**DecisionSpace®**

**Dynamic Frameworks to Fill®**

Next Generation Interpretation and Mapping

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**SUPER-ACCURATE COMPARTMENT-BASED VOLUMETRICS**

**FULLY-VALIDATED, MODEL-READY FRAMEWORKS**

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**OVERVIEW**

DecisionSpace® Geoscience suite provides a full range of integrated interpretation, mapping and modeling technologies. A next generation interpretation and mapping system, Dynamic Frameworks to Fill® workflow is at the core of Landmark’s integration strategy. Its underlying technology elegantly integrates surface and fault data from geology and geophysics and automatically generates fault polygons ‘on the fly’ as part of the interpretation and mapping process. As such, Dynamic Frameworks to Fill workflow is the industry’s only system that allows interpreters to dynamically and iteratively validate their multi-surface frameworks (maps or models) during the interpretation process. When the interpretation is completed the fully validated 3D framework is immediately available for use in 3D (geocellular) earth modeling applications. Dynamically updateable frameworks are utilized within DecisionSpace Geosciences suite for many critically important workflows including: horizon mapping/framework construction, velocity modeling, well-top mapping via conformance technology (see below), geosteering and volumetric applications.

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**BENEFITS**

Framework-based interpretation workflows help interpreters identify and fix problems while they are interpreting. This eliminates rework and improves prospect and development mapping accuracy.
Dynamically updateable frameworks (and reservoir properties) allow inputs from new wells to be immediately incorporated, which keeps the overall geologic model evergreen and ready for successive well planning exercises. Rework elimination and dynamic model updating substantially improves map accuracy and overall asset team efficiency.

FEATURES

Dynamic Frameworks to Fill® Technology

A structural framework topology engine enables sealed framework construction as users interpret. Using classic map-making principles, as outlined in Tearpock and Bischke’s (2003) Subsurface Geological Mapping text book, input data is independently gridded in the context of individual fault-block domains, projected into the fault planes, and truncated. The mapping algorithms have the ability to grid surface data in the context of fault blocks. In contrast to traditional mapping algorithms, which utilize fault centerlines or hand-drawn fault polygons to denote the location of faults in their gridding algorithms, Dynamic Frameworks to Fill workflows use fault plane data to segregate surface data and then grids these data on a fault block by fault block basis. In the figure above (a) you can see horizon surface data gridded initially without a fault interpretation. In (b) faults have been added, and in (c) you can see the results of incorporating the fault planes in the gridding process.

Effectively, the fault planes allow the segregation and gridding of surface data by fault block and then project the surfaces into the fault-block bounding faults where they are truncated.
The fault-surface intersections (i.e., the truncation lines) below are, in effect, fault polygons viewed in map view (right).

High-resolution sealed frameworks can be built quickly using tops, seismic, and conformance technology. The shared framework is dynamically updated as interpretations change and/or new data are added. Presentation-quality maps for all layers and properties become a byproduct of the sealed framework and can be created in minutes without manual fault-polygon digitizing and re-gridding.

**Dynamic Frameworks to Fill workflow is ‘Interpreter Friendly’**

Interpreters highly value how frameworks-based interpretation significantly accelerates interpretation speed, while simultaneously improving map accuracy and eliminating rework.

A key aspect of Dynamic Frameworks to Fill workflow is its automatic, dynamic updateability which lends itself to faster and more accurate interpretations. This is how it works:

The updateability capability, along with our advanced topology engine, allows the complete multi-surface framework to be updated with each addition or edit to the interpretation. In other words, as interpretations progress their interpretation (e.g., changes/additions to well picks, faults or horizon data), the model automatically executes updates for multi-surface offsets (and fault polygon calculations), conformance, and erosional truncation in a cascading fashion. Immediate examination of surface geometries, fault polygons, and erosional truncation relationships at multiple levels, allows interpreters to assess the three dimensional implications of their decisions and identify and fix problems early in the process.

For example, seeing evidence of mis-ties in structure maps, inconsistent thickness relationships between surfaces in isochore maps, and mis-correlated faults in emerging fault-polygon maps allows interpreters to fix their errors immediately. This eliminates rework and helps guide the interpreter to a fully validated 3D structural framework when the interpretation has completed.
**Framework-Based Velocity Modeling**

Velocity modeling and depth conversion is a critically important aspect of subsurface interpretation and mapping. Frameworks can be utilized to perform geologically reasonable velocity interpolations for scenarios where highly-cemented rock formations have significant fault displacements, and when high-velocity salt bodies are associated with slow, poorly cemented sediments. In many geologic systems the use of a structural framework is the only technique that will give a robust result for depth conversion. The adjacent image illustrates the use of complex structural frameworks to intelligently interpolate velocity data as part of the depth conversion process.

