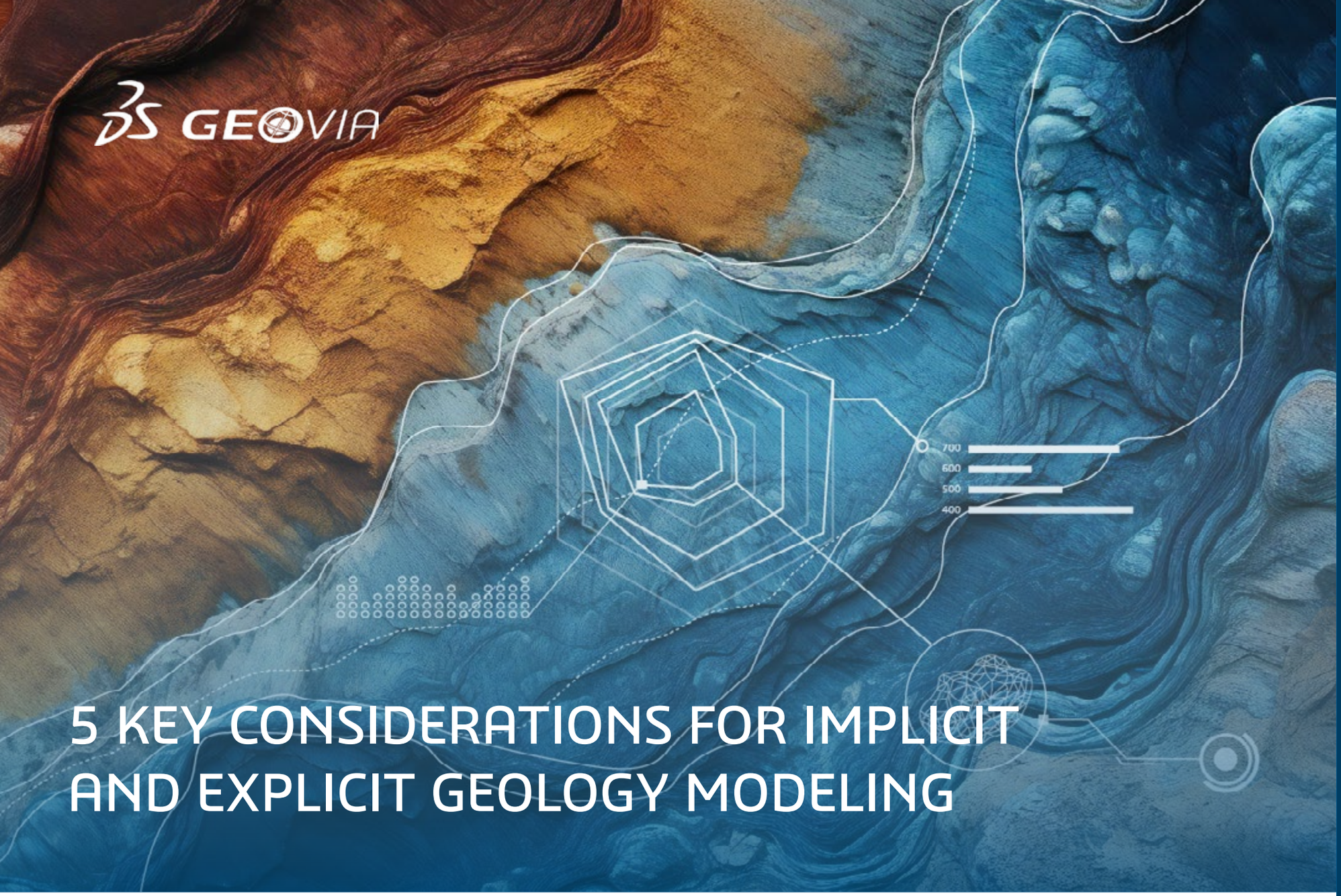
