

# End-to-End Oil and Gas Value Chain Optimization Across Complex Production Operations

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## Abstract

Optimization of the end-to-end oil and gas value chain, where multiple plants, processes and assets are interdependent, has been a complex challenge for the upstream oil and gas industry. Canada's largest integrated oil and gas producer set out to apply the latest artificial intelligence (AI) and data science methodologies to improve production optimization within their upstream operations facilities. The goal of the project was to optimize across siloes, flag upsets early for timely response and identify and action opportunities in real-time. The scale of the project included a 130 Km<sup>2</sup> area with 35 individual plants which included over 134,000 individual tags operated by thousands of front-line operators, engineers and supervisors who spanned 12 individual business units. The solution included over one hundred machine learning models in a multi-layered approach where applied to bring value in both Normal and Upset conditions. This 'systems of systems' approach included advanced AI models for a predictive systems layer - including predictive and adaptive mass balance models - an optimization layer with end-to-end optimization models and an opportunities and process layer for opportunity identification including 58 variations of process upset flagging models. In order to truly scale production optimization, a dynamic optimization engine connected to business unit specific optimizers was implemented to rapidly generate production schedules to maximize plant throughput and production performance. By continuously monitoring production every two to three minutes, the solution identifies gaps between current and most effective and achievable – not theoretical - variables, providing recommendations to maximize business objectives such as production volume, quality, inventory levels, profitability etc. Plant operators are placed in full control

of process upset management and opportunity awareness enabling them to predict and minimize plant upsets and take action to optimize processes and quality where required. The solution currently predicts upsets 20-25 minutes before with more than 80% accuracy. Opportunity awareness further helps operational decision makers identify production opportunities that may have been missed and actioned opportunities improve product quality and minimize energy use. Unbiased, data-driven scenario generation ensures comparison of multiple strategies by creating a new production plan in less than 10 minutes. The end-to-end production optimization solution includes a user interface that delivers anytime insights via mobile, complemented with tablet and desktop, enabling operators and decision makers across teams to instantly access a comprehensive picture of their plant operational environments wherever they are.