OVERVIEW

DecisionSpace® Well Planning software helps asset teams keep pace with ambitious drilling schedules in complex offshore development and in unconventional plays where planning hundreds of horizontal wells is often required. The software helps reduce well planning cycles by leveraging advanced automation techniques to quickly plan any combination of targets, pad or platform locations, and well trajectories for single wells, relief wells and field development scenarios.

The software delivers a step change in well planning efficiency by supporting a multidiscipline approach where geoscientists, well planners and drilling engineers can work collaboratively in a single application, and in the context of a shared earth model. Algorithms optimize field development plans based on user-specified cost parameters, risk and uncertainty, and degree of difficulty.

DecisionSpace Well Planning software is a module of the DecisionSpace® software suite, a unified visualization, interpretation, and modeling workspace where asset teams can collaborate more effectively to evaluate and develop assets. The software delivers a true multi-user environment with unprecedented integration across multi-domain workflows and data types—all on the award winning, data management foundation of Landmark OpenWorks® software. The DecisionSpace Well Planning software module includes the following integrated components: Single-Well Planning, Multi-Well Planning, Horizontal Targeting, and PrecisionTarget™ application.
BENEFITS

Reduced Well-Planning Cycle Time
Field development planning for offshore or unconventional assets can be reduced from months to days. Asset teams work together more efficiently in a unified 3D visualization environment, where well planning decisions are made in the context of relevant geologic, geophysical, and GIS data. Automation technology replaces cumbersome manual methods of the past.

Better Planning and Design Decisions
Cross-domain data integration and workflows ensure that planning results can draw on the combined expertise of geoscientist, well planners and engineers. Well planning in the visual context of subsurface geoscience data and known surface constraints, or hazards, can lead to more effective design. Algorithms optimize site location, well path, and target selection based on user-specified cost parameters, risk and uncertainty, and degree of difficulty. The software delivers tools to manage and rapidly analyze multiple planning scenarios.

Lower Cost and Environmental Impact
By planning complete field scenarios in a unified plan, asset teams are able to maximize drainage while reducing drilling delays and eliminating hours of rework, costly pad extensions, and unnecessary environmental impact. Advanced technology helps reduce surface area and environmental impact by optimizing well spacing and pad design. Whether developing deepwater targets or unconventional resources, the software can help drilling engineers and geoscientists rapidly iterate through field development scenarios while taking into account go and no go zones, lease lines, and hazard avoidance spacing for both surface and subsurface constraints.

FEATURES

Target Generation
DecisionSpace Well Planning software allows users to pick reservoir targets visually in the context of all geophysical and geological data, or automatically generate multiple targets against user specified reservoir characteristics. Auto-targeting can be performed in various reservoir models such as S-grids and VIP® files. Multiple target geometries are supported. Polygonal and point targets can be drawn on 3D surfaces such as seismic data, horizons, or reservoir models. Wellpath plans are recalculated automatically when targets are manipulated interactively, in the 2D or 3D views or by way of grab handles.

In complex faulted scenarios, targets and trajectories can be automatically created a specified distance behind the interpreted fault plane and a specified distance from each other. Behind the fault targeting uses grids and earth model horizons as well as the seismic horizons.

Horizontal Targeting
Developing shale and other unconventional resources often requires targeting options specific to horizontal drilling. Horizontal targets in shale, or SAGD develop-
ment, can be defined as a percentage distance between two interpreted surfaces. A minimum formation thickness parameter can be set to control both the target and the length of the generated lateral. Well spacing, heel/toe length, minimum/maximum lateral length, and lateral increment can also be specified. Seismic horizons from the OpenWorks database can now be used in the target depth specification for horizontal, producer/injector pattern or elliptical targeting.

Horizontal targeting capabilities include an orientation option to “fan” out the laterals to achieve better coverage in areas where parallel orientation would not line up well with the lease boundaries. Targets can also be based on modeled drainage area or hydraulic fracture area.

