



NXP
Semiconductors

Challenge

Design, test and manufacture new semiconductor solutions that can power a rapidly changing automotive industry.

From semiconductors to semis: using data to drive the future of mobility

The auto industry increasingly relies on chip technology. NXP Semiconductors increasingly depends on analytics to optimize chipmaking.

As the automobile industry moves toward alternative power sources, expands connectivity options and embraces autonomous vehicles, it will require hardware and software that is both more diverse and more capable. At the core of those developments reside computer chips - and NXP Semiconductors. NXP is the world leader in connectivity solutions for embedded semiconductor applications in three primary areas: automotive, industrial and Internet of Things (IoT). NXP claims the No. 1 market position in automotive semiconductors and microcontrollers, in-vehicle networking and entertainment, secure vehicle access and automotive safety features such as airbags and radar.

"Electronics are more and more necessary in a car," says Corinne Bergès, PhD, who manages risk assessment, statistical and safety analysis for NXP's Advanced Automotive Analog department and leads Six Sigma training across Europe, the Middle East and Africa. "It's not possible to even imagine a car now without semiconductors." But to continue to lead the industry, NXP must design and make semiconductor solutions faster, more efficiently and with greater precision than ever before. And to achieve that goal, the company must continually improve its manufacturing and testing processes.

Central to the design and manufacture of semiconductors is data. For NXP and its partners, every aspect of the manufacturing cycle, as well as the continual improvement of that process, is data-driven. This data abundance represents both opportunities and challenges. "The more data we have, the more we can correlate that data, and the more information we can extract from that data," Bergès observes.

The challenge, Bergès says, lies in effectively managing the data volume - especially when it comes to testing. Chipmakers test their solutions with a variety of parameters and environmental conditions to identify the limits at which a device could fail or to control process variability. That process

generates a vast number of data points. "Data is worthless if we don't have the right tools to work with it," Bergès notes. "So we need to be using the newest and most innovative means to manage this data. JMP Pro uses the most innovative and effective methods, and that's very important."

JMP Pro helps with both data visualization and data analysis. "Product engineers rely on data visualizations," Bergès says, because an image can be read and understood much more quickly than rows of data alone, thereby enabling engineers to quickly spot outliers, correlations or any issue. And interactive visualization functionalities in JMP she says, have done much more than that; they have helped engineers and operators across NXP grow their capability from univariate to multivariate analysis. "In the past we did many tests, but we studied only a single test at a time, in visualization and univariate analysis," Bergès explains. "Today it's no longer possible to work with only one test." Instead, the company must correlate data for multivariate experimentation. "This kind of analytics requires advanced statistics and methods," she says - capabilities available in JMP Pro.

Cornering the market on 'corner lots'

While JMP software enables data analysis for a broad range of users, JMP Pro adds advanced features such as predictive modeling and cross-validation for scientists and engineers. One important practice for which NXP uses JMP Pro is in studying manufacturing-process variability for automotive semiconductor "corner lots." In chipmaking, a "corner lot" is a design of experiments (DOE) technique that tests extreme fabrication parameters. To verify the quality of a circuit design, chipmakers fabricate



It's simply no longer possible to do our work without JMP Pro.

Corinne Bergès, Six Sigma Training Leader in EMEA and Risk Assessment Expert for NXP's Advanced Automotive Analog Department



corner lots, or sets of semiconductor wafers with process parameters set to extremes. They test devices made from these wafers under varying environmental conditions, such as voltage and temperature, to identify their operational limits. When NXP develops a new semiconductor, it uses the corner-lot approach to perform a comprehensive analysis of variabilities that could be encountered during manufacturing. This allows the company to identify and correct any technical weaknesses in the manufacturing process.

"The traditional corner-lot approach used many engineering lots, up to 75 and more for an automotive valve driver component, with each parameter assessed separately," Bergès points out. "It was limited in that it didn't evaluate interactions between parameters." JMP Pro enables the assessment of real corner points on single lots. As a result, NXP can control dispersion of class probe parameters. Its new statistical methodology also generates yield modeling and predictions.

The journey toward defect-free manufacturing

Bergès boasts Black Belt certification in Six Sigma, the well-known set of techniques and tools for process improvement. Six Sigma is essential to Bergès - who provides Six Sigma training for NXP departments around the world - and to her company. Some 3,300 of NXP's employees are certified as White, Yellow, Green, Black or Master Black Belts.

And at NXP, JMP Pro is essential to Six Sigma. "In the Yellow Belt curriculum, there are simple concepts such as distributions and standard deviations," Bergès says. "Between Green Belt and Black Belt training, there's much about statistics to learn. And the best trainings we have at NXP are performed in JMP Pro."

NXP uses JMP Pro in numerous Six Sigma trainings covering analysis of variance (ANOVA) and regression, custom DOE, modern screening design, measurement system analysis, sources of variation analysis, and reliability. "We designed these courses with JMP three years ago," Bergès says. "And these are now the main courses for the many people within NXP who are advancing to Green Belt and Black Belt levels."

The company's Six Sigma training also covers a data-driven approach to improving process quality, called e-DMAIC (elimination-Define, Measure, Analyze, Improve, Control). e-DMAIC lies at the heart of Six Sigma. "In fact, Green Belt certification requires an improvement project with an e-DMAIC approach," Bergès says. "This e-DMAIC project has to be validated by management and scorecarded. That ensures that the knowledge being gained is actually applied in a real-world situation." While DMAIC is a well-known, structured problem-solving framework, the letter e refers to the elimination of root cause(s) that can become a real mindset. This enhancement comes from a collaborative study between NXP and Toyota, and it continues to increase quality levels. Quality is everywhere in NXP; it's at the core of the company's "Total Quality" concept.

Benefiting users, driving industry success

NXP's use of JMP Pro has been an evolution. "We were using Minitab and then JMP," Bergès recalls. "And the engineers chose JMP for its compatibility and ease of use. Now I think we'll never give up JMP." Today, 1,600 of the company's data experts actively rely on JMP solutions.

One advantage of JMP Pro, she says, is that it can be used effectively by both highly advanced statisticians and engineers with only entry-level statistical training. "With Minitab, you have to have a certain knowledge of statistics to produce meaningful analytics," she says. "But because JMP is so intuitive, anyone can achieve useful analytics." Another clear benefit is the efficiency with which JMP Pro enables NXP to conduct testing and optimize processes. "With one or two clicks, we have the most complete and accurate statistical analysis possible. We use Python for high-volume data, but if we want the fastest result, without any need for programming, we use JMP Pro."

The ability of NXP to use JMP Pro to optimize semiconductor design and testing will help keep the company at the forefront of the market. As the pace of change in the automotive industry accelerates, NXP's capacity to rapidly and reliably design and manufacture new solutions will increasingly be a differentiator. Or, Bergès says, "It's simply no longer possible to do our work without JMP Pro."

Solution

Use advanced analytics in JMP Pro to transform chip testing and manufacturing processes.

Results

JMP® Pro tangibly improves solution design and manufacturing, Six Sigma training and other process-improvement efforts that help keep NXP at the forefront of the market.

To contact your local JMP office, please visit: jmp.com/offices



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