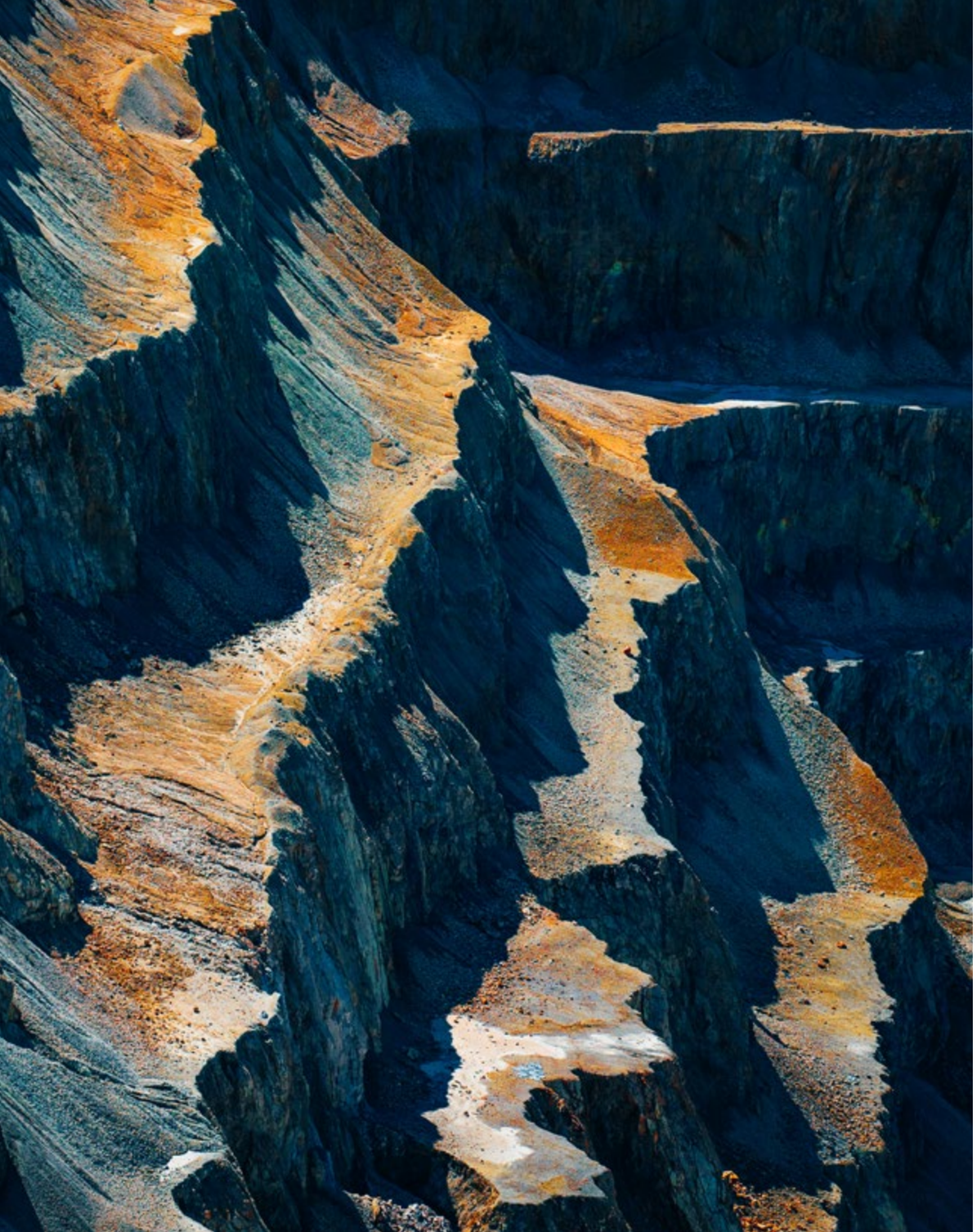


