rotations can lead to inefficiencies and increased costs if they are not flexible enough to respond to on-the-ground realities. Agility allows Saudi Aramco's survey teams to optimize resource allocation, reduce downtime, and avoid unnecessary expenditures by adopting a dynamic approach to project planning.

To support the oil and gas industry, Saudi Aramco has a pool of seabed surveys that must be completed within a set timeframe over the entire Saudi Aramco's concession areas. When certain areas are badly affected by adverse weather, agile relocation of offshore survey resources to less affected areas within a very short timeframe, has enabled the reduction or prevention of survey production downtime. This flexibility ensures the surveys continue on schedule, reducing financial losses and improving overall project timelines.

4. Regulatory Compliance and Client Expectations

Saudi Aramco operates within a highly regulated environment, where compliance with national and international standards is essential. Regulatory requirements, environmental assessments, and health and safety protocols often evolve during a project. The ability to adjust to these changes quickly and efficiently is vital.

For instance, environmental monitoring may require survey adjustments as added information about marine life or seabed conditions emerges. Through a dynamic approach, Saudi Aramco can quickly adapt survey methodologies to meet regulatory requirements and ensure compliance, avoiding costly project delays and mitigating the risk of non-compliance.

5. Health, Safety, and Environmental (HSE) Considerations

Safety is a cornerstone of Saudi Aramco's operations, especially when conducting hydrographic surveys in challenging environments. Offshore surveys often involve complex logistical coordination, and the risk of accidents or safety breaches is ever-present. Versatility in safety management enables survey teams to respond to emergent hazards swiftly, such as equipment malfunctions, sudden changes in weather, or unanticipated underwater obstacles.

Safety has been into Saudi Aramco's operations from the start and communicated in a range of innovative and creative ways. All company activities are supported by a safety-first mindset that is embedded into the company's business strategies, processes and performance measures. Safety is one of Saudi Aramco's five corporate values – alongside excellence, integrity, citizenship, and accountability. An example for this, the company launched a SafeLife app allows the employees to log safety concern and, if necessary, escalate any urgent issues.

Agile teams in Saudi Aramco's hydrographic survey operations can shift focus and adjust operations to mitigate risks, ensuring that safety protocols remain robust and flexible to the specific conditions encountered. This proactive safety mindset helps protect workers and minimize disruptions to operations.

II. PRINCIPLES OF AGILE HYDROGRAPHIC SURVEY OPERATIONS FOR SAUDI ARAMCO

Saudi Aramco can leverage adaptive principles to ensure its hydrographic survey operations are efficient, safe, and adaptable. These principles can be applied across a variety of survey environments and operational contexts:

1. Collaboration over Contract Negotiation

In hydrographic survey operations for Saudi Aramco, the emphasis on collaboration fosters a more responsive and efficient workflow. Instead of rigidly sticking to a predetermined contract or methodology, agile hydrographic surveys encourage open communication between survey teams, proponent liaison, Marine SMEs, and clients.

For example, there is a general predefined work scope that our survey must be 200m by 200m around the offshore infrastructure. By understanding the primary objective, urgency and time frame, and site challenges such as shallow water or clearance requirement, the survey operations could be adjusted to the focus area only.

This collaborative approach allows for continuous feedback and adjustments. For example, if environmental conditions change during an offshore survey, survey teams can immediately discuss how to adapt their methods or equipment to optimize data collection. Involving stakeholders early and often helps ensure alignment with company's goals and enhances overall vessel outcomes.

2. Responding to Change over Following a Plan

While detailed planning remains an essential component of hydrographic survey operations, being flexible in the face of change is key to maintaining efficiency. Saudi Aramco's survey teams need to adapt to changes in the survey area, unexpected environmental factors, responding to urgent critical jobs, or new regulatory requirements. With a nimble mindset, survey teams are able to respond quickly without derailing the entire project.

For instance, should a multibeam sonar survey encounter unforeseen seafloor obstructions or tidal variations that impact planned operations, the team can respond by deploying Autonomous Underwater Vehicle (AUV), modifying survey lines, or reallocating resources to parallel tasks. This operational flexibility supports the continuity and efficiency of the overall hydrographic program, even if adjustments or delays occur within individual survey components. Such adaptability ensures that data integrity and program objectives are maintained across the broader survey scope.

The hydrographic survey team established a weekly engagement with all stakeholders to jointly identify critical jobs for the company operations and develop the weekly vessel plans. This enabled the team to maximize the utilization of resources by addressing multiple critical jobs in case the site or location was occupied by another operation.

3. Delivering Value Through Incremental Progress

Saudi Aramco's large-scale hydrographic survey projects can benefit from an incremental, results-oriented approach. Rather than waiting until the completion of the entire survey before delivering results, agile teams deliver smaller outputs at various stages. This ensures that clients and stakeholders receive timely insights, which are critical for decision-making.

