**Zinc Production Wells: Digital Twin**

**Maana Platform Training Case**

The Zinc onshore oil field is an important asset for Claroil E&P, with over 50 active production wells with an average production of 300,000 barrels of oil per day (bbl/d). As Zinc enters its third year of continued operation, oil production has started a natural decline.

As part of production management operations, Zinc production wells are ‘tested’ on a regular basis. Well testing involves taking a well temporarily offline, gathering fluid samples for analyses, and measuring production parameters[[1]](#footnote-1). While well testing is an essential operation, cost implications and logistical constraints also need to be considered. Zinc’s production engineers compare well test measurements against a production forecast, to inform their decisions. In short:

* Instances where there is a large difference between measured and predicted parameters, might be indicative of a potential problem in a well, which could be solved in some cases via well interventions.
* Instances where differences between measured and predicted parameters are small, might indicate opportunities to reduce testing frequency and therefore cut down operating expenses.

As the Head of Production Operations for the Zinc field, you are ultimately responsible for maximizing oil production and optimizing operational expenses. Well testing and well intervention falls within your area of accountability. Recently, Claroil’s Central Digital Transformation Unit briefed you on the benefits of using Maana’s Knowledge Platform to support Zinc’s business objectives. From these conversations, you learned that the Maana platform allows you to create a digital twin of your business processes.

Your immediate objective with this Digital Twin is to help you identify 2 types of profit enhancement opportunities on a well-by-well basis. These are:

* **Incremental Revenue**: Well intervention opportunities targeting increase in oil production.
* **Reduction in Operating Expenses**: Via a reduction in well test frequency.

Appendix A and B include all information required to build this Digital Twin.

Good Luck!

**Appendix A – Use Case Details**

**Well Metrics**

Well metrics to be used in this problem, include:

* **Oil flow rate:** Oil production from each well expressed as barrels per day (bbl/d).
* **Water cut:** Water production over total liquid production for each well. Calculated as [Water Flow Rate / (Water Flow Rate + Oil Flow Rate)] and expressed as a percentage (%).
* **Gas to Oil Ratio (GOR):** Gas production over oil production for each well, expressed as standard cubic feet over stock tank barrels (scf/stb).

**Production Forecast (Predicted Parameters)**

Predicted daily rates (from numerical simulation) for a 2-year period and 15 wells are included under: <https://maanainc.box.com/s/zjn12n874im2poe1t1ljs0m2260ar8w3>

**Recent Well Test Data (Measured Parameters)**

Well tests performed during a 1-month period. This is, every well is tested at least once in a month: <https://maanainc.box.com/s/5llugbef3pn21em3bmyx987vosavll1b>

**Operational Constraints**

<https://maanainc.box.com/s/g8ot6hgzkq7ppbe567dclstgmasp5mfk> including:

**Well intervention constraints**: (1) Well intervention types applicable to Zinc wells, (2)Well intervention costs, (3) Well intervention effort, i.e., man-hr, (4) Estimated increase in oil production as a result of intervention.

**Well test constraints**: (1) Cost of well test, (2) Probability of anomaly if no well test is conducted.

**Global constraints**: (1) Total well intervention monthly budget, to be defined during creation of the use case, (2) Total well intervention crew capacity, i.e. man-hr available on a monthly basis. To be defined during creation of the use case.

**Appendix B – Business Logic[[2]](#footnote-2)**

**Well Intervention**

## Business Logic for Determining Type of Well Intervention

IF Water Cut Gap (i.e., Measured – Predicted) > 7%, THEN “WATER SHUT-OFF”

IF Oil Rate Gap [100 \* (Predicted – Measured)/Predicted] > 8%, THEN “HYDRAULIC FRACTURING”

IF Oil Rate Gap [100 \* (Predicted – Measured)/Predicted] > 5%, AND < 8%, THEN “ACIDIZING”

## Business Logic for Estimating Incremental Revenue Following Well Intervention

Revenue Increase following well intervention = Measured Oil Rate \* % Increase in Oil Rate \* Oil Price \* 180

**Well Testing**

## Business Logic for a Well Health Index

WC\_HI = Water Cut Health Index

WC\_HI = 1 – ABS [(Forecasted WC – Measured WC) / Forecasted WC]

IF WC\_HI < 0, THEN WC\_HI = 0

IF WC\_HI >1, THEN WC\_HI = 1

GOR\_HI = Gas-Oil-Ratio Health Index

GOR\_HI = 1 – ABS [(Forecasted GOR – Measured GOR) / Forecasted GOR]

IF GOR\_HI < 0, THEN GOR\_HI = 0

IF GOR\_HI >1, THEN GOR\_HI = 1

OR\_HI = Oil Rate Health Index

OR\_HI = 1 – ABS [(Forecasted OR – Measured OR) / Forecasted OR]

IF OR\_HI < 0, THEN OR\_HI = 0

IF OR\_HI >1, THEN OR\_HI = 1

HI = Composite Health Index

HI = 0.33 \* WC\_HI + 0.33 \* GOR\_HI + 0.33 \* OR\_HI

## Business Logic for Determining Opportunity to Skip a Well Test

IF Health Index (HI) >= 0.8, THEN Opportunity to skip a test

1. Note that 3 other well testing techniques have been contemplated in Zinc but proved impractical. These are: 1) Testing over a central facility test separator: Not feasible due to terrain features in the Zinc area, which induce unmanageable / severe slugging when flowing a single well on a test flowline, 2) testing by difference, which has proved inaccurate in the past, and, 3) multiphase flow meters: which are found to have limited accuracy for Zinc reservoir fluids and result in high operating expenses. [↑](#footnote-ref-1)
2. Note that this logic represents an over-simplification of the decision-making processes in a real oilfield. These simplifications are made in order to illustrate use creation in the Maana platform. A couple of limitations of this use case include: (1) Differences between measured and predicted parameters in reality can come from different sources, i.e., faulty measurements, biased predicted model, larger reservoir issues not possible to solve through well intervention. (2) Production engineers would typically rely on a larger set of information, analyses and simulation software prior to suggesting a well intervention activity.

   Given this, it is also worth noting that the Maana Platform supports increasing level of complexity (e.g., decision trees, connection to numerical simulators, documents, etc.). [↑](#footnote-ref-2)