5 KEY CONSIDERATIONS FOR IMPLICIT AND EXPLICIT GEOLOGY MODELING



Introduction

Geological modeling has undergone a significant evolution over the past few decades. The manual process in traditional explicit modeling has given way to automated implicit modeling techniques.

While this evolution has created benefits in terms of time reduction to create robust geological models, the insight and skill of a geologist are still an integral part of the process, which is constrained by the following:

1. Data management and accessibility
2. Geological interpretation
3. Managing geological complexity
4. Automation and repeatability
5. Transparency and auditability

In this ebook, we explore how these five considerations can be further optimized using emerging technology, including artificial intelligence (AI), to help you develop a successful geology model.

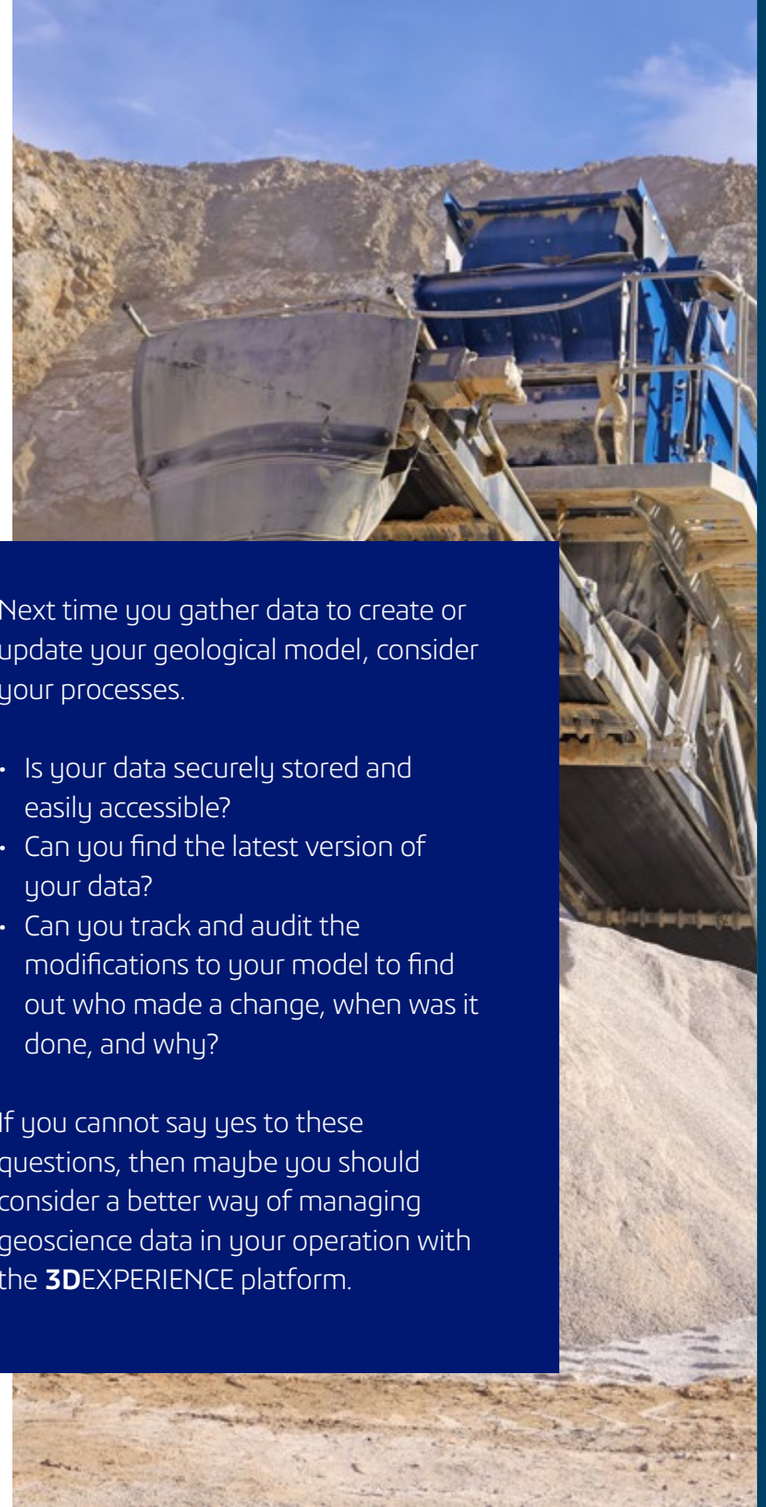
Data Management and Accessibility

Notwithstanding which geological modeling method is used, data accessibility and management are key to define and build the best geology model possible. This requires having access to the right data at the right time.

At the start of a project or reporting cycle, the geologist needs to know where the data is as quickly as possible. Has it been validated? Has it been reviewed? Is it approved for use? In practice, data is often stored by different people and departments on local machines or servers that are disconnected from each other. Information can easily get lost or superseded, leading to rework and task overrun.

