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Accelerating Innovations in Subsurface Modeling and Analysis: The Human Factor

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When we look to the future of data and computation and how it will transform our understanding of the subsurface, it's easy to focus on the changes in technology and data we're experiencing today. For example, over the past decade we've been influenced by increasing volumes and types of geoscience data and have implemented artificial intelligence and machine learning.

Certain data and processing trends are clear—we will continue to see an uptake in sensor technologies and increased spatial and temporal sampling of data, and geoscience data will need to be shared across increasingly large groups of stakeholders. In data processing, technologies like cloud computing will enable complex levels of analysis, and we will be able to leverage technology development from other sectors that are tackling similar computational challenges.

However, the increase in data volumes and computing power represent only part of what is required to transform our understanding of the subsurface.

Unlike other applications of big data and high-performance computing (e.g., autonomous driving), geoscience data do not and will not—for the foreseeable future—contain enough information on its own to uniquely describe subsurface geology. As well, our understanding of geological theory alone is not sufficient to support deterministic modelling of geological systems. Geoscience is not exact. This is an interpretive science—a synthesis of theory and practical experience from our geologists, who provide a rich, tacit understanding of subsurface processes that cannot be described succinctly by deterministic equations.

This means as we move forward, we must turn our attention to technologies that

1. enable geoscientists to leverage maximum insights from technological innovations; and
2. codify the tacit understanding of geology that seasoned practitioners possess.

Enabling geoscientists in this way requires a shift in how we view innovation, to include transformative approaches in areas like the human-computer interface (HCI) and visual analytics. By investing in HCI, we ensure that geoscientists can experience multidimensional data in a way that allows them to draw insights and empowers them to communicate risks, uncertainty, and outcomes easily. Additionally, by focusing on visual analytics, we can move beyond simply providing a rich experience with data to learning how to understand and codify how a geoscientist sees and solves a problem.

This shift will allow the geoscience community to better share, scrutinize, and ultimately act on the insights provided by an individual geoscientist or learn from the differences in how geoscientists view problems.

In the next 100 years, technologies like machine learning and artificial intelligence will no doubt underpin an improved understanding of the subsurface. But for this technology to be truly transformative, we must ensure that technology enables geoscientists to get the most out of their data by focusing on the human side of the equation.