Solving E&P Mobility Needs with DecisionSpace® Mobility SDK
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Upstream Exploration and Production (E&P) Mobile Enterprise
There are myriad sources, sizes, and types of data and workflows in everything from prospecting to abandonment in upstream E&P, which together create challenges in upstream information management. These include generation, access, retrieval, usage, and archiving data to maximize value for users and the E&P company as a whole.

The varying data needs posed by deep water, unconventional reservoirs, and mature assets and the continuing trend of data explosion in every domain and data store in a company add more complexity. Both offsite workers and field teams need access to this data throughout the asset lifecycle, from seismic and geoscience workflows to drilling and production notifications across a collaborative environment. Managers and supervisors want access to data-driven asset and production reports via their smartphones. Geologists want to view and use well logs on their tablets and laptop computers in the field.

Mobility is pervasive in our daily lives through usage and presence of smartphones, tablets, and other devices. E&P enterprises have invested in a large array of devices, both within the enterprise and in their offsite facilities, to enable collaboration and decision making.

The DecisionSpace® Enterprise Platform is the only complete and open E&P platform spanning prospecting to abandonment, where teams collaborate and solve challenges by sharing data and knowledge in a secure and scalable environment. It enables enterprise mobility by providing specialized E&P Mobile applications and deployment options for mobility that enables an E&P enterprise to make unmatched decisions.

The DecisionSpace® Mobility Software Development Kit (SDK) leverages the power of DecisionSpace Enterprise Platform for developing and delivering customized mobile applications for upstream E&P. This mobility SDK leverages the DecisionSpace platform in combination with the powerful Xamarin cross-platform framework, a C#-based mobile development environment designed for creating native iOS, Android and Windows mobile apps. As a result, the DecisionSpace® Mobility SDK delivers domain-specific mobile components supported by the tremendous capabilities of a modular, open and first-of-its-kind-for-E&P platform. Halliburton used the SDK platform internally in production to create native mobile apps that showcase 3D capability and real-time E&P data. The SDK offers enormous opportunities for developers to create dynamic E&P mobile apps for a multitude of uses.

What is DecisionSpace?
Upstream E&P generates and accumulates extreme amounts of data through the lifecycle of a prospect and asset, from data acquisition to decision and archival. Within the context of subsurface computing, this data comes in various sizes, formats, standards, sources, regions, speeds, frequency, and quality. The data is used by different technology domains – geophysics, geology, earth modeling, reservoir...
“There is data everywhere in the company; however, there is limited information.”

engineering, drilling and completions, and production. The challenge is to make this data explosion available and comprehensible.

These challenges are typically addressed by a company’s business users, data and geographic information systems (GIS) managers, and the information technology (IT) organization by resorting to manual data loading and quality control, moving and duplicating data, working on smaller data sets, domain application proliferation, and enforcing governance in the form of inflexible business rules.

The DecisionSpace platform technology focusses on solving upstream E&P data challenges and enabling safe, fast, and more accurate reservoir decisions to accelerate reserves replacement and maximize asset recovery. It embraces the diverse application portfolio of a company and their need to create, develop, leverage and protect intellectual property. A company can migrate to this open and scalable platform over time, mitigating any risk while enabling them to tailor it to their growth, strategy, and operations profile.

Architecturally, the full DecisionSpace Enterprise Platform includes four key foundations. The delivery of information (Information Foundation) is done by federating domain and master data stores, providing application and data management access through an integration layer (Integration Foundation). This data is made available to the Application Foundation layer, which enables end-user visualization and deployment in a hyper-collaborative environment. Finally, a cloud-enabling and role-based dashboard layer (Ecosystem Foundation) enables knowledge review and understanding in an easily and efficiently searchable workflow structure, particularly when this requires integration across proprietary and commercial applications and extensions supporting both private and virtual private cloud environment.

As the latest addition to the Application Foundation, DecisionSpace Mobility enables the delivery of customized E&P mobile apps using the DecisionSpace platform.

