Customer Story

OLEDWorks

Challenge

Set the pace in a rapidly emerging market.

A shining example of expert precision

Well-designed experiments deliver results for an OLED pioneer

On May 8, OLEDWorks, the country's leading manufacturer of organic light-emitting diode (OLED) light engines and panels, announced the addition of the Brite Amber panel to its suite of products. With application in health care, senior living and residential markets, Brite Amber is the first OLED lighting panel to be manufactured in the US.

Producing OLED panels requires great precision. OLEDWorks panels are coated with as many as 20 layers of organic materials. Each layer may be a single component or a co-deposition of up to four materials. The total thickness of all organic layers is only two to three tenths of a micron. Each step of this delicate process is dependent on the next, and painstaking preparation is required. Vigilance throughout is of the essence.

That's where David Lee enters our story. Lee is Director of Quality and Reliability at OLEDWorks' Rochester, NY, headquarters. (The company also has operations in Aachen, Germany.) He served as commercialization manager of the Brite Amber project, coordinating with research scientists and formulators, conducting experiments on the research side, then transferring the process into production.

A couple of years ago, Lee sat in on a talk by Bradley Jones, Principal Research Fellow for JMP® statistical discovery software. The topic was six-factor definitive screening designs (DSDs), and Lee immediately recognized the potential of DSDs in his environment – the potential to model some pretty complex systems in very few runs. "This was the beginning of the development of a robust formulation for the Brite Amber panel," Lee attests. "It could only have been done with JMP. JMP is just an amazing tool."

Properly schooled in the DOE way

Lee remembers vividly the first time he used JMP: March 9, 1992. "That's the day I started at Eastman Kodak," where he was employed for more than 20 years. "I was introduced to JMP, and I said, 'This is certainly a powerful tool.'" His enthusiasm for the tool has never waned. Lee has made a career of advocating for diligent experimentation in both R&D and production. "I've witnessed what too many people call an 'experiment,' but I call 'a random collection of trials.' You don't get the intended result, because your experiment wasn't designed to give you that."

JMP is precisely the tool for precision work, and it all starts with design of experiments (DOE). Lee can't imagine starting otherwise. "I often say that people want to run an experiment in the worst way … and they do" – prior to getting schooled in the DOE way, that is. The JMP DOE platform, he says, is a "phenomenal tool for extracting information on multiple factors in a single experiment. It needs to be set up with the right questions in mind and, of course, is only as good as the assumptions behind the experiment. But DOEs are critical to getting independent information on multiple factors."

After an experiment has been run, Lee uses profile prediction plots to examine all sorts of "what-if" scenarios. He can then take that further, conducting simulations to better understand defect probabilities. "DOE is just so fundamental," he says. "It's a springboard for other experiments, other analyses, understanding sensitivities. I can't overstate how important it is."

jmp
Statistical Discovery.™ From SAS.

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>
> David Lee, Director of Quality and Reliability, OLEDWorks

Making sense of a 'sea of data'

OLEDWorks manufactures hundreds of devices a day, and each gets tested, generating a wide variety of data types – on light output, efficiency, voltage and spectral output, for example – and Lee examines that data each day, conducting a range of tests including reliability and accelerated life tests. "We have a sea of data, and JMP is a great tool for pulling all that data together and for then doing the analysis – for making sense of that sea of data."

In conducting his analyses, Lee says he feels he's "doing a disservice" if he looks only at "x" and "y" and not at the data, especially with respect to correlated multivariate data. He analyzes the spectral response curves using principal component analysis or partial least squares. "With JMP, multivariate analysis is so easy to do." Multivariate analysis allows his team to examine wavelength-by-wavelength spectral data, looking across the visible spectrum, collecting data at almost every point.

"We of course strive for a high level of confidence around all of our decisions," Lee says. "But gathering the data and testing and manufacturing the devices is a big expense, so we have to balance risk versus sample size versus the confidence level that we want to achieve." JMP lends confidence that they've hit the sweet spot.

ROI: Running things the right way

While Lee says it's difficult to quantify the return on investment from JMP, the anecdotal evidence is strong. For example, the software's dynamic graphical interface allows him to quickly evaluate data and make decisions. He can make a plot, color by a factor and change the points to different markers, sizes and shapes based on another factor, without having to recreate the plot every time. "I'd say that interface allows me to analyze data from an experiment in half the time, maybe even less." One of the primary returns, Lee says, is simply having the ability to analyze an experiment the right way from the outset; not having to repeat it. Wasted runs are prohibitively expensive.

But the biggest return is in the ability to perform multiple analyses on a wide range of data types, such as spectral responses and life data, and be able to optimize and understand product trade-offs. Lee recalls many team meetings where data, instead of opinion, was used to derive product specs and balance trade-offs such as color point versus efficacy versus lifetime. "The combination of the JMP Prediction Profiler with the Simulation tool allowed us to understand where we might have defect losses, and thereby minimize yield loss," he explains. "Being able to predict the customer experience, and that this experience is a favorable one, is probably the ultimate ROI – customer satisfaction!"

Embracing the tools of tomorrow

Lee and his team continue to fine-tune the performance of each process step, with JMP as their analytical tool of choice. They use JMP exclusively in Rochester, and the Germany team has recently switched to it from Minitab. Lee says he's sampled other software, but found the competitors wanting: "They don't offer the newer analytic techniques that JMP embraces. I think they're falling behind.

"I really like that JMP is embracing some of the newer generalized regression techniques," he says, citing Lasso and Elastic Net as examples. He's also been very impressed with additions to the reliability platform. "As the world gathers data more quickly, you need better methods to handle it all. Some of the old-standard methods just aren't cut out to handle that much data."

With such tools, Lee and his colleagues at OLEDWorks will continue to drive the future of organic light-emitting diode technology. In 10 years, he says, they hope that all new builds will involve solid state lighting. Lee is proud to be at the forefront, with the distinction of having helped produce the first OLED lighting panel manufactured in the US. "That's a nice feeling," he says.

Solution

OLEDWorks fully capitalizes on the design of experiment capabilities of JMP, and other platforms with JMP, to refine its delicate processes.

Results

The company has produced the first organic light-emitting diode lighting panel manufactured in the US.

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