**Conformance Mapping – Using Seismic Horizons to Guide Poorly-Imaged Top Reservoir Surfaces**

Conformance mapping leverages a classic concept in geology which asserts that in the vast majority of cases formation thicknesses tend to vary very slowly as compared to structural variability. When this assumption is believed to be valid (and there are exceptions worth noting), you can use surfaces that are well-sampled horizontally (e.g., seismic surfaces) to guide the mapping of surfaces with poor horizontal sampling (e.g., well top surfaces). This mapping technique is ideal for mapping reservoir levels that cannot be imaged seismically. In contrast to other software systems which require scripting and multiple grid-to-grid operations to set up, conformance mapping with Dynamic Frameworks to Fill workflow is very easy to set up and execute. You simply define the guiding surface (typically a seismic horizon) and the surface to be guided (usually a well-top surface) using a simple drag and drop user interface.

The software then automatically constructs thickness isochores between the two surfaces and adds this thickness grid (downwards for top-down conformance and upwards for bottom-up conformance) to the guiding surface to model the well top surface.

In the above illustration, the dashed green line is the seismic horizon (reference surface) and the dashed black line is the well top surface gridded before (left) and after (right) conformance has been applied. In essence, conformance adds a thickness map to the reference surface to ensure that the well top surface is conformable (i.e., approximately parallel) with the reference surface.
For complex geologic systems, there are typically a few high quality seismic horizons which can be easily mapped across a reservoir. However, it is also typical that there are many more reservoir levels that are below seismic resolution. Constructing maps at each reservoir level can be challenging. With Dynamic Frameworks to Fill workflow’s conformance mapping technology, users can utilize the seismic horizon-based framework surfaces to ‘guide’ the construction of multiple reservoir tops. In the example below, the top (red) and base (purple) reservoir surfaces along with a series of well-top surfaces that are gridded based just on well control (i.e., naively).

The strategy is to utilize the base reservoir surface as the guiding surface for the reservoir well tops. This will project the well top surfaces parallel to the conformable base reservoir and project them ‘through’ the top-reservoir unconformity. When users apply conformance and erosional truncation (below) users can see the well top (reservoir) surfaces exhibiting excellent conformance with the base horizon surface and the upper reservoir surfaces appropriately truncated against the top reservoir unconformity.
**Framework-Based Volumetrics**

Explorationists need a quick and accurate methodology for calculating reserves on mapped prospects. Dynamic Frameworks to Fill workflow uses its 3D topology engine to create solid-body compartments where calculations of both gross rock volumes and full oil (or gas) in place can be made. These methods represent significant improvements in accuracy and usability over traditional ‘slicing’ methods or thickness grids. Compartment-based volumetrics are capable of calculating accurate volumes under complex geologic prospects. For example, traditional tools for volume calculations under highly faulted (or unconformity-truncated) prospects were extremely time consuming and subject to errors. Dynamic Frameworks to Fill technology utilizes its 3D topology engine to overcome these limitations.

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**Model-Ready Frameworks**

A major advantage of frameworks built during interpretation is that once the interpretation is complete you have a fully validated final model which will not require additional editing/ rework during the earth modeling and simulation phase. This is in contrast to other legacy interpretation and modeling systems, which perform the interpretation and mapping phases in a serial fashion – i.e., interpretation > mapping > modeling (see image on the next page) - framework-based interpretation helps the interpreter progress the overall interpretation and model building process in a holistic manner, ensuring the final model is consistent and ready for earth modeling and simulation.

Dynamic Frameworks to Fill workflow represents a step change in interpretation and mapping efficiency for E&P geoscientists. By automating the dynamic updateability of framework construction, interpreters can build frameworks as they work thus identifying inconsistencies early in the overall workflow. Finding problems early eliminates rework and leads to more accurate maps. In addition to efficiencies gained from building frameworks while they work, Dynamic Frameworks to Fill workflow allows geoscientist to build and validate complex geologic models in a way never before possible. This new interpretation and model building capability, placed in the hands of experienced interpreters, gives geoscientist the power to envision, experiment and then immediately build complex structural and stratigraphic prospects and models.
System and Software

**OPERATING SYSTEMS**
Windows® 7, 64-bit

**SOFTWARE REQUIREMENTS**
There are no software prerequisites
“It’s the best seismic interpretation QC tool in the industry and it’s amazing how much quicker I can pick horizons.”

**SEISMIC INTERPRETER**

“Frameworks is a game changer.”

**E&P CHIEF GEOSCIENTIST**

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