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<th>Geosciences</th>
<th>Reservoir</th>
<th>Drilling</th>
<th>Production</th>
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**Ecosystem Foundation**
*Easy to Use, Easy to Deploy, Role-Based Dashboards*

**Application Foundation**
*Building & Customizing Richer E&P Applications Faster*

**Integration Foundation**
*Enterprise Class Data and Process Purpose Built for E&P Applications*

**Information Foundation**
*Comprehensive, Industry-Specific Data Management*

*Figure 1. DecisionSpace Platform foundation now supports mobile apps*
The DecisionSpace Enterprise Platform enables:

1. Information management is combined with a strategy for company-wide data stores.
2. Integration and standards adherence are enabled through a common data model and data federation.
3. Visualizations are made easily accessible in multiple deployments and modes.
4. Hyper-collaboration ensures that domain data in an application is available in real time and near-real time for visualization to other applications and domains, to form a continuous, closed-loop, cross-domain collaborative system. Mobility extends this concept to enable teams to work across environments and devices.

Mobile App Use Cases in E&P

Almost all workflows can benefit from mobility. Some E&P use-case examples might include:

1. A production officer out on the field reporting on drilling status with a tablet
2. An engineer sending in a site inspection report for an existing business process (BPM) workflow
3. An operational technician needing an alert and well data after viewing a well log curve on a mobile device to inform him or her of a mission critical change in status on the remote worksite

In each case, the need for integrating E&P data with mobile devices with is evident. Today’s operator expects full and fast data access to perform similar tasks from a smartphone or tablet. DecisionSpace Mobility SDK enables enterprises to connect to and use an open E&P-specific platform and create customized apps as well as reusable components to meet these needs.
INFORMATION MANAGEMENT & PLATFORM WHITE PAPER

**Multimedia Figures and Descriptions**

*Figure 3. Mobility is integrated into the DecisionSpace Application Foundation*

**DecisionSpace subsurface environment running both**
*DecisionSpace® Geosciences (Application Foundation)*
*and GIS from within the information management web, running together in the thick client and sharing data.*

Gulf of Mexico well data from OpenWorks® database for a field, shown on an iPad.
*(DecisionSpace 5000.10 Platform)*

**A well surveillance dashboard illustrating a web design schematic within DecisionSpace® Well Engineering (Application Foundation), where the user is responding to a query on a particular behavior in a well within the field being monitored.**

**Gulf of Mexico well data from OpenWorks® database shown on desktop and iPad.**
*(DecisionSpace 5000.10 Platform)*

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**Mobility - Extending E&P Situational Awareness and Enabling Rapid Decision-Making**

Like the Internet and web technologies that precede it, mobility is a value-add in any business workflow because of its capability to go beyond traditional closed desktop behaviors, not to replace them. In software terms, that means creating custom apps and mobile-friendly features that involve and utilize—i.e., extend—existing data, desktop workflows, and even aspects of user interfaces, from existing thick and thin client applications. Mobility offers the ability to leverage federated data access and cloud-based, back-end capabilities so that engineers and key decision-makers can have a consistent situational awareness of E&P data. In areas like well engineering and production, such knowledge can mean time and cost savings. For example, a mobile app that delivers push notification warnings when a remote drilling team reaches certain depths can deliver savings throughout the drilling process.
Added to that, the increased expectations of today's mobile, tech-savvy workers, already accustomed to personal smartphones that deliver increasingly tailored consumer oriented user experiences, makes the demand for well-designed, responsive and native-performing—that is, specifically designed for mobile use—apps, quite clear.

**Support Enterprise**

Enterprise IT departments must be prepared to rapidly deliver innovative and useful mobile applications customized to specific engineering tools and technologies. IT departments in E&P companies must also respond to mobile needs that enable complex and data-intensive engineering software to be made available through tablets and smartphones. The average E&P worker, ranging from drilling scientist to field service worker, is now expecting a mobilized environment, if not actively demanding it.

**Deliver Mobile Apps to Enterprise Apps Stores**

Mobile apps created with DecisionSpace Mobility SDK are native iOS or Android apps and can be released to standard Enterprise Mobile Device Management (MDM) or Company App stores using standard deployment processes.

