

Digital tool support for exploration geologists: Towards a use-centered approach to innovation in SIRIUS

Elena Parmiggiani, Thomas Østerlie, Eric Monteiro
Department of Computer Science, NTNU

Introduction

Exploration geologists use digital tools to make better and more accurate decisions about whether and where to drill in a prospect. The quality of these decisions depends to a large extent upon how well the tools available support geologists' workflows.

However, both operators and vendors report that the digital tool set currently available is not always a good match for all exploration geologists' workflows. Most of these tools are measurement-based, whereas



geological thinking is a history-based and analogical form of reasoning drawing on qualitative interpretation and constant interplay between theory and data.

Preliminary results

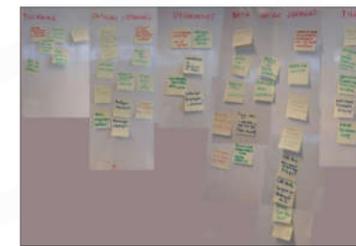
Initial interviews with explorationists indicate that the existing tool set poorly supports how geologists reason about the subsurface by creating and continuously modifying geological histories. *Geological histories* are narratives explaining existing data in terms of how the subsurface in an area has developed over geological time.

Existing digital tools are predominantly aimed at accurately modelling the subsurface. This accuracy comes with a high up-front investment in setting up and configuring the model. Such extensive configuration also makes these models hard to modify in response to new data.

The work of exploration geologists, however, hinges on just this kind of *flexibility*. Geological histories often change dramatically with new data. Furthermore, exploration geologists juggle *multiple* geological histories to keep the scope of possibilities as open as possible, for as long as possible to make sufficiently accurate decisions about whether and where to drill in a prospect.

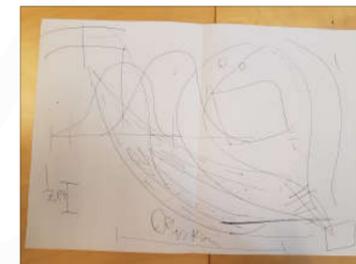
High up-front investments make it difficult to do more than one or possibly two digital models of an area, narrowing the scope of possibilities too much too early in the geologists' work process. Combined with a lack of flexibility in modifying these models, exploration geologists instead resort to more mundane software such as PowerPoint or Adobe Illustrator as these tools seem to better support the geologists' form of reasoning.

Scoping for possible topics to pursue



Picture 1: Post-it notes with possible research topics from scoping work-shop among SIRIUS partners. A lack of tool support for exploration geologists emerged as a topic from such activities.

Identifying user needs through in-depth interviews



Picture 2: Hand drawing made by exploration geologist during an interview. Used in re-telling the creation and modification of different geological histories as they sought to grasp the subsurface in a license.

Refined understanding of user needs and context of use through design workshop with users



Pictures 3 and 4: User needs and context of use explored through rapid iterations of producing possible design solutions individually, and presenting and evaluating the designs collectively.

Future activities

The use-centered approach developed through this feasibility study is an alternative way of capitalizing on the SIRIUS consortium by bringing customers (operator's business side) and vendor organizations together in close collaboration, with an explicit focus on digital transformation by addressing workflows and activities that currently have limited tool support.

Towards a full SIRIUS project

By focusing on the *job to be done* by exploration geologists, we have identified *innovation pull* from the business side. Knowing how the geological history is performed, communicated, and made relevant as part of exploration activities provides the basis for further development of a full SIRIUS project on this topic.

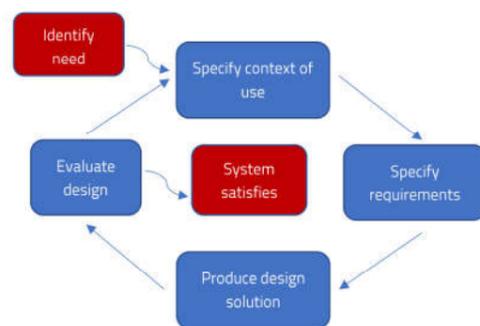
A full project needs to match innovation pull with *innovation push* from the technology side of SIRIUS in order to explore how leading edge solutions that can not only satisfy user needs, but also help transform exploration geologists' workflows to better utilize the possibilities of Big Data and analytics.



Picture 5: Elena Parmiggiani presenting our ongoing research on models and simulations at the leading international conference on digital technologies, work, and organizing (IFIP WG 8.2).

Materials and methods

In this SIRIUS feasibility project we employ a *use-centered* approach for exploring how digital tools can better support the methods and goals of exploration geologists as part of their workflows.



Feasibility project partners



SIRIUS feasibility project leader: Thomas Østerlie (Department of Computer Science, NTNU)

Industry contacts: Peter Eilsø Nielsen (Statoil), Hallgrim Ludvigsen (Schlumberger)

Project participants: Eric Monteiro and Elena Parmiggiani, (Department of Computer Science, NTNU)

Acknowledgements

This project was initiated and conceived by Hallgrim Ludvigsen and Peter Eilsø Nielsen, without whose efforts it would never have come about. Also thanks to Arild Buland (Statoil), Per Eivind Solum (Schlumberger), as well as Arild Waaler and David Cameron (SIRIUS SFI management) for invaluable support in setting up the feasibility study.



Center for Scalable Data
Access in the Oil and Gas Domain