APOTEX

Innovating for
patient affordability

# APOTEX CASE STUDY

## Bid Win Rate Prediction and Optimization

# About Apotex

Founded in 1974 by Dr. Barry Sherman, we're a proudly Canadian, global pharmaceutical company that produces high-quality, affordable medicines (both generic and innovative pharmaceuticals) for patients around the world.

From our humble origins of only two employees, we've grown to employ more than 8,000 people worldwide in manufacturing, R&D and commercial operations.

Apotex has a unique, vertically integrated model comprised of multiple divisions and affiliates which focus on generics, biosimilars, consumer health and active pharmaceutical ingredients. Through vertical integration, Apotex is comprised of multiple divisions and affiliates.

**Apotex Values**
Our culture is guided by our core values of Collaboration, Courage, Perseverance and Passion. They inform how we work and how we connect internally and externally with our customers, partners and other stakeholders.

**Our Community Support**
As a purpose-driven organization, we recognize the important role we can play in supporting the communities in which we operate. Around the world, our company and our employees are actively involved in supporting charitable and academic causes.

**Our Global Footprint**
We export to over 100 countries and territories, and our global footprint includes presence in the US, Mexico and India, and includes a network of distributors and strategic alliances.

Globally, we have the capacity to produce 24 billion tablets and capsules per year, which, in turn are used to fill over 90 million prescriptions in Canada alone, or one in five prescriptions.

**Our Canadian Footprint**
Apotex is proud to have roots in Canada with a strong focus on the core Canadian market:

- Strong Canadian leadership team
- >95% of Apotex products sold in Canada are made in Canada
- 4 state-of-the-art manufacturing sites
- 1 in 5 prescriptions filled in Canada is an Apotex product

Our leadership team is focused on growing and sustaining the Canadian business and maintaining thousands of high-quality, highly skilled jobs in our country.

Over the years, Apotex has helped to bring prescription drugs to market before patent expiry, and in doing so we have saved Canadians almost $19 billion by bringing products to market early.

# The Case

**Abstract**

A significant portion of Apotex global business is gained through customer bids and Request for Proposals (RFPs) for our product portfolio. The U.S. generic market is predominantly driven by a bidding process, where business is won or lost through multiple, short-term (annual or lower) bid opportunities, as well as less frequent full line RFPs that extend over multiple years. Pricing and market share vary dramatically based on the number of competitors for each product and in each market. With over 50 generic competitors operating in the U.S. market, it is a highly competitive and challenging market to operate in; the key differentiators for success are portfolio, relationships, service, and bids response time.

Apotex takes a strategic cross-functional approach to assessing our supply capability and pricing strategy for submitting bids on time to optimize our chances of gaining new business and maintaining existing business. The Commercial Operations team for each market notifies the Global Demand Planning team when a bid/RFP contract is opened by a customer and provide the details of the list of products, monthly/annual volumes being requested, supply start date and bid submission deadline for supply evaluation. At the same time, the Sales Planning and Pricing teams work on determining the pricing strategy for each product on the bid. The Global Demand Planning team assesses and compiles additional data on each product within the scope of the bid to enable further evaluation by the supply chain teams including:

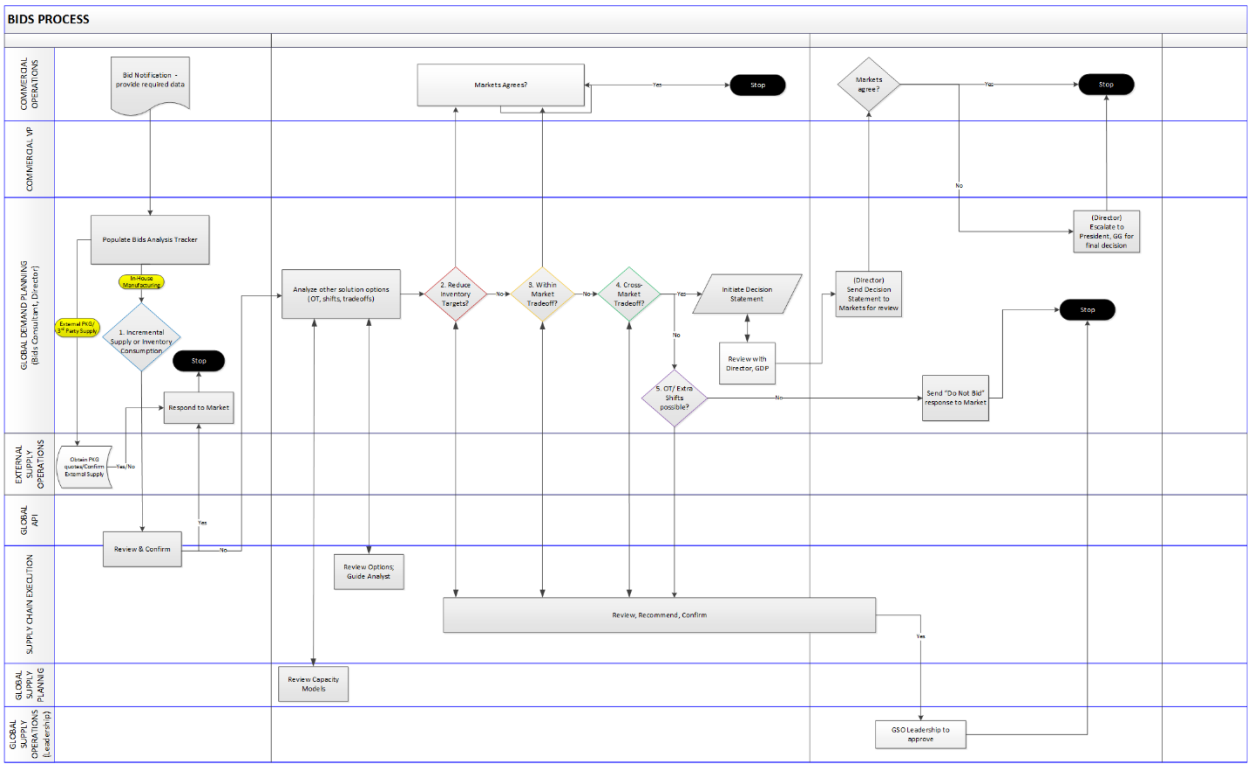
- Current forecast and potential forecast increase based on bid volume
- Current inventory on hand, and inventory levels after consumption based on bid volume
- Risk inventory
- Next supply replenishment dates and quantities
- API inventory on hand, on order, and API quantity required based on bid volume

The bid is assessed by Supply Chain Execution, External Supply, and Global API teams for manufacturing and packaging capacity and API coverage. A recommendation is made to the Commercial team to approve the bid for the supply start date requested or offer an alternate date based on supply availability and production replenishment plans. Before recommending to decline to submit a bid, all options are explored to support the bid and escalated for discussion and final decision making. This includes exploring the option to adjust production schedules by trading off an already-planned product to make a requested product for the bid, or to make the decision to carry lower safety stock levels on products to support the volume requested for the bid.

It is imperative that a proper supply chain assessment is performed prior to the decision to pursue a bid as the inability to fulfill the details of a contract could lead to significant Failure to Supply penalties. Given that the turnaround time for responding to bids in the U.S. market is within 24-48 hours of receiving a bid notification, it is crucial to optimize the bid process with a focused effort to not only meet customers' response time expectations but also to make a bid

recommendation that provides Apotex with the best competitive advantage in the market to win bids.

## Process Overview




*Please see attached file with case package for better view on PFD*

## Current State of Bidding

The current process of evaluating a bid requires input and approval from several cross-functional teams. We spend considerable time and effort evaluating all incoming bids with the same rigor and effort to ensure we can support the proposal even though the probability of winning may be low.

## Desired Future State

Using information available, Apotex is looking to predict the probability of winning a bid/RFP proposed by existing and new customers. Each bid consists of a different mix of products, supply start times and durations. Apotex would like to determine which products and for which customers we have a high win rate and identify the factors (features) that will give a strategic competitive advantage to win bids for products and customers that we have historically low win rates. We also want to consider the impact of the current competitive landscape (market share and number of competitors), and to determine if there are any additional considerations that should be incorporated in our bid's analysis (Optimization of features).