**Platform Challenges – Native Apps and Native Components Delivered**

Most competing mobility platforms provide web technologies that enable HTML5 (web) or hybrid apps to be built, yet these apps are 20 to 40 percent slower and end up being more complicated to build and debug than native apps. It’s very difficult, for example, to find a responsive 3D viewer with mobile web technologies. Heavy engineering-oriented disciplines such as E&P need the ability to create native apps for such purposes and the DecisionSpace Mobility platform enables that. In addition, mobile operating systems such as the Apple® iOS, intentionally slow down the performance of web-based, hybrid apps to incentivize native development with Apple products. Native apps avoid these types of built-in performance issues and offer the most compelling user experiences.

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**Figure 4. DecisionSpace Mobility SDK high-level capabilities and features**

Figure 4. DecisionSpace Mobility SDK high-level capabilities and features
The DecisionSpace Mobility SDK

The DecisionSpace Enterprise Platform is the first E&P-specific platform for integrating workflows across multiple technologies and disciplines. Likewise, the DecisionSpace Mobility SDK gives development teams the ability to ensure workflow integration across multiple technologies and E&P disciplines. It provides third-party development teams the tools and documentation necessary to efficiently create and deploy plug-ins for the collaborative DecisionSpace platform. The DecisionSpace Mobility SDK addresses the demand for customized mobility in this E&P space.

E&P applications and data sources connected to the DecisionSpace Enterprise Platform are available to the DecisionSpace Mobility SDK. This data connectivity is possible through the DecisionSpace® Integration Server and mobile devices via a data client component. This deep integration is what distinguishes the DecisionSpace Mobility SDK from standard enterprise mobile components. Mobile applications built with this SDK gain access to the wealth of back-end DecisionSpace data sources, data models, and well-specific business logic through a federated data tier made specifically for E&P workflows.

The DecisionSpace Mobility SDK also includes dozens of components, on-device databases, and an ORM business layer for mobile devices. Full sample apps are also provided, along with data-sync and data connectors for a range of federated and service-based back-end data sources. Support is provided for OS-specific features, including push notifications and barcode scanning.

Subject matter expertise in engineering-intensive problems helped to guide design of specialized components for the SDK. For example, the native 3D object viewer component enables for the use of translated CAD objects. Such objects include those translated from COLLADA or .OBJ model formats into a mobile viewer that presents natively on an iPad or iPhone (iOS 6 or higher).
Underlying Technology

Users Demand Native App Experiences

Whether accessing past order history, checking a geosteering path, or viewing the schedule for the next meeting, the mobile users expect data to be instantly accessible in a format that takes full advantage of their devices’ capabilities. Applications that cannot meet these immediate needs simply do not get used.

Factors that may determine app usage include performance, reliability, design, and ease of use. In all of these areas, a fully native application has significant advantages over a non-native (web and platform technologies) application, including:

• Standard, native user interface controls that are used in a manner that fully conforms to each platform’s design conventions
• Hardware acceleration that delivers unmatched responsiveness
• Access to the full spectrum of functionality that is exposed

Native Capabilities

DecisionSpace Mobility apps look native, because they are native. By using this capability, DecisionSpace Mobility SDK can provide sample and test native apps (starting with iOS) that work and perform as native iPhone and iPad apps. Through the platform’s unique binding technology, developers have complete access in C# to all of the same APIs and user interface controls used to build iOS, Android and Mac apps in the respective platform’s languages. Thus, the full feature set of the mobile device’s platform is exposed, including capabilities such as face tracking, calendar integration, NFC (near-field communication) and core Bluetooth, and in the case of Apple, newer capabilities such as iBeacon. The technology supports any app use case or user experience requirement.
In addition, the binding technology underlying this SDK makes it possible for the platform provider, Xamarin, to quickly deliver support for new features as they are introduced in each supported mobile operating system. Xamarin released updates for iOS 5.0, iOS 6.0, and iOS 6.1, all within 12 hours of their public release. They provided full support for new Apple capabilities such as PassKit, and full compatibility with new device features such as the larger screen size on the iPhone 5. In the highly competitive mobile application landscape, users increasingly expect apps to support the latest features on Day One.