For example, during an offshore oil field survey, Saudi Aramco's survey teams might provide survey reports highlighting seabed mapping data after the first phase of data collection. These interim results allow project managers to make timely decisions regarding drilling plans or infrastructure development, without waiting for the full survey data to be completed. Another example is that during a large pipeline inspection survey project across several oil fields and span more than 2 weeks to complete the data acquisition phase, interim project deliverables such as Field Reports would keep the stakeholders well informed if maintenance plans need to be adjusted.

4. Continuous Improvement

Continuous learning and adaptation are central to agile operations. In hydrographic survey operations for Saudi Aramco, teams should regularly evaluate the success of survey methodologies, equipment performance, and data quality. Retrospectives and post-project reviews enable teams to identify areas for improvement and apply lessons learned to future surveys.

For example, after completing a survey, a review might highlight the need for better calibration of survey equipment or the adoption of new software for data processing. These insights can lead to more efficient workflows, improved accuracy, and higher-quality results in subsequent surveys.

5. Simplicity and Focus

On large-scale operations like those undertaken by Saudi Aramco, focusing on the most critical tasks and avoiding unnecessary complexity is essential. A dynamic approach prioritizes delivering value through simplicity, ensuring that survey methodologies remain streamlined and effective.

For example, if a survey team is conducting a bathymetric survey in shallow waters, an agile team might decide to use lighter, more mobile equipment to simplify the process, avoid delays, and reduce costs, rather than relying on larger vessels or more complicated methodologies that could introduce delays.

III. ADDITIONAL APPROACHES TO ENHANCE AGILITY IN OFFSHORE HYDROGRAPHIC SURVEYS

1. Redundant Survey Equipment Systems

In offshore hydrographic surveys, having redundant survey equipment systems is crucial for ensuring uninterrupted operations. Redundancy provides a safeguard against unexpected failures or malfunctions of primary equipment, reducing downtime and the risk of survey delays.

- Uninterrupted Data Collection: Redundant systems, such as backup sonar systems, autonomous underwater vehicles (AUVs), and GPS devices, ensure that the survey continues even if the primary equipment fails. This redundancy minimizes the risk of disruptions and keeps data collection on track.
- Increased Reliability and Accuracy: With multiple systems available, Saudi Aramco can cross-verify survey results, increasing data reliability and improving accuracy. This is especially useful in challenging underwater environments.
- Cost Efficiency: While initial investments may be higher, redundant systems reduce costly delays and downtime, ultimately saving on overall project costs.

Saudi Aramco adopts the “plus one” strategy for its hydrographic survey equipment, whereby critical systems such as positioning units, sensors, and data acquisitions components are duplicated or backed up on-site. This redundancy ensures operational continuity by reducing the risk of downtime due to equipment failure, thereby safeguarding the overall efficiency and reliability of survey operations without compromising data quality or project timelines.

2. Adaptable Crew Rotations

Offshore hydrographic surveys often require extended operations, and having adjustable crew rotations is essential for maintaining operational efficiency while preventing fatigue and ensuring high levels of safety.

- Continuous Operations: Flexible crew rotations allow survey teams to operate around the clock without compromising performance. This ensures faster data collection and analysis, without risking safety or data quality.
- Optimized Team Performance: Regular crew rotations help ensure that workers remain fresh and capable of responding to challenges effectively. This flexibility also allows specialists to join teams as needed, improving problem-solving capabilities.

3. Continuous Communication with Stakeholders

Maintaining continuous communication with stakeholders is essential for agile operations. Whether it's clients, or internal teams, ensuring that all relevant parties are informed and aligned allows for quicker decision-making and adjustments to survey operations.

- Real-Time Updates: Keeping stakeholders informed with real-time data and progress reports helps adjust strategies promptly, ensuring the project stays on course even when unexpected challenges arise.
- Enhanced Coordination: Continuous communication prevents bottlenecks and promotes smooth operations. It ensures that teams, both on the ground and offshore, are fully aligned with the project's goals, leading to a more efficient survey process.

IV. CONCLUSION: EMBRACING AGILITY IN HYDROGRAPHIC SURVEYS AT SAUDI ARAMCO

Saudi Aramco’s hydrographic survey operations are essential to the company's exploration and infrastructure development, but they come with inherent challenges that require a flexible, responsive approach. By adopting agile principles—such as

collaboration, adaptability, continuous improvement, and the integration of advanced technologies—Saudi Aramco's hydrographic survey teams can stay ahead of the curve in a rapidly evolving industry. An agile mindset ensures that Saudi Aramco can effectively manage changing conditions, regulatory requirements, technological advancements, and environmental challenges while maintaining the highest standards of safety, accuracy, and efficiency.

By integrating strategies such as redundant survey equipment, flexible crew rotations, and continuous communication with stakeholders, Saudi Aramco can further enhance the agility of its offshore hydrographic surveys. These approaches ensure smooth operations, faster problem-solving, and more effective decision-making, helping the company remain a global leader in offshore exploration and infrastructure development.

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