Introduction, Process and Scope

This section of the DSA Roadmap report describes the launch of this initiative, the process we followed and the foundation we set under all the following sections.

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Introduction

An increasing number of technical publications describing technology advancements, new processes, and relevant case histories, clearly indicates that the oil and gas industry has developed significant interest in Drilling Systems Automation (DSA) over the past decade. Despite the well-known potential benefits of automation, a perception persists that automation in other major industries has out-paced that achieved in drilling. Reportedly, issues and barriers associated with automation in complex drilling operations, coupled with a fragmented business environment, have been responsible for inhibiting the growth of DSA.[1]

In response to a need identified during a 2012 industry workshop held in Vail, Colorado, a concerted cross-industry technology roadmap initiative was launched in June 2013.[2] The workshop was unique for the oil and gas industry in that it included 30% non-oilfield participation, which served to open new avenues of thought and discussion. The independent DSA Roadmap initiative was supported by an all-volunteer committee composed of members affiliated with three organizations interested in the development of this technology: Society of Petroleum Engineers (SPE), International Association of Drilling Contractors (IADC), and Association of Unmanned Vehicles International (AUVSI).

This effort, operating in the virtual world, delivered key content and published critical industry papers that captured stages of its progress.[3,4] In 2015, the committee recognized that delivery of the initial Phase II Stage I report would take years in an all-volunteer mode. To speed the process, a Joint Industry Project (JIP) was launched through the International Association of Drilling Contractors (IADC) Drilling Engineering Committee. The IADC committee's endorsement led to funders being progressively added until the JIP 1 reached final funding in September 2016.

Fully funded, this JIP enabled the delivery of a draft of the Phase II, Stage I roadmap report in April 2017. A funder-only, one-day workshop was held in Houston on April 6, 2017, to present the material and seek feedback from JIP participants. Overall the response was very positive, and organizers recorded some specific points for consideration in the next version. Subsequently, a JIP 2 was successfully funded to organize an industry workshop for feedback to the DSA Report Stage II version, to update the Stage II version, and to employ a professional technical editor before releasing the report to the public. These JIPs are described below.

A technology roadmap is a detailed, structured document that articulates the clearly defined objectives and technology resources required to meet specific long-term goals. It differentiates various technology elements and ties them together though a coordinated timeline that identifies when and how business value may be realized. The roadmap process developed by Sandia National Laboratories was the most appropriate for adapting to the DSA roadmap process.[5] JIP members analyzed and adjusted the process to meet the specific needs of this oil industry roadmap.

In January 2018, an industry workshop was promoted and administered in Houston by the IADC. During the workshop, DSA Roadmap challenge team leaders facilitated work groups to discuss the sections in the development process that they headed and to receive industry feedback for adoption into the report. The feedback from 90 attendees representing the spectrum of industry expertise was reported in a 33-page report, the contents of which were applied to this Stage II report update.[6]

Background

Technology roadmapping is an important tool for planning and coordinating collaborative technology across entire industries. Technology roadmapping enables improved industry investment decision-making by providing better information with which to:

- identify critical product needs that will drive technology selection and development decisions
- determine the technology alternatives that satisfy critical product and customer needs and to select appropriate technology alternatives
- generate and implement a plan to develop and deploy the appropriate technology alternatives.

At the industry level, technology roadmapping has several potential uses and resulting benefits. Three primary uses include:

- help in development of a consensus about a set of needs, and the technologies required to satisfy those needs
- a mechanism to help experts forecast technology developments in targeted areas

- providing a framework to help plan and coordinate technology developments within a single company or an entire industry.

The main benefit of technology roadmapping is that it provides information to help make better technology investment decisions. It does this by enabling industry players to identify:

- critical technologies or technology gaps that must be filled to meet product performance targets
- ways to leverage R&D investments by coordinating research activities within a single company or among alliance members.