**Reach 2.6 Billion Devices with Existing Teams and Code**

Together, DecisionSpace Mobility SDK and Xamarin provide a frictionless glide path for migrating existing C# skills, teams, tools and code to the world’s most popular mobile platforms, making it possible to use C# to reach 2.6 billion devices. Xamarin makes it easy for any C# developer to become a mobile developer, eliminating a large amount of duplicated code. Companies that transition their existing .NET teams to Xamarin achieve mobile productivity within a matter of days.
**Application Architecture**

When building mobile applications with DecisionSpace Mobility SDK and Xamarin, best practice is to isolate core application logic in a portable layer of platform-neutral code that uses .NET frameworks and APIs. The developer can then build a separate user interface for each platform on top of the shared code, using native controls and native platform APIs that Xamarin exposes.

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**The Xamarin Approach**

- **Write apps entirely in C# with access to 100% of each platform’s APIs**
- **Deliver a device-specific native user interface while sharing an average of 75% app logic code across device platforms**
- **Compile apps as native binaries for fast performance**

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**Figure 9. Cross-Platform Approach - DecisionSpace Mobility SDK utilizes this innovative platform to connect E&P-specific data models across the mobile device landscape**

**Develop iOS Apps on Windows Development Machines Using Microsoft Development Tools and Support**

*Microsoft supported, Production-Proven Technology for Mission-Critical Apps*

By choosing Xamarin, DecisionSpace Mobility SDK enables enterprise customers to build upon a proven and innovative mobile platform. Xamarin is built on top of Mono, an open source implementation of the .NET runtime and framework class libraries and a C# compiler. Mono is highly mature, with over a decade of innovation and successful production use in a variety of environments, from embedded devices to enterprise back ends. Xamarin’s advanced compiler technology uses highly sophisticated techniques to ensure optimal performance and reliability while bringing the power and stability of Mono to iOS, Android, and Mac devices. Xamarin’s recently established, deep partnership with Microsoft indicates the degree of support for this platform as well.

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**Figure 10: C# and .NET teams familiar with .NET and Visual Studio can use familiar environments and code sharing to create iOS, Android and Windows apps all with the same solution.**

(A Mac build host is only required for compilation and simulator, and can be shared.)
Internal Success at Halliburton: mQuest

Leveraging the power of Halliburton | Landmark’s DecisionSpace Mobility SDK, the Halliburton Completion Tools group, the division’s existing desktop .NET developers created iPad and iPhone mobile apps for their tool catalog. These mobile apps enabled engineers to view and share 3D and technical specifications on over 144,000 completion tools. The DecisionSpace Mobility platform has subsequently been adopted company-wide for mobile app development.

Availability

The beta version of the DecisionSpace Mobility SDK is available in 2014 as part of an iOS-only release. Cross-platform availability of DecisionSpace Mobility is planned for 2015 introduction. Halliburton | Landmark is actively working with partners to support creation of E&P-specific components and apps for everything from well log viewers to reporting dashboards, for release to a future app store.

What is mQuest?

mQuest is a mobile application that searches the entire Halliburton Completion Tools’ saleable product list. The search function is intuitive and powerful, enabling users to compare tools via SAP, Legacy or class type. The results show engineering design specifications, bill of material, and a stunning 3D image of the tool. The data is updated in real time, and the application works in connected or in disconnected mode.

Key Features

- Search engineering data for 144,000 tools
- Access data online and offline
- Compare basic tool data
- Sort and filter search results
- View and interact with 3D models
- Retrieve bill of material data for each tool
- Store up to 400 recently downloaded 3D models on device

Figure 11. mQuest: Internal Halliburton tool catalog mobile app
This Platform’s modular approach gives E&P companies the ability to match customized workflows with business needs and deliver them to the devices and environments of their workforce.

About Landmark
Landmark’s integrated software and technology services support industry standards and encompass a complete range of information management solutions for E&P. They include the underlying data and information repositories along with the tools you need to extract knowledge from all your E&P data. From tiered solutions for master and project/operational data, to big data associated with analytics, Landmark can provide everything you need to enable cross-domain workflows and effectively solve complex business challenges.

Our goal is to help you transform your business and maximize assets by enabling the safe, fast, and accurate decisions needed to find and recover every last drop of hydrocarbons.

For more information, contact your Landmark account representative or send an inquiry to Landmark@Halliburton.com.

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