PRODUCTION OPTIMIZATION THROUGH MACHINE LEARNING AND AI

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ABSTRACT

- Energy producers are required to be dynamic and constantly improving to retain economic growth. Normally, technological improvements are achieved in the form of:
  - Mechanical Equipment
  - Advanced Process Controls
- Massive amounts of data possessed by energy industry producers can be utilized to maximize potential yields through the application of Machine Learning and AI
  - Automate Manual Systems
  - Improve Organizational Efficiency
  - Reduce Human Management Hours
- The ML aspect of this project utilized over 350 million time series data points from PETRONAS Canada's database and leverage it to
  - Optimize Production on Lift Wells
  - Detect Well and Facility Abnormalities
  - Improve Production Deferment Targets

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REFERENCES

Chava, G. F. (2008). Development of a New Plunger-Lift Model Using Smart Plunger Data. *SPE Annual Technical Conference and Exhibition.* Denver, Colorado. Retrieved October 2022, from https://doi-org.exproxy.lib.ucalgary.ca/10.2118/115934-MS

Lea, J. F. (2003). Gas Well Deliquification. In *Solutions to Gas Well Liquid Loading Problems.* Retrieved October 2022, from https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/detail.action?docID=294142

TASQ. (n.d.). *TASQ.io Interface*. Retrieved from https://www.tasq.io/resource-center

Texas Tech University. (2012, February). Retrieved 2022, from Introduction to Plunger Lift: https://www.shaletec.com/files/Introduction-to-Plunger-Lift1.pdf

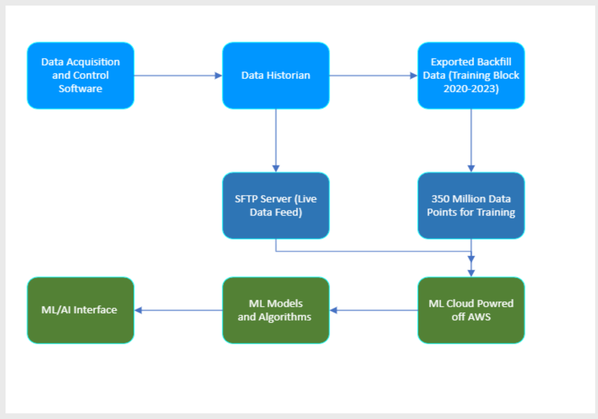
Zhao, Q. e. (1996). Transient Modeling of Plunger Lift for Gas Well Deliquification. *Society of Petroleum Engineers Journal (U.S.)*. Retrieved October 2022, from https://doi.org/10.2118/205386-PA

INTRODUCTION

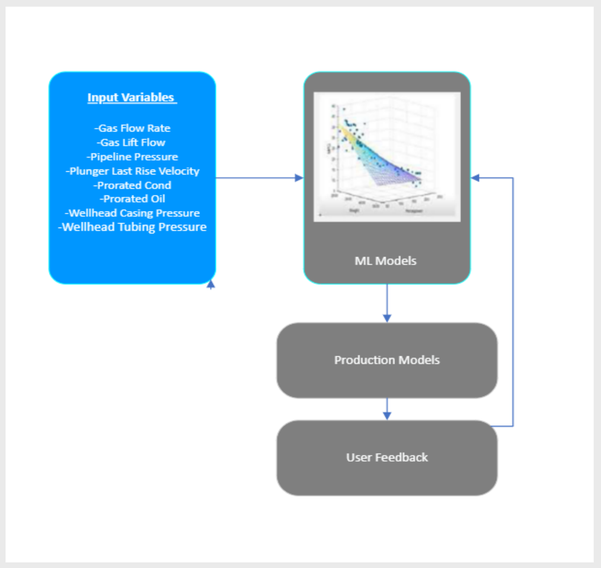
- Currently, PETRONAS Energy Canada has over 900 producing wells and numerous mid-stream assets in the Montney.
  - As this number continues to grow and older wells require more work/time to enhance recovery, the need for smarter automated systems will grow.
  - This project has served to assess current systems and find the highest value areas where machine learning and AI can be implemented.
- The primary objective for this project will be to develop a starting point for PETRONAS to integrate ML/AI into their operations