For many years, especially during the past decade, the oil and gas drilling industry identified drilling systems automation as a key potential value driver of drilling performance, well cost reduction and well quality that leads to reduced well operational costs. Despite an industry desire to advance the application of drilling systems automation, numerous barriers must be overcome to do so successfully. An industry technology roadmap offers the means with which to gain insight that will enable the industry to overcome these barriers and to deliver the technology sooner than it could otherwise be delivered. And because it is expected to reduce well costs, in the current volatile and, relative to the past, low oil price environment, it is highly desirable that effectively implemented drilling systems automation be delivered earlier rather than later.

The DSA-R cross-industry initiative was launched in June 2013 by co-founders John de Wardt, Ed Tovar and Daniel Declute-Melacon. The aim of the initiative was to address the industry need for a common understanding of how drilling systems automation is anticipated to develop and to provide a foundation of support to accelerate implementation. This initiative was initially affiliated with the IADC Advanced Rig Technology (ART) Committee, the SPE Drilling Systems Automation Technical Section (DSATS) and the AUVSI. In Addition, affiliations were developed with Energistics and the OPC (open platform communications) Foundation.

The Process

The founders of the DSA-R undertook a review of roadmaps and roadmapping processes in domains similar to Drilling Systems Automation (DSA). The roadmapping process developed and published by Sandia National Laboratories (SNL), for unlimited release, was found to be the most appropriate example for adoption to the DSA Roadmapping process. The SNL process forms the basis of the version found in Wikipedia and is remarkably similar to the roadmap described by IEA in their guide to energy technology roadmaps.

The DSA-R process description document for this DSA Roadmap development was adopted from the Fundamentals of Technology Roadmapping report issued by the Strategic Business Development Department, Sandia National Laboratories. The DSA Roadmap development followed the DSA-R Process Description Document.

Steering Committee

The steering committee formed by the founders met repeatedly to develop the foundation and the challenges defining the segmentation of the work. The meetings were held via video conferences coordinated by the program manager using GoToMeeting. As a result of a company re-assignment, Daniel Declute-Melacon exited the program. John de Wardt, who had been leading the process, took the role of Program Manager and Ed Tovar assumed the role of Deputy Program Manager. An initial process map (Figure 1) was created from the SNL model. The superimposition of the DSA-R activities was high level and was particularly optimistic regarding time given that the program was an all-volunteer activity, in contrast to the funded processes used by the Department of Defense and others.

