

STMicroelectronics Shenzhen

At STMicroelectronics Shenzhen, building analytics capability is a key priority for growth

CHALLENGE

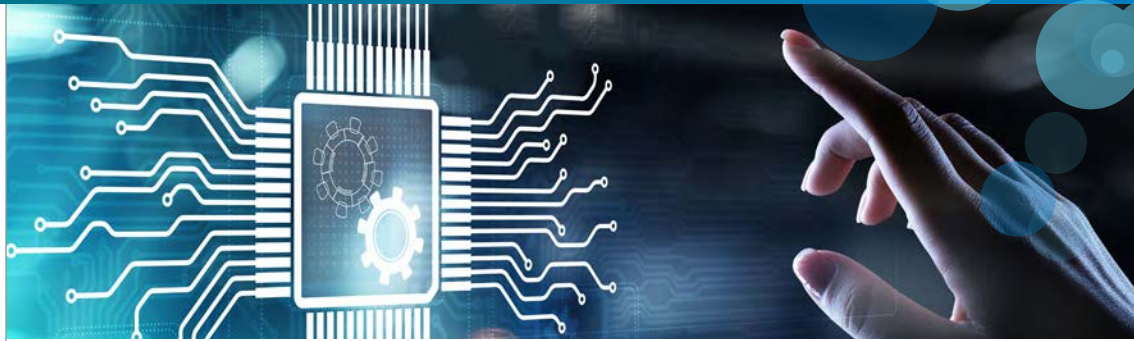
Rapid advancements in artificial intelligence, increased connectivity and progress in automation have fundamentally changed the consumer electronics landscape around the world. High-tech manufacturers like STMicroelectronics Shenzhen are seeking strategic ways to accelerate innovation toward smaller, faster, more energy-efficient high-performance microcircuit technology.

SOLUTION

Given the physical and resource constraints of a fast-paced manufacturing environment, leadership at STMicroelectronics Shenzhen recognized the need to extract more value from development and manufacturing cycles by cultivating organizationwide analytics capability. They introduced a tiered Six Sigma program that would democratize statistical problem solving with the help of a single user-friendly tool: JMP statistical discovery software.

CHALLENGE

With the widespread deployment of JMP, engineers across the organization have bid farewell to an empirical approach to problem solving and early wins - like the reduction of one manufacturing line's defect rate by 40% - have helped build momentum for analytics transformation. JMP - a tool that Deputy General Manager Wu Ling calls "a powerful complement" to the company's talent development - has changed not only engineers' ability to use statistical methods, but also the way they approach and think about data challenges.



A tiered Six Sigma program and move to standardize around JMP® software at the leading semiconductor joint venture are driving large-scale improvements in efficiency, yield and sustainable development

The consumer electronics industry is in the throes of a seismic shift with advancements in both the automation and miniaturization of smart technologies - everything from phones and computers to refrigerators and cars. In addition to the demand for ever-smaller high-performance microcircuits, concerns about global climate change are fueling a movement toward green energy and high-efficiency electronic components.

STMicroelectronics, a global leader in semiconductor manufacturing, has embraced these at times competing industry pressures using integrated approaches to microcircuit innovation. Together with its partner Shenzhen SEG Hi-Tech Industrial Co., one of the most advanced semiconductor sealing plants in the world, joint venture STMicroelectronics Shenzhen (STS) is well positioned to meet the demands of a new consumer electronics landscape. Their success, however, has been largely enabled by the organization's strategic decision to focus talent development efforts on building analytics capability from R&D to manufacturing and beyond. Data analysis, says Deputy General Manager Wu Ling, is a strong engine for growth.

"Companies can make [improvement and optimization] projects more efficient when they develop data analytics talent," he says. "That's why the introduction of JMP across STMicroelectronics has been a very powerful complement to our talent development."

Standardizing around JMP® streamlines data workflows

With its user-friendly interface and code-free end-to-end analytics workflow, JMP statistical discovery software provided an easily deployed solution to STS' need for more agile statistical tools. First adopted widely with the introduction of a tiered Six Sigma program at STS in 2019,

"There's a lot of room for improvement when it comes to using statistical methods in our plants, so some of our engineers have joined the Six Sigma Black Belt team. This is a good trend."

- Li Mingjie, Power System Operations Manager



change agents within the company began recognizing the potential of the new tool to not only make advanced industrial statistics more accessible to the plant's engineers, but also to motivate a sea change in critical thinking. With the backing of the company's executives, Six Sigma courses had by 2020 produced 41 certified Black Belts from across process engineering, R&D and quality.

As the helm of STS' Black Belt promotional efforts, Power System Operations Manager Li Mingjie is involved in many stages of the analytics workflow from data collection and metrology to analysis and automation. Without much previous exposure to statistical tools prior to the company's licensing of JMP, Li explains, she and others at STS' power facilities immediately recognized how the tool might enable them to take a more proactive approach to continuous improvement and statistical process control (SPC). Some engineers from the department have joined the Black Belt project team, with Li's encouragement, opening new opportunities for the group to apply the JMP workflow to SPC challenges.

