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Simulation-based Complexity Management: Leading-edge Optimization Technology allows for strategic and tactical Decision Support in the Global Silicon Verbund Supply Chain

Context

The *Silizium Verbund Optimizer* in use by BU Inorganics Materials of *Evonik Degussa GmbH* (Hanau, Germany) was developed by *SAT Strategic Advisors for Transformation AG* (SAT AG) and provides decision support for tactical and strategic planning and decision-making in the context of a global, strongly interconnected chemical production network (over 100 production units located at 11 plants). The optimizer uses a familiar Excel spreadsheet interface for data presentation, editing and solution reporting. Behind the interface lies powerful, dedicated optimization engine developed by SAT AG. This optimization engine is able to quickly compute detailed and optimal production plans that address the following classic questions of Supply Chain Management:

- Which customer orders should be produced at which production locations?
- In case of an overcapacity customer forecast, which customer orders to leave unfulfilled?
- What quantities of which raw materials to source from which suppliers?
- What is the impact of introducing new production locations, or of extending production infrastructure at existing locations? Under a range of forecasts, when should such measures be applied to maximize return on investment?
- What is the impact of closing production locations, or of reducing production infrastructure at existing locations? Under a range of forecasts, when should such measures be applied to best trade off fixed cost savings against lost revenue?

In order to ensure the relevance and accuracy of the optimizer's findings, 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 supplier relationships – minimum and maximum quantities

A further key constraint is that flow of material within the production network is “closed” in the following sense. The nature of the production network is not “linear” from raw material to finished goods. Instead, loops exist whereby “later” production steps provide input materials for “earlier” production steps. There is effectively no storage possibility, hence the production decisions must be carefully integrated to avoid build-up or shortfall of such materials. This situation applies not only within plants, but between plants through interplant shipments, and includes special customer relationships where there is a connection between the quantity of material delivered to the customer and quantities of other materials that the customer supplies as “raw material” input to production network.

Tactical Planning

The *Silizium Verbund Optimizer* can be applied to plan annual production on a monthly basis in order to optimize Contribution Margin. The availability of production resources can be freely altered, month by month, and inventory of material can be built within specified limits. This allows situations such as planned shutdowns to be incorporated in the planning. Further, the optimizer can be used to generate recommended actions in exceptional or unexpected situations, such as unplanned outages.

Strategic Planning

The solution delivered by SAT AG includes powerful facilities to support strategic planning over a five year time horizon. These enable “what if” scenarios to be constructed and evaluated efficiently, and with a high level of precision. For example:

- alternative forecast scenarios can be generated within the tool by increasing or decreasing customer demands, regionally or by market sector

- various scenario parameters can be set, such as Customer Approvals, Service Level above which complete order fulfillment is guaranteed, etc.
- as the optimizer input data is accessible from Excel, individual configuration details can be modified, and the effects assessed.

The *Silizium Verbund Optimizer* includes facilities for solution comparison, so that the results obtained on different scenarios can be compared on many levels, from the effect on high-level balance sheets down to detailed differences in production and servicing decisions.

Through the user specifying that certain production units can be optionally brought into service, or taken out of service, during the planning period, the optimizer has the freedom to balance fixed costs expenditure or savings against revenue gains or losses. In doing so, the optimizer does not simplistically examine the effect of such infrastructure changes on a single plan, but integrates decision-making on the infrastructure level – and the associated impact on fixed costs – into the context of all other planning decisions, so that the end result more accurately reflects the impact of such decisions on the business.



Optimization Technology

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

Business Benefits

The *Silizium Verbund Optimizer* provides Evonik with highly sophisticated and configurable decision-support for tactical and strategic planning, conveniently accessible through a spreadsheet interface on a standard business laptop.

The tactical dimension delivers high quality yearly plans that are focussed on optimization of Contribution Margin, while the strategic dimension provides

important input to the planning of investment decisions or cost reduction measures, allowing risk and benefit to be analysed over a range of scenarios.

The functionality provided by the optimizer makes it possible for Evonik to understand their production network better, with all its complexity and inter-connectness. Working with the optimizer can provide confirmation of already sensed characteristics of the production network. It also discloses new relationships and possibilities, and under the dynamic market conditions in which the business operates, it generates plans that are tuned to exploit changes in forecasts, raw material supply conditions or exchange rates, so maintaining competitive advantage.

As Dr. Ralph Splanemann, Vice President Supply Chain Management Inorganic Materials, says: "Due to the very complex and highly interconnected nature of our integrated global Silicon Verbund, our actual business decisions require powerful methodologies such as SAT's Simulation-based Complexity Management. The *Silizium Verbund Optimizer* provided by SAT AG is a highly sophisticated "Enterprise Model" of our worldwide Verbund and provides unmatched decision support solutions to all stakeholders in our company. We constantly use the *Silizium Verbund Optimizer* to review, control and optimize the network balance that is strongly influenced by the agile demand situation. Savings already delivered by the optimizer are in the range of a 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).