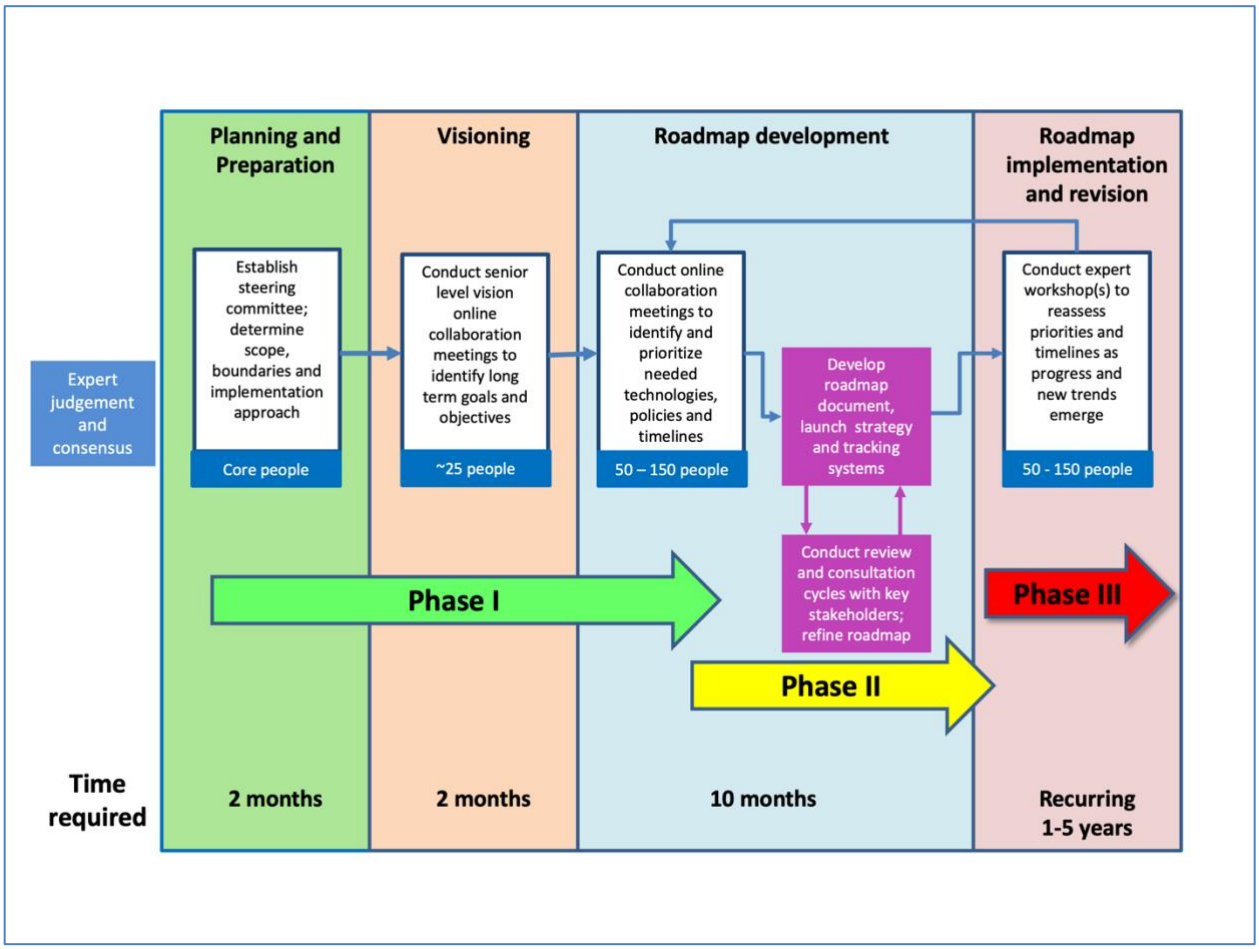

Figure 1: Original Process Map

The process map detailing Phase II was updated (Figure 2) as the steering committee worked through the phases and stages and adding the two JIPs.