Having a model to determine win rate probability can improve the efficiency of our bid analysis process and help our organization optimize how much time and effort is spent on each bid.

# Recommended Case Approach

While going through the case it is vital to understand the context of data. At the same time pay consideration to correlation between data elements. What are the relationships between conditions? You also must be careful about correlations. You might find a correlation that makes no sense because the context is wrong.

The value of learning from data means that the machine learning system can look at underlying patterns and anomalies that aren't necessarily obvious.

While approaching the case towards solution keep in mind what difference could machine learning make in business strategy?

Ensure that you are using the right algorithms, ingesting the most appropriate data (that is accurate and clean), and using the best performing models

Selecting the right algorithm is part science and part art. Two data scientists tasked with solving the same business challenge may choose different algorithms to approach the same problem. However, understanding different classes of machine learning algorithms helps data scientists identify the best types of algorithms. Make sure the model is generalized and not overfit to your training data.

**Your Task**

Your task is to create a recommendation that will help Apotex better understand win rate by products and customers. This will enable our supply chain and commercial teams to assess and respond to individual bids more strategically and optimize our chances of gaining new business. Based on the inputs that are available, determine what their correlation to win rates are so that we can either focus or completely ignore certain inputs and make the bids analysis process more efficient.

The model should also be able to help in optimization by predicting feature set that Apotex needs to adjust/achieve in order to be 100% successful at its first attempt at its bidding

Typical output of ML model will be:

1. Probability (%) of winning an individual bid at the customer and molecule level.
2. For bids with a low probability, recommend what factors can be adjusted to have the greatest marginal increase in win probability.

Justify how the outcome can be used for:

1. Driving demand/supply balancing actions within our supply chain that will better position us to win and support new bid opportunities, including:

    a. Forecast adjustments that will drive downstream MRP requirements.

    b. Trade-off discussions and adjustments to master production schedules so that we can prioritize certain opportunities.

2. Pricing strategy for individual bids.

3. Identifying growth opportunities on specific molecules so that our commercial team can start to approach customers for opportunities instead of waiting for bids to come in for the product.

**Selecting a team**

Build a team with a mix of skills. You want to make sure that you are balancing technical knowledge team members with business knowledge members.

- Pick a lead data scientist who is well versed in both programming and architectural principles. In addition, the individual must have proven leadership skills in order to direct the team to execute on case goals.
- Bring in a member who knows the supply chain in relevant industry as well as the company.
- Make sure a member of the team can tell a story from the data. This skill is different than interpreting the data or understanding the data; it's using the data to frame a discussion or provoke an action.
- Add member to the team who really understand the details of how processes work and the nature of the data.

## Data Sets:

You will be provided data set in a digital medium for this case.

先预测各个客人的成功率
成功率低的看其他因素?

# Marking Schemes

Your report and recommendation will not only be assessed on how well your model is but also on how well the team understands the problem. What are the statistical methods the team utilized to find patterns and anomalies in these data sets? Your approach to training a machine learning algorithm and ensure models

1. Representation of the problem
2. Evaluation and FIT of data
3. Optimization

### Recommended Report/Presentation format

1. Introduction

   Briefly describe your understanding of the problem and Apotex environment that you see as being critical to the solution of the problem.
2. Related Work

   Describe all extra research you performed to dig deep into the problem and your approach to recommendation.
3. Materials and Methodology
   a. Data Description, Analysis details (e.g. Statistical-ANNOVA, K-W. Auditing, Variable subsets etc.)
   b. Feature Augmentation (e.g. dimensional reduction, DTM, SVD)
   c. Selection of Machine Learning Technique (Different algorithm considered based on the problem, Optimization technique used e.g. Bayesian)
   d. Experimental Process
   e. Data Visualization (plotting-correlation, covariance etc.)
4. Results
5. Discussion and Conclusions

   Read the desired future state section above and justify all the requirements with your results and recommendations

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