Course Project

Article

Digging Deeper

https://www.informs.org/Impact/O.R.-Analytics-Success-Stories/Digging-Deeper

Summary

The article "Digging Deeper" on INFORMS describes how BHP Billiton used operations research and analytics to optimize its Jansen Potash Project. The Jansen Potash Project is BHP Billiton's plan to get into the bulk fertilizer market by creating its first potash (potassium bearing minerals used for fertilizer) operation that they are calling the Jansen Potash Mine.

Data

To construct and operate an entire profitable mining system, a lot of data is needed to best plan out a course of action. After reading the article I believe that the following data was needed at minimum:

1. Operational Data
    - Data needed:
        - Production rates (how much they are mining)
        - Maintenance schedules
        - Instances that cause downtime
    - How to collect:
        - Operation logs
        - Sensors in the machines
    - When to refresh:
        - Weekly
            - Updating these weekly will allow for the company to quickly assess if something is different than normal without it causing too big of an issue. They could look at the data each week's end and plan for the next week accordingly
2. Financial Data

- Data needed:
    - Amount spent on capital (ex. machines, railcars, etc.)
    - Operational costs
    - Cost of potash on the open market
- How to collect:
    - Market reports
    - Company accountants
- When to refresh:
    - Quarterly
        - Looking at the quarter end numbers will allow for the company to see if the operation is more expensive/cheaper than anticipated

3. Resource data
    - Data needed:
        - How many workers do they have
        - How much work can each piece of equipment do
        - How much energy is needed for everything to function (ex. gas, electricity, etc.)
    - How to collect:
        - A company census
        - Monitors/sensors in each piece of equipment that can measure their output
    - When to refresh:
        - Quarterly
            - It makes sense for the company to see if their workforce has increased/decreased and if their machines are still working as predicted every couple of months
4. Market data
    - Data needed:
        - Anticipated demand for potash
        - Anticipated price for potash
    - How to collect:
        - Industry forecasts
        - Market research
    - When to refresh:
        - Quarterly

- Markets are generally looked at quarterly, so it makes sense for the potash market to be looked at that frequently as well

Models

With all this data, and probably much more, I believe that the following three analytics models were used:

1. Regression to Forecast Demand and Market Prices

   I would find it hard to believe that Jansen would build an entire mining system and get into an entire industry they were not in without believing they could turn a profit on it. A multiple regression model could be used to predict future demand and price of potash using multiple variables. A time series regression model could even include trends and seasonality of this specific market. I think that this was possibly the first model Jansen created to see if it even made sense to go through with the Jansen Potash Project or not, and would continue to use now that they are in the market. A model like this should be updated quarterly to keep up to date with changes in the market and demand.

2. Net Present Value (NPV) Maximization

   The company would want to maximize the NPV of the mine because it gives them the highest possible profit of the operation by turning future cash flows to present values. To find the NPV of the mine, Jansen would have had to create an optimization model with the objective function being to maximize the profit. The NPV optimization model would incorporate future cash flows, discount rates, and operational constraints to maximize the project's profitability. Some operational constraints could be labor and machinery availability, any budget constraints, the physical size of the mine, and hours of operation. This optimization model should likely be updated quarterly to make sure it is up to date on the company's financial conditions and how the economy is doing.

3. Detailed Integrated Capacity Estimate (DICE)

This was the name of the model in the article. I believe that DICE was a discrete event simulation. These types of simulation are useful when a system has high randomness, which an entire mining operation would most likely have. A discrete event simulation is used when a system only changes at discrete time points. This simulation was most likely used to examine the production of the mine, for example the mining, hoisting (transporting equipment, people, what is being mined, etc.) and operations of the mine, as well as the outbound processes of the potash, for example the rails, shipping, and best ways of delivering to customers. This model needs updated when new operational data or needs are collected. For example, if a machine breaks then they will need to find the best new simulation for the time being while it is being repaired, or if they gain a larger workforce, it might make sense to station the workers in different spots than before.

Interactions

These three models work hand in hand with each other. To find the NPV, Jansen would need to know what the long-term finances would look like. Those long-term finances would come directly from the regression model. Knowing what the projected prices and demand for potash is going to be what allows for the NPV optimization to know what future cash flows may look like and how it should maximize those. The article talked about how the simulation model, DICE, was ran with respect to NPV among other things. This means that the simulation model was built to maximize the profit of the mine using the values given by the NPV optimization model. The models work together in almost a sequential pattern, Forecasting Model → NPV Maximization → Simulation Model (DICE).

Conclusion

The application of analytics models in real-world cases demonstrates how data-driven approaches can solve complex business problems. In the BHP Billiton case, forecasting, optimization, and simulation models were used to optimize resource allocation and maximize NPV for the Jansen Potash Project. These models relied on accurate and regularly updated data, including operational, financial, resource, and market demand information. By integrating these models effectively, the company balanced efficiency with profitability.