SPC applications in JMP, adds Operational Excellence Training Manager Xiao Zhenglin, are illustrative of the advantages STS has observed since it consolidated its data analysis and management tools. SPC had previously been undertaken with the aid of an SPC-specific tool and engineers had to move between platforms to convert outputs, perform other analyses and report outcomes. By dispensing of the company's disparate specialty analysis tools and standardizing around JMP, he explains, engineering workflows are now far more time- and cost-efficient; JMP is equally adept at SPC, design of experiments, reliability, modeling and visualization applications, for example, and facilitates a more integrated approach to the way business value is extracted from data. "JMP is very practical," says Xiao. "The integrated analysis it facilitates is very helpful to the way engineers think - and think critically at a high level."

The resolution of a quality issue marks a shift toward statistical thinking - and builds momentum for a culture transformation

Statistical thinking has also become an important theme within STS's quality engineering group where JMP enablement and the Six Sigma ethos have introduced time- and cost-saving improvements. "Mastering JMP has helped us to deal with our

customers' problems and requirements at the Six Sigma Black Belt level," says Quality Engineer Sun Wentao.

Sun, who primarily works to identify and resolve quality issues that arise during the production process, is a prolific JMP user. The tool, he says, has enabled him to move from reactive quality engineering to proactive as he is now able to apply lessons from past production incidents to new product development. Though not all STS engineers were so eager to see the benefits of a companywide standard tool in JMP, Sun adds, quantifiable ROI from early proofs of concept helped to build momentum for a culture transformation.

In the first example, a team of engineers found that the Process Capability Index (CPK) for an aluminum wire bonding point thrust was less than 1.67 - the capability threshold - and that several machines were affected. Sun and his team had to answer a range of questions: What factors were associated with the decrease in CPK and was it related to the thrust direction or test parameters?

Previously, Sun explains, the team had to rely on tedious fishbone diagrams for root cause analysis wherein the probability of each cause was based on empirical inferences not backed by data. This method of theoretical and empirical argumentation may be acceptable for some qualitative root cause analysis, he says, but the data-driven approach made possible by JMP is far superior.

Ultimately, the team used a combination of hypothesis testing, single-factor variance analysis and double-sample T-tests to find significant correlation between low CPK values and artificial thrust test inconsistency. In other words, Sun says, they discovered that the setup of the thrust test tool was prone to human error - hence significant process variability. By reconfiguring the instrument, the team quickly solved the problem, returning CPK to its normal level and improving yield.

Turning to JMP®, engineers improve the defect rate by 40%

A second test case involved the resolution of a welding issue that had caused the defect rate to reach 86%. In the aluminum wire bonding industry, there are prescribed upper and lower specifications for the width of each weld; too narrow and there is insufficient bonding, too wide and the chip will fall outside of the weld parameters. Sun explains how a project team conducted defect analysis in strict accordance with DMAIC logic. First, measurement system analysis in JMP ensured that the line's equipment had the capacity to meet the weld's requirements.

"Mastering JMP has helped us to deal with our customers' problems and requirements at the Six Sigma Black Belt level."

- Sun Wentao, Quality Engineer



"JMP is very practical. The integrated analysis it facilitates is very helpful to the way engineers think – and think critically at a high level."

– Xiao Zhenglin, Training Manager, Organizational Excellence Department



Then, a root cause analysis helped Sun and his colleagues to identify unreasonable parameter settings as the source of the high defect rate. An orthogonal test in JMP followed by an analysis of the bonding point, CPK, bond point width and other indicators helped to assess whether the model was significant. With an optimized model, the STS team derived a range of two parameters from their contour line engraver and used the parameter range defined by the simulator estimate to carry out batch trials for verification.

Ultimately, Sun explains, the team reduced their defect rate by 40% without compromising bond strength. These two case studies, he adds, marked a fundamental shift in the team's thinking and helped to bring early skeptics of statistical methods in JMP on board.

Talent development begins with analytics

The momentum driving analytics transformation at STS, Wu Ling explains, is inseparable from the organization's commitment to sustainable development – a mission that not only includes social responsibility, but also the nurturing of engineering talent. From a birds-eye view, he adds, sustainable development is organizational excellence, and STS has a platform for cultivating technical expertise with very mature processes and standards.

The company, Wu says, will refine and expand its talent pool step by step, including an extension of Six Sigma projects to energy conservation and waste reduction initiatives. Furthermore, a new project called "Future Inside" focuses on data analysis and optimization to increase equipment utilization and shorten production cycles.

Looking ahead, STS aims to double its sales within three years. It's an ambitious goal, and Wu notes, will only be achieved through dual investments in technology and personnel. JMP, he adds, is the bridge between the two, and once all engineers across STS have developed the capability to really implement analytical approaches in JMP, the organization will surely feel the impact of efficiency, optimization and sustainability.

"Companies can make these projects more efficient when they develop data analytics talent. Therefore, the introduction of JMP across STMicroelectronics is a very powerful complement to our talent development."

– Wu Ling, Deputy General Manager



OTHER RESOURCES

Try JMP for free by downloading a 30-day trial: jmp.com/trial

Streamline your data access and analysis workflows with one self-service platform: jmp.com/workflow

How JMP empowers the semiconductor industry: jmp.com/semiconductor