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Simulation-based Complexity Management: Leading-edge Optimization Technology saves Millions of Euros in the Global Carbon Black Supply Chain

Context

The *Carbon Black Optimizer* currently in use by BU Inorganics Materials of *Evonik Degussa GmbH* (Hanau, Germany) was developed by *SAT Strategic Advisors for Transformation AG* (SAT AG) in cooperation with A. T. Kearney in two stages. The first version, conceived at a time when orders were falling due to global economic conditions, was designed to optimize production costs for “within capacity” forecasts. Through its optimized tactical production plans, and through its strategic use to investigate “what-if” scenarios – for example, the benefit of negotiating a different production location for a customer’s order – the optimizer enabled its users to preserve and enhance profitability during a time of considerable uncertainty and change. Following its rapid development, the optimizer was quickly integrated in the company’s S&OP process, and in its first year of operation it generated very significant cost savings.

As the global economy staged a recovery and forecast volumes once again increased, an enhanced version of the optimizer was developed to optimize overall contribution margin. This version integrates production planning and sourcing decisions with order acceptance and rejection. It maximizes the profit delivered by the whole global production network for a given forecast by identifying the subset of all orders in the forecast that allows the available production capacity to be used to best advantage, and produces a production plan that delivers this return.

Scope

The Carbon Black production landscape is divided into three regions, Europe, North America and Asia, and optimization can be applied for the individual regions, or globally. The optimizer uses a familiar Excel spreadsheet interface for data presentation, editing and solution reporting, and receives data feeds from existing company systems for e.g. customer orders/forecasts and current production data. Behind the interface lies a powerful, bespoke optimization engine developed by SAT AG.

Production plans are constructed under a comprehensive set of constraints including:

- Production capacity
- Customer Approvals – which production facilities have been approved by individual customers as suitable to produce the product they require in the quality they require it
- Raw material availability
- Plant minimum and maximum production quantities
- Plant emission restrictions

Costs arise at various points in the business, for example:

- Raw material sourcing (oil prices)
- Other variable production costs
- Delivery Costs (logistics), including sea transportation, harbor duties etc.

In Carbon Black production, complexity arises from the many possible ways of servicing customer orders. A particular material may typically be produced at a number of locations within a region, as well as on a number of production lines within a single plant. Moreover, the same material can be often produced from a variety of input raw materials, each giving different characteristics with respect to yield, production rate, emissions, and cost. The quickest production method is not necessarily the cheapest or cleanest. In combination with the various constraints – (capacity, emissions, customer approvals etc.) and the various prices paid by the customers, the task of optimizing contribution margin given an over-capacity forecast is highly complex as millions of options exist.

The production lines themselves are capable of producing a range of output materials. The management of bottlenecks in production – for example, where newer, more efficient production machinery is, individually, the best option for many materials, so that some materials must be produced on other, less efficient or otherwise less desirable production lines at higher cost – is very challenging. Typically, a business will develop strategies or “rules-of-thumb” to attempt to manage this complexity: however, such strategies can become significantly sub-optimal unless they can be carefully and constantly reassessed and tuned to evolving demand and forecast patterns. When capacity hits limits, and orders from a forecast must be rejected, the interface between production planning and order acceptance becomes crucial.

During an optimization run, the *Carbon Black Optimizer* moves fluidly and effortlessly between production planning decisions and order acceptance, so that its production plans are always strongly influenced by the actual demand and forecast with the goal of maximizing overall profitability.



Optimization Technology

The technology underlying the results delivered by the optimizer was developed by SAT AG using the *Comet™* optimization platform of Dynadec, Inc. At the heart of the optimizer is a bespoke algorithm which uses the advanced facilities of *Comet™* to go beyond the results achievable with more conventional, less flexible, optimization methodologies. The extreme power of the *Comet™* platform allowed this algorithm to be developed and delivered within a relatively short time scale.

Business Benefits

The *Carbon Black Optimizer* provides *Evonik Degussa GmbH* with highly sophisticated and configurable decision-support for tactical and strategic planning, conveniently accessible through a spreadsheet interface on a standard business laptop. It has been integrated into the company's S&OP processes and serves as an important communication tool between various aspects of the business. Under the changing market conditions in which the business operates, it generates production plans that dynamically exploit changes in forecasts, raw material supply conditions or exchange rates, so maintaining competitive advantage.

In addition to its "state-of-the-art" optimization capabilities, through "what-if" scenario testing it enables planners to reduce negative effects on profitability that arise from bottlenecks in the production network by identifying customers whose production could be advantageously moved from one location to another.

As Dr. Ralph Splanemann, Vice President Supply Chain Management Inorganic Materials, says: "Due to the very complex, highly constrained, and multidimensional character of our global Carbon Black supply chain, our business environment is moving to a place where SAT's Simulation-based Complexity Management is needed to drive our decision-making. The *Carbon Black Optimizer* provided by SAT AG is a highly sophisticated "Enterprise Model" of our worldwide business and provides unmatched decision support solutions to all stakeholders in our company. The *Carbon Black Optimizer* is part of our monthly S&OP process and savings already delivered by the optimizer are in the range of multi-million Euros."

About *Evonik Degussa GmbH*

Evonik is one of the world's leading specialty chemicals companies. Specialty chemicals activities focus on high-growth megatrends – especially health, nutrition, resource efficiency,

and globalization. In 2011 Evonik's roughly 34,000 employees generated sales of € 14.5 billion and an operating result (adjusted EBITDA) of € 2.8 billion. More than 70 percent of sales are generated outside Germany, providing convincing evidence that our business is global. Evonik Degussa GmbH is based in Hanau, Germany. For more information please refer to www.evonik.com.

About *SAT Strategic Advisors for Transformation AG*

SAT Strategic Advisors for Transformation AG headquartered in Freiburg, Germany, is a worldwide operating simulation and optimization consulting company dedicated to the systematic application of Simulation-based Complexity Management, a new methodology set up to model and optimize complex-dynamics systems in all branches of industry. For more information on SAT AG please refer to www.sat-ag.com (info@sat-ag.com).