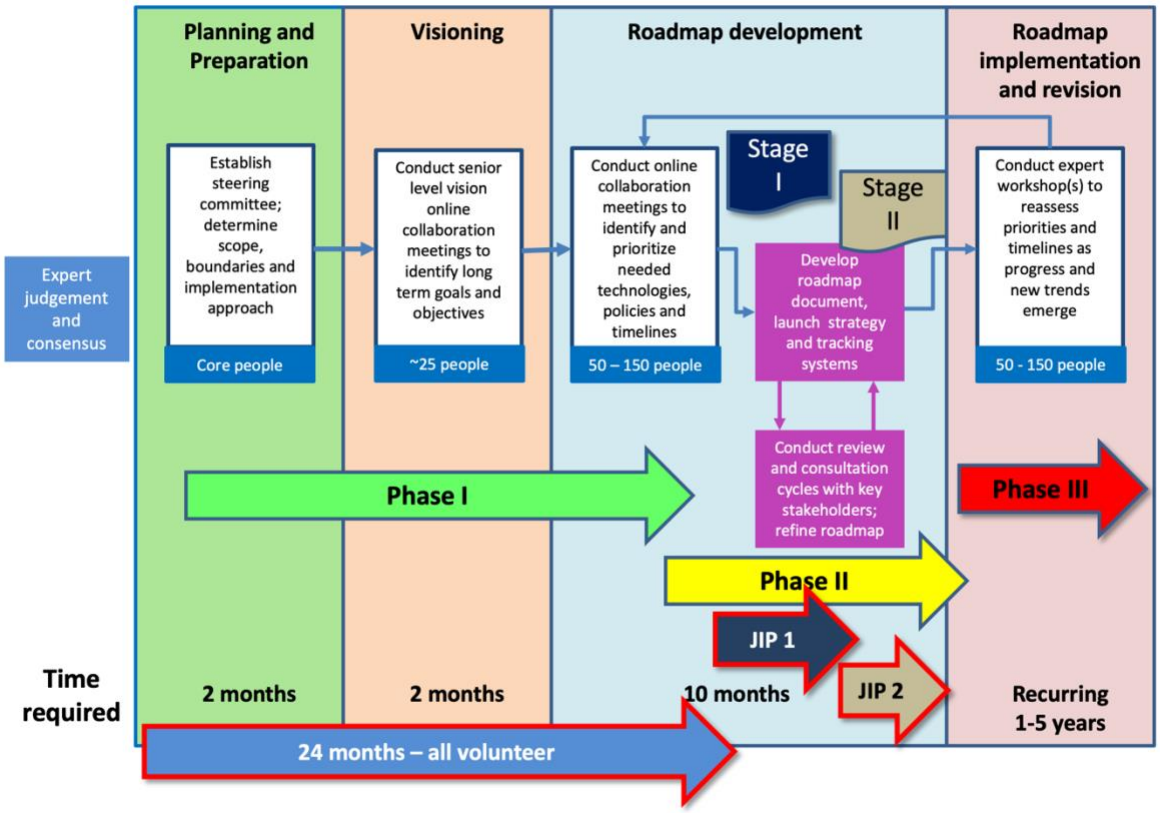

Figure 2: Updated Process Map

Phase I: Foundation Phase

Summary of Phase I of the DSA-R Industry Initiative:

- Launched all-volunteer initiative June 2013
- Identified the Sandia National Labs Technology Roadmap as best process to adapt to the DSA-R purpose
- Formed a committee of industry experts covering the necessary range of skill sets
- Affiliated to IADC ART, SPE DSATS and AUVSI
- Operate in the virtual world using video conferences, web, e-mail
- Brought on board four key, experienced advisors
- Developed the needs, visions and boundaries
- Defined eight key challenges that require mapping to effectively describe the future potential implementation of DSA-R
- Assigned a committee member to lead each key challenge and build sub-teams to work on each challenge with industry experts — globally, the total number of experts in sub-teams reached 50.

The Committee

Program Manager: John de Wardt, DE WARDT AND CO
Deputy Program Manager: Ed Tovar, InTechSys (2013 – 2016)
Steering committee:

- Amanda DiFiore (Charles River Analytics)
- Blaine Dow (Schlumberger)
- Bob Moran (Halliburton)
- Calvin Inabinett (Aerodyne Industries)
- Clay Flannigan (SwRI)
- Eric Cayeux (IRIS)
- John Macpherson (Baker Hughes)
- Lindsay Voss (AUVSI)
- Mark Anderson (Shell)
- Moray Laing (SAS)
- Randy Mutch (Ensign)
- Robin Macmillan (NOV)
- Slim Hbaieb (Schlumberger)
- Terry Loftis (Transocean),
- Mario Zamora (Schlumberger)

Advisors

Significant standing and history in automation systems transformations:

- John Berra—Past Chairman Emerson Process Management—was a critical industry leader during the industrial automation process in the 1990s and a key proponent of open systems architecture during the "Fieldbus Wars."
- Eric Nettleton—formerly Rio Tinto—was a key technology manager during development of the autonomous mine application in Western Australia, known as Mine of the Future™.
- Tom Sheridan—American Professor of Mechanical Engineering and Applied Psychology Emeritus at the Massachusetts Institute of Technology—is a pioneer of robotics and remote-control technology with emphasis on Human Systems Integration.
- Luca Save—PhD in Human Computer Interaction and Cognitive Ergonomics—has been working as a Human Factors and Safety R&D expert since 2004, with emphasis on safety critical systems, including air traffic management, railway transport, and clinical risk management. He plays a key role in the European air traffic management modernization program.