Utilizing unique positioning buffers, for deviated non-reservoir wells and horizontal reservoir wells allows maximum reservoir lateral coverage.

For areas where there are many surface constraints, the software allows well planners to create the sites, plan targets, and horizontal trajectories all in one step.

When dealing with abstract boundaries, particularly multi-edge concave polygons, the application can utilize additional patented technology to determine more than one target azimuthal direction.

Automated boundary divisioning.

**Wellpath Design**

The software delivers directional planning algorithms similar to those in the industry-standard COMPASS™ software. Well planners can create individual surface wells, sidetracks, or platform wells. Plan individual wells based on user-defined constraints such as kick-off point, dogleg severity, turn/drop rates, and inclination. Create well-paths using any combination of targets, kickoff points, or surface locations. Trajectory plans will visually change to red when any of these design constraints are exceeded while interactively dragging platforms or individual plan targets.
The software offers basic and advanced modes for automated path planning. In the advanced mode the user specifies the type of trajectories to be generated and the ranking. Complicated multi-lateral and horizontal wells can be generated to increase target coverage in slot limited environments.

With horizontal targeting, there are increased capabilities for infill planning around existing wells, by way of parameters.

Capabilities include:

- **Sidetrack net** - Visually determine where a planned sidetrack can reach by displaying a sidetrack net from a given kick-off point. A 3D representation will be drawn based on defined redline parameters. This allows for a quick determination of whether a particular horizon or target can be reached.

- **Automated hazard generation and avoidance** - Hazard areas can be manually defined in the 3D visual environment. Additionally, hazards can be automatically defined based on subsurface attributes or by specifying faults. The software will automatically avoid penetrating these areas with plans during the auto planning process. “No Go” areas can also be delineated at surface to define areas where platforms/pads should not be positioned.

- **Uncertainty** - Create and define survey tools. The software computes and displays positional uncertainty related to survey tool errors in 2D and 3D views. Error ellipses can be displayed for existing surveys as well as new plans. ISCWSA tool information can be imported from COMPASS software.

- **Scope project costs** - Estimate costs for the field development plans based on the number of platforms, number of wellpaths, and wellpath designs. The costing functionality can help establish dry hole costs, completion costs, contingency costs and drilling days. Cost estimates are automatically updated when platforms or wellpaths are modified.

Sophisticated horizontal infill techniques.
Field Scenario Planning

DecisionSpace Well Planning software delivers workflows for field level well planning, enabling asset teams to create and evaluate multiple well planning scenarios against field development objectives.

The software manages existing well planning results including scenarios for all combinations of target sets, site options, plan options, survey and tool options. Analysis considers drilling cost, degree of difficulty and anti-collision risk. The software provides diagnostics and cross plots to compare and evaluate scenario parameters down to the individual target level. Asset teams are no longer tied to a single field development plan. They can now dynamically update and optimize plans on-the-fly.

Capabilities include:

- **Scenario Builder Wizard** - Create a set of development scenarios or to modify previously created scenarios for analysis. The software creates one scenario for each combination of target, site setup, plan setup and survey setup for subsequent analysis.

- **Scenario Set Viewer** - Provides tools to view scenario results as a set of projects, compare gross values and costs, and then drill down to look at the individual scenarios; allows filtering and sorting.

- **Scenario Target Analysis** - Compare scenario results on a target-by target basis when scenarios were created with similar sets of targets or when scenarios are similar in terms of cost.

- **Diagnostics and cross plots** - Compare and evaluate scenario parameters down to the individual target level.

- **Scenario Costing** - Specify cost parameters for scenarios. Cost can incorporate parameters from actual drilling cost, degree of difficulty and anti-collision risk.
**Platform and Pad Positioning**

The software will automatically determine the optimum number of platforms or pads required for field development. Where infrastructure is in place, the user has the option to utilize existing structures for planning purposes. The technology determines the optimum origin for path plans based on existing surface locations. Users can define slot templates under a platform or pad. Plans can be assigned to slots manually or by an automated slot assignment optimization utility.