Today, such data management and accessibility issues can be mitigated by an advanced enterprise business platform that can ingest, integrate, or index data to ensure the right people have access to the right data at the right time to make the right decisions. The platform acts as a single source of truth to anchor outcome-based processes and capture all activities in one place. It securely connects individuals, teams, departments, and external collaborators working together.

This is the premise on which the **3D**EXPERIENCE platform is built and has been successfully implemented in many industries, including mining. It creates a unified geoscientific data referential that underpins the single source of truth for structured and unstructured data. This facilitates better data management and control with the application of Data Lifecycle Management through version control and data maturity for all documents, files, and objects. Read, write, and editing permissions can be applied that protect the integrity of data with the option of reverting back to a previous version of a specific data point if necessary. It's a game changer for business and innovation.



Next time you gather data to create or update your geological model, consider your processes.

- Is your data securely stored and easily accessible?
- Can you find the latest version of your data?
- Can you track and audit the modifications to your model to find out who made a change, when was it done, and why?

If you cannot say yes to these questions, then maybe you should consider a better way of managing geoscience data in your operation with the **3D**EXPERIENCE platform.

Geological Interpretation

A new approach to geological modeling developed by Dassault Systèmes (through our GEOVIA brand) enhances the capability of geological modeling by addressing some of the disadvantages of traditional methods.

With explicit geological modeling methods, geological interpretations are typically defined by the digitization of wireframes. These are often time-intensive and manual to create, requiring significant time and patience. Despite the manual nature of explicit modeling, it remains a popular method for geologists who want full control over the representation of their interpretation in the virtual world.

With the advent of the Radial Basis Function (RBF) algorithm, geological modeling evolved from explicit manual steps to implicit automated and repeatable modeling. Implicit geological modeling automates the creation of geology, which in complex datasets saves many days of effort. However, this typically comes at a cost: using an automated solution means the geologist cannot always fully control the model, particularly at the local level, and may have to compromise on their desired interpretation.

As part of our **3D**EXPERIENCE offering, we have developed the platform-based GEOVIA Geology Modeler role, which provides geologists with the tools to create quick and accurate implicit geological models (and incorporate explicit intrusions) with the ability to composite drill hole information and create rules-based classifications.

The geological models are parametrically set up to allow for quick updates, speeding up the time to value. It also provides geologists with the control they need to represent the in-ground conditions and geological structures. By using control lines to control the meshing, along with a vast array of estimation settings, such as dynamic anisotropy, geologists can maintain the control needed to create the best possible model but also benefit from the time saved through automated data management, process control, and auditing.

The result is a robust and documented virtual twin of the geological asset.

Managing Geological Complexity

The relative challenges associated with explicit and implicit modeling already described become more evident with increasing geological complexity. A platform with integrated data management, analytics, 3D modeling, and simulation makes life a lot easier.

Successful geological modeling is built on the ability to visualize a deposit's genesis by replaying the chronological sequence of events that produced the geology we have in front of us today. In some cases, the sequence of events is obvious. In other deposits, it's less so, requiring the geologist to test different "what-if" scenarios. Again, the GEOVIA Geology Modeler role empowers geologists to model geological complexity quickly and easily by creating branched revisions to test different "what-if" scenarios to better understand a deposit's genesis and model complexity.

As a result, a highly complex geological model can be visualized and analyzed by all interested stakeholders, not only in 3D but also in the evolution of the geology over time. The same virtual twin can be shared in varying levels of detail, ranging from the granularity required by the Competent Person (or Qualified Person), responsible for compliance with reporting standards and potential investors to other stakeholders, including the local communities who simply want to see what it looks like.

The GEOVIA Geological Modeler role provides geologists with the functionality to model complex geological scenarios, including faulting, folding, unconformities, pinch outs, intrusions, the orebody and grade shells.

Automation and Repeatability

Platform-based modeling capability delivers the best of traditional geological modeling methods. Explicit modeling does not generally lend itself to repetition or automation as it's manually executed by geologists, even though discreet macros can be run on a defined data set. When new data is received (e.g., a new drilling campaign), the entire model often needs to be rebuilt from scratch taking significant effort and time. Even so, the processes, knowledge, and know-how are the same and can be captured through machine learning and other AI techniques. This provides a valuable foundation for automation and repeatability.

