Case Study: Blending Optimization

Industry: Clay Production

ESAN Industrial Raw Materials

Led by a leadership determined to put analytics in the core of decision making processes, a unique solution is created to crystalize the blending dynamics

SELCO business analytics experts worked with the ESAN analytics and planning teams to develop an optimization tool on IBM ILOG Optimization Studio that creates a space of blending recipes to increase responsiveness to solving business challenges.

Blending process challenges at ESAN

ESAN

Established in 1978 to produce high quality raw materials for the ceramics sector, ESAN became one of Turkey's foremost industrial mineral and metallic mineral producers. The plants for clay enrichment, feldspar flotation, quartz, bentonite, kaolin, magnesium metal, cat litter transform the mineral resources to high quality ingredients in many sectors.

Competency in analytics

Putting people, reliability, environmental and social responsibility and passion as its core values, ESAN continuously thrives to improve its operations. Competency in analytics is one of the leading initiatives, as the company seeks to increase its competitiveness through optimizing its decision-making processes. To gain momentum for analytics, 'blending optimization' was chosen as a compelling business problem, where optimization techniques were expected to produce faster and better results, the Bozüyük plant being the first location to do the pilot study.

Blending planning process

The goal of blending is to achieve optimum mix of particle sizes and balance the variation of quality parameters. The actual crushing and mixing of the raw materials is preceded by a planning activity, when the planning team spends time to find an optimum mix recipe for the blending batch, trying to come up with the lowest cost of raw materials, while meeting the quality parameters and also a recipe that has a low filter press cycle time.

Business challenges

The fluctuation of the chemical and the physical contents of the newly mined raw materials compel the planners to frequently change the blending recipes. The objective is to arrive to that unique recipe of raw materials that provide the optimum cost, while chemical and physical properties conform with the quality targets of the end product. Other constraints like limited raw material inventories and recipe-content based processing times complicate the planning process further. All these challenges turn the recipe planning activity into rehashing of past experience, which in the past delivered satisfactory results, but at a price of long calculation times and opportunity costs for missing the optimal solution. A transformation was essential to stay competitive.

Solution

Transformation

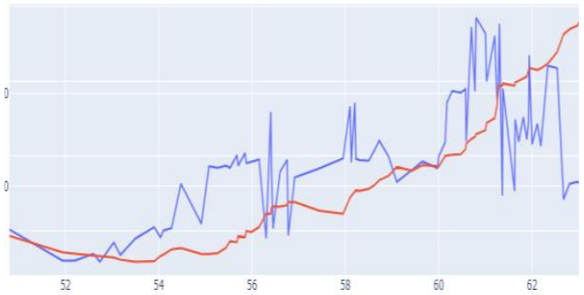
Led by a leadership passionate for managing by facts, a sophisticated solution was developed on CPLEX optimization software to provide insight to creating optimum blending recipes; the result is an instantaneous opportunity to view optimum material costs and product quality reflections.

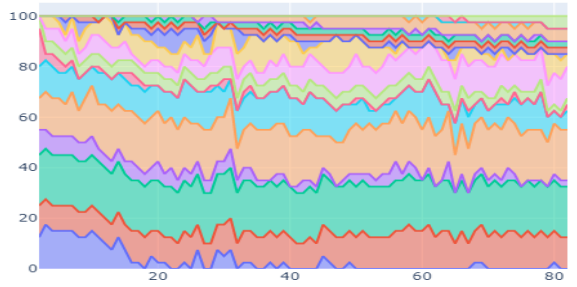
Business Requirements

The planning process has several dimensions which need to be addressed simultaneously. Raw material dynamics include batch sizes, limits on recipe contents, and inventory levels. Production capacity requirements favor those recipe contents that require less process times, as cheaper but longer process times may impose a bottleneck on plant throughput. Supply chain strategies for MTS or MTO products also shift recipe-batch size matches.

Tool

The analytical tool developed on CPLEX was supported with user friendly interfaces, allowing the users to move from managing the data to calculating the optimum blend which respects all the business requirements. It also provided a unique sensitivity analysis approach, whereby the planners can very elegantly identify how the cost and quality indicators tend to behave with different solution sets and relaxed physical/chemical constraints.