Affiliates

Multiple institutions joined this endeavor through affiliation, creating a broad footprint of connectivity while remaining institution agnostic, which enabled participation with all:

- IADC ART
- SPE DSATS
- AUVSI
- Energistics
- OPC Foundation

Phase II: Development Phase & Joint Industry Project

To develop their outlooks, challenge teams worked under the guidance of the program manager and the steering committee. Each challenge team reported back to the steering committee progressively as each advanced at different rates.

Phase II commenced with industry interaction as limited parts of the roadmap were released to the industry. These activities included:

- well received 2014 workshops held through IADC at IADC World Drilling (69 attendees) in Vienna and IADC ART Conference Galveston (133 attendees)
- a published paper SPE/IADC Paper 173010, "Drilling Systems Automation Roadmap–The Means to Accelerate Adoption" at the 2015 Drilling Conference in London
- publication of two papers at the 2016 IADC/SPE Drilling conference in Ft. Worth: paper IADC/SPE 178814, "Systems Architecture and Operations States for Drilling and Completion: The Foundation to Real Performance Measurement and Drilling Systems Automation" and paper IADC/SPE 178841, "Human Systems Integration–Key Enabler for Improved Driller Performance and Successful Automation Application."

The abstract of paper SPE/IADC 173010 was ranked number 1 of the 504 abstracts submitted for the IADC/SPE Drilling Conference and served to demonstrate the strong industry interest in this work and in quality deliverables by the DSA-R committee.

The rate of DSA-R progress was intentionally accelerated through the creation of a Joint Interest Project (JIP) funded by 10 companies (Figure 3). This funding enabled an earlier delivery of this report than otherwise would have been possible. A draft of the Phase II Stage I report was made available to the JIP funders in April 2017. The positive feedback enabled the launch of JIP 2 (Figures 2 and 4), which provided the funds to continue through to a professionally edited and publicly released Phase II Stage II report. Stage II included an industry workshop in January 2018 at which the DSA-R challenge team leaders presented their work and work groups debated and provided feedback for the Stage II report.