METHODS AND MATERIALS

- Data acquisition and analysis

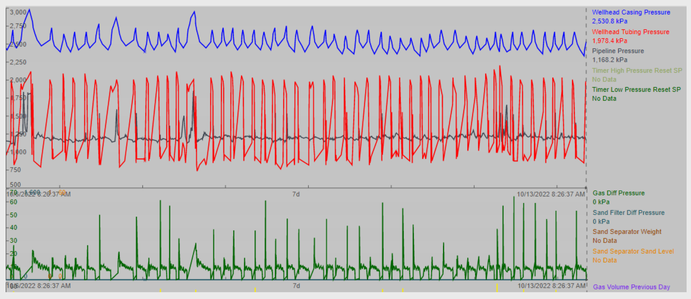


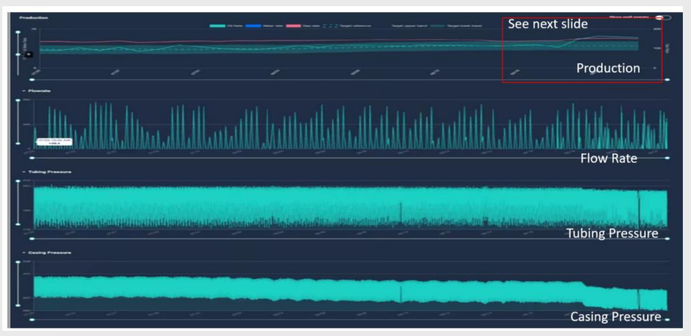
- Training of models

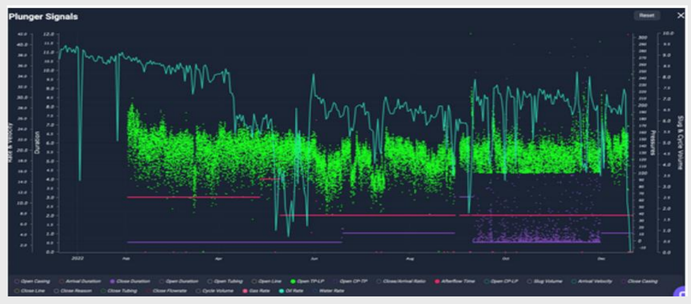


RESULTS

- Successfully analyzed over 350 million data points to build and train models
- Found many under-leveraged areas to deploy machine learning including
  - Live well modeling
  - Lift well set-point optimization
  - Automated Downtime reporting
  - Well-level abnormality detection
- Devolved and implemented a trial of ML software to become a production hub giving users faster access to higher-quality data
- Found potential for up to 15% increase in production from lift wells







DISCUSSION

- Currently PETRONAS relies on engineers to manually create and optimize set points based on production trends and physical calculations. These methods have proven to be time consuming and at times will lead to wells producing at lower than their potential.
  - Machine learning model was proven to be capable in automatedly adjusting these setpoints recurrently
- Similarly, the process used to optimize plunger lifts PETRONAS relies on engineers to manually create and optimize set points for timer wells based on production trends and physical calculations
  - Cycle times were optimized to maximize production sequence regularly
- With the current PI visions software processes that PETRONAS uses, built in formulas are not capable of predicting well production in an intelligent manner and frequently lead to false alarms and missed alarms.
  - Machine learning model successfully classified and prioritized issues which prevented unnecessary shut-downs.

CONCLUSIONS

• PETRONAS Canada has the systems and means to deploy machine learning and artificial intelligence into their day-to-day operations

•Machine learning and artificial intelligence can be used to increase production on lift wells and find lost production from the field

•Trial implemented during capstone has the potential to be deployed field wide with the highest return on lift wells

•Costs of implementing technology are estimated at 250 dollars per well per year