Innovations in Six Sigma: DOE Techniques & Predictive Modeling Combined for a New and Powerful Advanced Six Sigma Methodology

Introduction

Bayer MaterialScience NA encountered unacceptable levels of dead and slow moving inventory (DSMI) across many of its business units. Furthermore, Bayer's compounding business wanted to significantly improve its response time to customers to achieve competitive advantage. Bayer's Business Excellence Group assigned an experienced Six Sigma team to tackle these related problems.

Background

Bayer MaterialScience is among the world's largest polymer companies. Business activities are focused on the manufacture of high-tech polymer materials and the development of innovative solutions to problems important to their customers. Bayer MaterialScience has 30 production sites around the globe and employed approximately 15,400 people at the end of 2007.

The Challenge

Connie Conboy, Vice President of Quality and Business Excellence realized that Bayer's manufacturing facilities with their complex interaction of constraints and operating processes would be very difficult to analyze using traditional approaches. Running trials in live operations to evaluate changes is prohibitively expensive and poses unacceptable risks to operations.

The Six Sigma team was chartered to leverage SherTrack's innovative predictive manufacturing and digital modeling technology in order to develop new operating policies and processes to:

- Reduce customer lead times,
- Reduce production costs ,
- Improve Working Capital, and
- Enhance capacity utilization.

An important additional goal of this project was to validate the coupling of digital modeling / discrete-event simulation with structured design-of-experiment (DOE) methodologies to evaluate many diverse and complex manufacturing hypotheses in a "safe" manufacturing environment. The DOE enables the selection of the optimal policies and set points to maximize business performance.

Multivariate digital models are recognized as the methodology of choice for analyzing complex, non-linear systems. The Analyze and Improve phases of DMAIC are particularly challenged by the multivariate and non-linear relationships in plants with multiple production lines and tens or hundreds of product items. SherTrack's digital models and discrete event simulation provided sophisticated analytical tools for the Bayer Team.

The Approach

Bayer Subject Matter Experts (SMEs) teamed with SherTrack's Six Sigma Services group to build a realistic digital model of the complete order to fulfillment process. The SNAPPS digital model & simulator can produce daily operating records that are virtually identical to those generated by the ERP and MES systems in actual operations. For each scenario, specific performance metrics were developed for each KPI. With this capability in hand, the DOE was constructed to extract statistically significant cause and effect relationships between selected discretionary policies and the resulting business performance. A parametric model was then developed to enable further study. The cross-functional team of Bayer SMEs, Black Belts and SherTrack Services consultants leveraged the strengths of the Six Sigma DMAIC process, digital modeling & discrete-event simulation, multiple-regression analysis and DOE techniques to test the interaction of over 44 different manufacturing hypotheses without touching actual production.
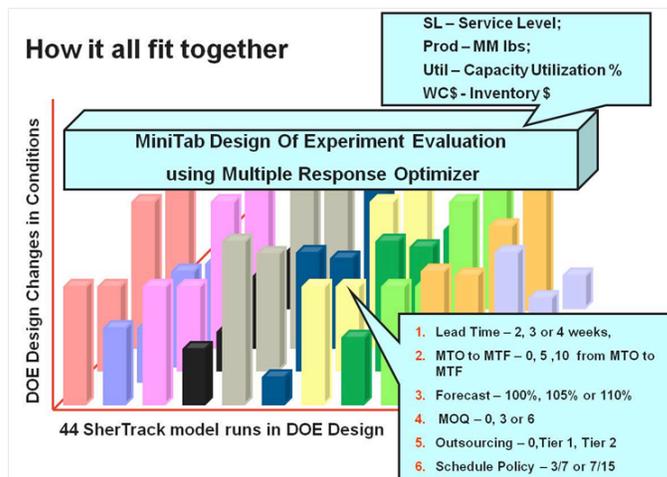
In the *Analyze* phase, SherTrack:

- Captured the physical process, operating policies and decision rules in a single integrated digital model of the process,
- Correlated operating performance with historical records,
- Enabled DOE techniques to determine feasible & optimal process capability, statistically significant cause & effect relationships and sensitivities,
- Evaluated and compared alternative process improvement scenarios, and
- Used Predictive Modeling and Predictive Analytics as decision support for executing the process improvement activities

The Results

In this DMAIC Continuous Improvement project, SherTrack demonstrated its value to the business with rapid, quantitative scenario simulation results. Hypotheses were tested and complex cause and effect relationships between project inputs (I), business and production processes (X) and expected outcomes (Y) were explored. *"This methodology provided the Bayer project team with a very robust set of quantified and qualified analyses associated with every manufacturing hypothesis within the Six Sigma set of criteria and our CTQ's"*, said Bayer's Senior Six Sigma Lead, Rick Baxendell.

What the Bayer team learned from this new and novel DMAIC methodology was that:

- Lead times can be reduced by 50%,
- Service levels can be improved by more than 5%,
- Capacity utilization rates can be raised by 10%,
- Cash flow and working capital can be improved by as much as 20%,
- Tremendous insight can be gained into production issues that impact performance,
- DMAIC / SNAPPS / DOE methodology was valid and more importantly, applicable to other plants.

| Improve |
| Lead Times AND Service Can be Improved |
| Virtually no Physical Process Barriers to Improvements |

Lead Time Reduced by 50%

Service	95%
Inventory	11.4 MM lb
Plant transitions	50 / month

Lead Time Reduced by 67%

Service	93%
Inventory	11.2 MM lb
Plant transitions	51 / month

More Information

For more information, call SherTrack at (248) 383-5620 or visit us at www.SherTrack.com