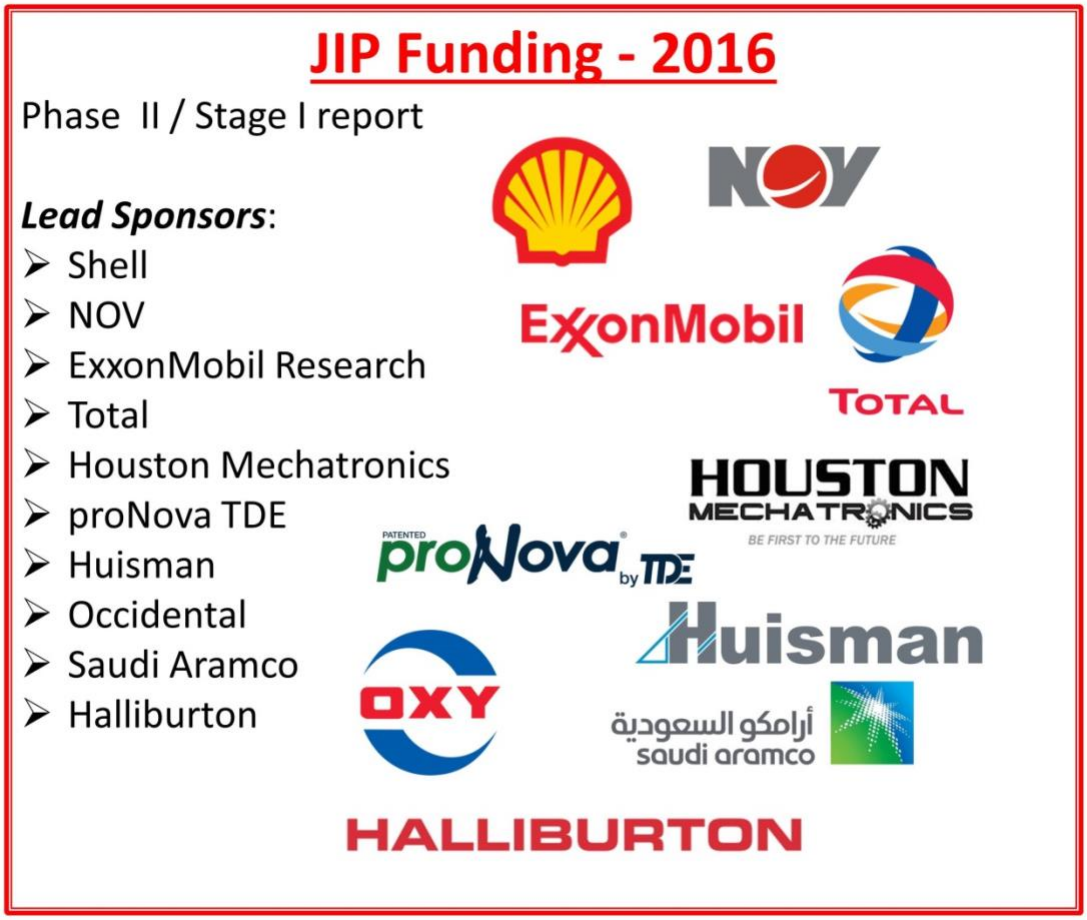

Figure 3: Funding Companies in JIP 1

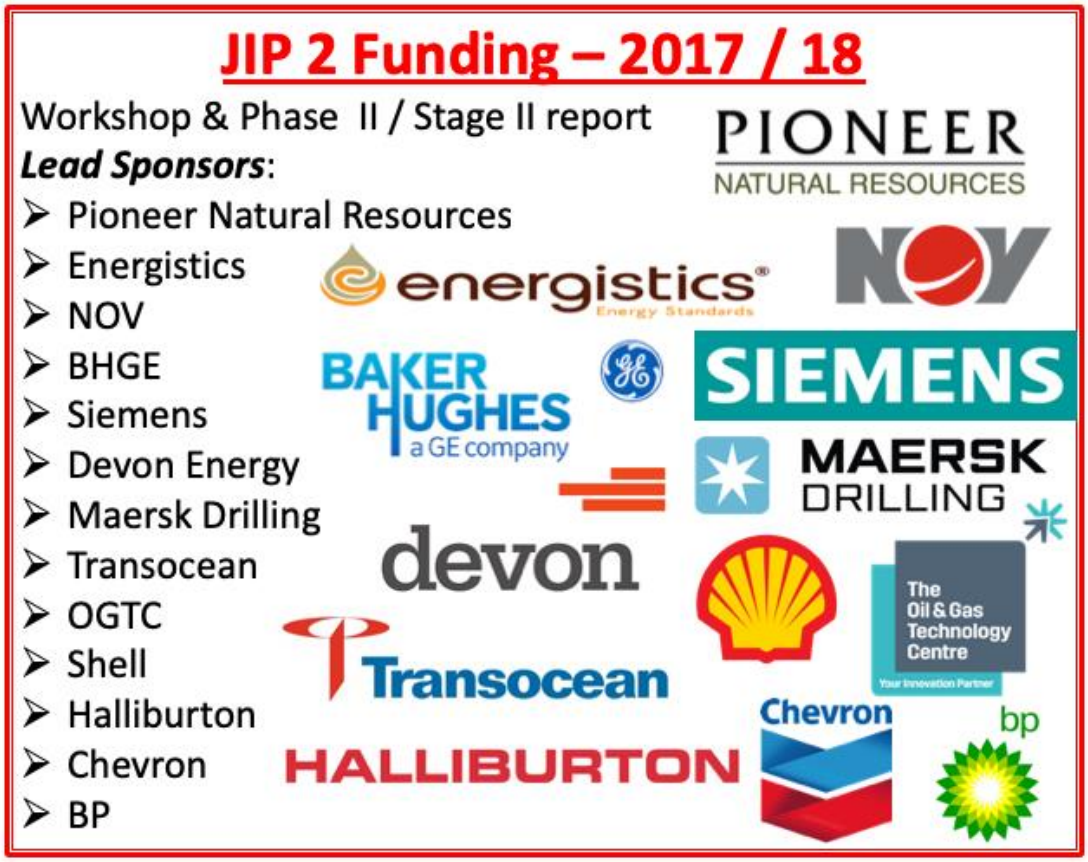

Figure 4: Funding Companies in JIP 2

Purpose, Scope and Boundaries

Technology roadmaps are guided by basic tenets defined in the earliest stages of development: the purpose of the roadmap and the vision it is intended to address, its scope, and its boundaries.