Analytical model

Analytical approach

Decision optimization is the analytical technique used and IBM's CPLEX optimizer is the tool chosen to generate the absolute best decision from a multitude of possible alternatives in a rigorous, repeatable, and provable fashion.

Model nature

The objective function to be optimized is convex and made up of two cost components: cost of raw materials and cost of filter press operations, which were respectively non-linear and quadratic in nature. The constraints also had non-linear and integer elements, making the optimization model even more complicated to be solved to optimality. Optimization in a non-linear environment is often characterized by relatively long run times and often provide a solution whose 'optimality' is at stake. The challenge was to come up with a global optimality and to produce it in single-minute run times.

Technology and techniques

The optimization model was developed on PHYTON and runs on IBM ILOG CPLEX Optimization Studio. The optimization team at SELCO came up with an intelligent solution that employed simultaneous use of 'branch and bound' and 'dynamic programming' techniques, in such an innovative fashion that the model not only guaranteed global optimality, but also produced it in single-second run times. The techniques also allowed mapping of all feasible recipe solutions across a strategic performance indicator.

Performance

The analytical model with its carefully balanced performance tuning is able to map an entire cross section of the feasible solution space, enabling the quants to better understand the dynamics of how cost improvements were made. The solution map was shown to produce a set of optimal solutions having zero-gap tolerance, despite the non-linear and quadratic nature of the problem.

The blend optimization problem is solved in single minute cycle times, including all data handling and actual optimization runs. This extraordinary performance provides valuable opportunities to planners to test multiple scenarios on demand and devote their times to be more innovative with respect to other critical supply chain decisions.

Benefits for the client

Opportunity

Top management has strategically invested into an "optimization culture" that will ensure widespread adoption of analytical tools to maximize benefits across all plants, such as but not limited to improving quality, reducing cost, speeding up product development cycles, decreasing customer response times, and better utilizing assets is fueled by optimization.

Results

SELCO's experience in supply chain made the difference for ESAN, as an idea of a tool for blend optimization quickly transformed into a broader outcome, which helped the planning teams to analyze supply constraints, to increase production capacities, and better align demand to supply.

Rapid calculation of optimal blending mixes was achieved in the early stages of the cycle and in single minutes, planners can see the optimum recipe (with a 10% less cost) and all the other feasible recipes across various key performance indicators. This capability not only dramatically reduces the new product development cycle, but also allows the planners to dedicate their times to value added and innovative tasks.

Other features of the tool allow ESAN to manage raw material inventories, increase asset utilization, and better matching customer orders to production capacities, hence allowing upper management to concentrate on optimum strategic and tactical decisions.

Testimonial

«With the help of Selco Consulting, IBM CPLEX enabled our blending process to have an optimal answer from a space of countless solutions. This methodology showed us that optimization methodology can be very useful in many sectors, where very complex and unsolved problems of dozens of parameters can be solved within seconds, more accurate than human-being could ever do.»

Timuçin BÜLBÜL
Business Development Director,
ESAN

Excellence is not a single act, but a habit

IBM ILOG CPLEX Optimization Studio is a consolidation of the OPL integrated development environment and the CPLEX and CP Optimizer solution engines in a single product. CPLEX Optimization Studio provides the fastest way to build efficient optimization models and state-of-the-art applications for the full range of planning and scheduling problems. With its integrated development environment, descriptive modeling language and built-in tools, it supports the entire model development process. CPLEX, a feature of IBM ILOG Optimization Studio, offers state of the art performance and robustness in an optimization engine for solving problems expressed as mathematical programming models.

IBM Silver Business Partner

SELCO is a recognized consulting company with distinguished capabilities in supply chain and logistics management, delivering outstanding results and helping clients to use their resources more effectively by combining leading information technology and advanced analytics.

Our culture based on integrity and diligent effort, coupled with exceptional passion for delivering results enable us to retain and develop our customer base across all major industries and service sectors. Our partners around the globe with unique knowhow clusters accelerate and enhance the value of our services.

We are a team, always proud to do the right by our clients, our partners, and our communities.