Manual site positioning methods are also available, allowing users to control the sites location, which have the ability to generate laterals or complete well design plans when picking site locations. Users may also choose to perform a click and drag, when picking a site location, to define the direction of the lateral targets.

![A click-and-drag action used to pick a site location results in painting wellbores in the viewer.](image)

**Relief Well Planning**

Relief Well Planning features can help save significant time when compiling the required data to permit deep water wells. The software offers multiple types of profile intersections including intersection depths, hazard avoidance, boundary restrictions, orientation distance and angle, reach limits, and tracking point offsets and distances. Engineering parameters such as kick off depth, dogleg severity, and maximum inclination are all taken into account. Advanced filtering techniques can easily reduce multiple results to only the most appropriate designs for review.

![Relief well planning for offshore projects.](image)
**Precise Driller’s Targets**

This technology incorporates risk and uncertainty into target generation. Initial targets are not always sized properly to account for risk or various geophysical, geological, and mechanical uncertainties. The software enables users to generate a driller’s target that considers the uncertainty related to each domain. Probability contours based on uncertainty and risk guide engineers to manually adjust plans to reduce error and increase the probability of landing within a geologic target.

Capabilities include:

• Account for geophysical data uncertainty present in processing and time/depth conversion. Geophysical uncertainties can be correlated with survey uncertainty once geological events are detected within the well.

• Determine the optimum survey program for a given plan. The ISCWSA error model is supported. ISCWSA tools can be imported.

• Define steering uncertainties for both conventional AKO directional assemblies as well as 3D steerable systems.

• Define target borders by embedding hard lines (faults), fluid contacts or similar features in the target definition to guide a refined driller’s target; invokes zero tolerance for crossing such features.

• Use geological markers to decrease the uncertainty between well and geology; relative uncertainty is incorporated into the driller’s target sizing.

• Calculate the probability of a successful geologic target intersection based on a range of parameters. Allows teams to iterate through parameter combinations to reach an acceptable probability level.

• Automatically update future targets based on positional differences between the actual well path and prior targets in the advanced target-drilling mode. The planned well path can also be corrected accordingly.

**DATA INTEGRATION**

The software is integrated with OpenWorks data stores, allowing users to store their projects in the industry’s most widely used project data store. Using existing reservoir models, users can automatically create targets and path plans then save them to the OpenWorks database.

ESRI ArcMap integration allows geoscientists and engineers to quickly view lease maps, topographic maps, cultural data, and bathymetry data to help place well sites and pads.

**APPLICATION INTEGRATION**

Field development plans can be imported directly into the Engineer’s Data Model™ (EDM™) database, where plans are immediately available to COMPASS™ software for rigorous path plan optimization including anti-collision analysis.
System and Software

SOFTWARE REQUIREMENTS

OpenWorks® 5000.0.3.0
Oracle 10g database
DecisionSpace® Base module is required

OPERATING SYSTEMS

Red Hat® Enterprise Linux®
Workstation 5.3, 64 bit
Windows® 7, 64 bit
Windows Vista, 64 bit

DATA MANIPULATION

The DecisionSpace Well Planning interface includes spreadsheet editors to assist users with data manipulation and visualization. Within the spreadsheet editors, users may easily toggle visibility or change common details of targets, plans, or sites.

Commonly used data import mechanisms have been updated with data preview panes, allowing users to easily import data without knowing the data format.

When extracting targets from geoshapers the user has the flexibility to add additional buffers on polygons and polylines. This is useful when loading data into a well planning project that might have different setback requirements.

“Decreasing the well planning cycle by 50 to 80 percent means you can spend more time looking at more drilling details and optimizing potential production.”

DRILLING TECHNOLOGIST, TALISMAN ENERGY

Landmark offers solutions to help you deliver on your business strategies. For questions or to contact your Landmark representative, visit us at landmarksoftware.com.