Implicit geological modeling is different. It's a connected automated system, built on an RBF algorithm, that ensures geological models respect borehole intervals and are generated in a matter of seconds or minutes. Settings are retained and can be replayed, ensuring repeatability and consistency. When new data is received, it takes minimal effort, skill, and time to update the geology model. Data objects are also connected and relational to each other to ensure the geology modeling process makes practical decisions that meet the geologist's interpretation and modeling requirements.

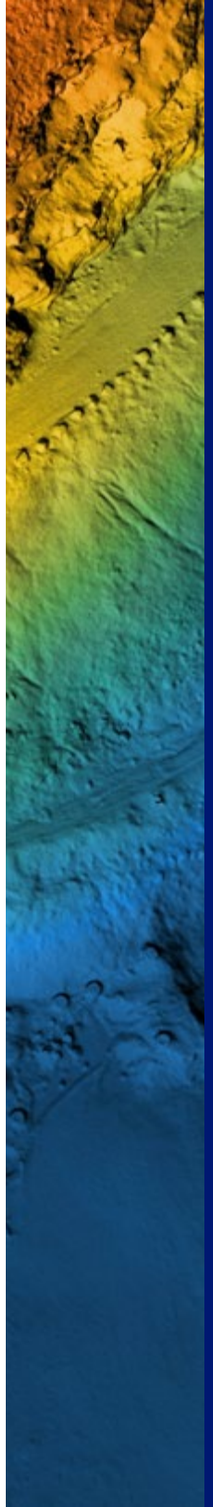
The result is a parametric model that is intelligent, features controlled execution, and can be replicated.

Transparency and Auditability

When a geologist builds a model, it's often used downstream in block modeling and mineral resource reporting, which is usually subject to international reporting standards (e.g., JORC, PERC, SAMREC, NI 43-101, etc.). This means it's crucial that the modeling steps, decisions, and observations are documented and recorded, as the modeling work may be later reviewed by peers or a Competent Person (or Qualified Person). To aid the geologist in this regard, the modeling software used must be able to record and capture every detail of the modeling process, whether that be through reports, macros, or other mechanisms.

With explicit modeling techniques, which are usually a series of independent disconnected steps or functions, this job of recording the settings and key information typically falls to the geologists themselves. This can vary from individual to individual and may require extensive time during the auditing stage.

In contrast, implicit geology modeling techniques record and capture the modeling process so that it's repeatable, allowing anyone in a team to update the model quickly and easily. These principles and the underlying architecture also mean anyone can inspect a model, review the version history, and audit the settings and steps taken, giving the reviewer full transparency and confidence in decision-making, workflow management, and document maintenance while mitigating many issues.



This approach is a better way of working. The **3D**EXPERIENCE platform with the GEOVIA Geology Modeler role, enables innovative collaboration within a common data environment that users otherwise would not have access to. The integration of the Project and Data Lifecycle Management with the Geological Modeling workflows allows for transparent and auditable models to be generated while the **3D**EXPERIENCE platform facilitates a single source of truth for all geoscientific data. Collaborative task management outlines the correct process flow for generating geological models and all necessary data and standard operating procedures can be attached to each task. A review or approval gateway can be included in the process to ensure proper quality control. Version control and maturity status management of all data objects ensure that only the latest single version of the truth is used in the modeling process. Governance regulation adherence is improved with project and data lifecycle management providing transparency to the entire modeling process and ensuring the auditability of the geological model.

BUILD BETTER GEOLOGY MODELS

As part of an extensive 3D modeling, analysis, and simulation suite connected via an advanced enterprise business platform, the Geology and Resource Modeling solutions from Dassault Systèmes are changing the face of geological modeling. Our technology can help you better manage and access data, control your geology models, model complexity quickly, automate your processes, and track all progress to build more robust geology models in less time.

To learn more, contact us today.

GEOVIA.info@3ds.com

Our **3D**EXPERIENCE® platform powers our brand applications, serving 12 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the **3D**EXPERIENCE Company, is a catalyst for human progress. We provide business and people with collaborative virtual environments to imagine sustainable innovations. By creating virtual twin experiences of the real world with our **3D**EXPERIENCE platform and applications, our customers can redefine the creation, production and life-cycle-management processes of their offer and thus have a meaningful impact to make the world more sustainable. The beauty of the Experience Economy is that it is a human-centered economy for the benefit of all –consumers, patients and citizens.

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