- *Purpose*

  The purpose of this document is to describe a vision for Drilling Systems Automation (DSA) and to describe the steps that can take the industry forward and enable it to affordably achieve this vision. DSA has attracted a significant amount of industry interest as a technology advance that can lead to increased drilling efficiency and wellbore quality, reduced human exposure to risks and fewer personnel required for operations. Because it is a complex operation, delivering on the promise of DSA requires a roadmap that describes the interrelations in drilling and that shows how automation can advance to deliver the intended value. This roadmap establishes a vision for DSA in 2025 and outlines major aspects, from technology to human systems integration, on which the industry should focus for timely effective adoption.

- *Scope*. The DSA roadmap addresses the full range of drilling operations and wells at a high level, termed the 'Reference Architecture,' which provides a framework for industry cooperation. This framework forms an umbrella over actual DSA implementation at the 'Solutions Level,' where innovation and competition thrive. The scope includes the full cycle, from spud to completed well ready to be connected and put on stream, and for all drilling operations and well types. The range of activities envisaged includes well planning and risk assessment and the full breadth of applications including:
  - instrumentation
  - surface mechanical systems
  - downhole systems
  - interoperability among sensors, tools and equipment
  - remote centers
  - human systems integration
  - decision processes inherent in drilling.

- *Boundaries*. Location construction (seabed surveying) and the arrival and installation of the drilling unit have not been included in this roadmap. Although they have an impact on the rate of adoption, business models were also excluded. It is considered likely that lump sum and financially incentivized drilling operations will be accelerators of the application of DSA, owing to elements of DSA that are related to rate of penetration (ROP) optimization, reduction of onsite personnel through application of advanced well bore steering, and the recent advent of a major service company program to purchase a range of relevant companies and invest heavily to implement a fully integrated DSA program called "Rig of the Future™".

References

[1] Macpherson JD, de Wardt JP, Florence F, Chapman CD, Zamora M, Laing ML and Iversen FP: "Systems Automation: Current State, Initiatives and Potential Impact," paper SPE 166263, presented at the SPE Annual Technical Conference and Exhibition, New Orleans, Louisiana, USA, September 30–October 2, 2013.

[2] de Wardt JP, Behounek M, Chapman C, Putra D: "Drilling Systems Automation - Preparing for the Big Jump Forward," paper SPE 163422, presented at the SPE/IADC Drilling Conference, Amsterdam, The Netherlands, March 5–7, 2013.

[3] de Wardt JP, Inabinett E Jr, Laing, ML, Macpherson JD: "Architecture and Operations States for Drilling and Completion: The Foundation to Real Performance Measurement and Drilling Systems Automation," paper IADC/SPE 178814, presented at the IADC/SPE Drilling Conference and Exhibition, Fort Worth, Texas, USA, March 1–3, 2016.

[4] de Wardt JP, Sheridan TB, DiFiore A: "Human Systems Integration: Key Enabler for Improved Driller Performance and Successful Automation Application, paper SPE 178841, presented at the IADC/SPE Drilling Conference and Exhibition, Fort Worth, Texas, USA, March 1–3, 2016.

[5] Garcia ML and Bray OH: "Fundamentals of Technology Roadmapping," report issued by the Strategic Business Development Department, Sandia National Laboratories. SAND97-0665 - Unlimited Release.

[6] IADC DSA Roadmap Workshop JIP Funder Report: revised and edited version released to JIP Funders December 15, 2018

