

# DuPont

Investing in an analytics-capable workforce helps DuPont extract maximum value from its state-of-the-art digital factories

## CHALLENGE

Modern manufacturing environments are subject to constant mechanical and process evolution – a result of increasing digitization, the advent of new technologies and the collection of ever more data. At DuPont's state-of-the-art facilities in Hsinchu Site II, Taiwan, a deep culture of continuous improvement is the only way to respond to ever-accelerating advances in systems infrastructure

## SOLUTION

A compulsory in-house Six Sigma training program based on JMP® statistical discovery software has accelerated the rollout of advanced analytics at the enterprise level. Today, every DuPont engineer has the ability – and tools – to apply best practices in data analytics, achieving key performance indicators faster and more cost-efficiently.

## RESULTS

By prioritizing the development of core analytics capability, DuPont Taiwan has optimized the value that can be extracted from its smart manufacturing facilities. The company's dual investment in both technology and upskilling has become a cornerstone of DuPont's competitive edge.



## Analytics enablement, a not-so-secret weapon

Recent advances in 5G and artificial intelligence (AI) have set off a cascade of innovation in adjacent technologies, from cloud-integrated manufacturing environments to smart sensors to high-end packaging. But with this new generation of manufacturing systems come both unprecedented demand and unprecedented challenges.

One of the world's innovation leaders in this space is DuPont, a company committed to providing leading-edge semiconductor material solutions. In Hsinchu Site II, Taiwan, DuPont has, over the course of more than 50 years, earned a reputation for driving innovation cycles that have advanced semiconductor technology not just in Taiwan but on a global scale.

DuPont Taiwan's leadership credits their competitiveness in the age of digital factories in part to the organization's embrace of modern analytical methods, which have been prioritized at the enterprise level. In fact, Six Sigma training is now compulsory for all new hires within their first year of employment at DuPont. This mandate is widely viewed as recognition that even the most advanced manufacturing systems achieve little if the engineering workforce that operates them lack analytics skill and capability – a reality that other companies have failed to act on with such agility.

## A robust Six Sigma training program builds analytics capability

How does one upskill an entire workforce in analytics? Invest in compulsory training and give staff the tools they need to engage with the data already being collected by the digital factory, explains Unit Manager Ifrans Pang. A Six Sigma Master Black Belt, Pang now oversees the company's Six Sigma training program and is often his colleagues' primary point of contact for one-on-one guidance when it comes to resolving especially complex data challenges.

In Pang's view, training courses are most successful when they encourage trainees to not only develop a more nuanced understanding of statistical concepts, but also to learn the practical skills that will enable them to implement statistical methods once they return to the factory. Standardizing around a single software has been key to scaling up DuPont's training philosophy – and analytics ethos. Following the lead of Dow Chemical in the wake of the two companies' 2017 merger, DuPont chose JMP® statistical discovery software.

"JMP has become the standard package for all Six Sigma training at DuPont Taiwan," Pang explains. At the introductory level, trainees who are just starting out with analytics install JMP on day one and progress through control charts, process capability analysis, measurement systems analysis and design of experiments (DOE). These skills are reinforced throughout the year even outside of training when employees are encouraged to participate in simulation games and the company's two annual continuous improvement project competitions – all of which exclusively use JMP.

These multidisciplinary analytics initiatives are seen as a key part of career development and an opportunity to keep analytics skills sharp while also deepening collaborative problem solving across the company. As more and more engineers move through DuPont's rigorous training program – and participate in continuing education – leadership says that the capability of the whole organization has advanced significantly. They attribute that improvement in no small part to more widespread use of JMP.

## Investing in employees who advocate for analytical approaches

"At DuPont, every project needs to be backed by data and statistics," explains Process Control System Manager Miles Chan. Those engineers who have most readily embraced analytics enablement, becoming power users of JMP, have gained recognition for thought leadership within the company. Moreover, since the software's introduction, leadership at DuPont began incentivizing JMP use through its internal promotion structures.

"JMP is very powerful. The interface is clean and tidy, and it is very intuitive," says Run Plant Engineer Vinson Wei. "Even without training, JMP is easy to use, especially for engineers." Wei, whose work focuses primarily on process reliability, uses distributions, Graph Builder, run chart and ANOVA in JMP for root cause analysis. But most importantly, he says, JMP helps to identify sources of variation quickly.

It is early proofs of concept, he explains, that have helped demonstrate quantifiable value in JMP – both in terms of time savings and cost reduction – and overcome initial skepticism among his colleagues. One early-stage critic was Analytical Lab Senior Engineer Jerry Huang, a longtime Minitab and SPSS user who was at first resistant to the change in tool. But after witnessing the success of several projects, Huang saw in JMP a more user-friendly tool for multivariate experimentation. And he has been a proponent ever since.

"When using DOE, JMP provides so much power – and complete model predictions, which can help us find optimal conditions very accurately and quickly. This is not available in other software."

## A more analytics-capable workforce more nimbly responds to customer needs

Data-driven communications are another key – and sometimes underappreciated – facet to the analytics culture DuPont has cultivated through its extensive training program. With the data outputs of DuPont's digital factory now entirely connected to JMP, DuPont's engineers use JMP reports to present to customers, standardizing around the common language of data visualization.


Whether working with customers or colleagues, Wei explains, it is imperative that teams articulate information clearly – and do so in the shortest possible time. Dynamic visualizations, he explains, are the best way to share information intuitively, and in a format where errors or outliers are immediately apparent.

"JMP outputs are easy to understand, concise and visually explain the project clearly and easily," Huang adds. Efficient communication with customers has enabled DuPont to respond more nimbly to the evolution in customer needs that is a defining feature of high-tech manufacturing.

For example, Huang explains, as customers' process specs have upgraded from 7nm to 5nm to 3nm, DuPont has set out to develop a new generation of detection instruments. In one case, Huang, working together with Wei, helped a customer to solve an external photovoltaic detection issue.

Photovoltaic detection can be adversely affected by a number of environmental variables including temperature, altitude or probe conditions, and DuPont's customer was seeking to identify the optimal combination of conditions achievable without sacrificing cost. When the issue was first brought to DuPont, the customer was at the time relying on one-factor-at-a-time experimentation, incrementally adjusting the formula and iterating tests without quantitative key output parameters.

Huang and Wei saw quickly that a multivariate approach via multiple regression and DOE in JMP could dramatically accelerate the time required to determine a solution. The software's premier experimental design platform enabled them to establish optimal conditions that met the customer's requirements for an advanced manufacturing process with very high correlation. Furthermore, distribution mapping in JMP enabled the DuPont team to quickly



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identify and resolve variability issues – a challenge that Huang says would have required numerous experimental iterations with any other software. Had they not used JMP, he adds, the yield rate would have been much lower, potentially leading to customer satisfaction problems.

## Twice the result in half the time

As more of DuPont Taiwan's engineering force have become highly skilled in analytics, it is not just the cumulative efficiencies that have brought value to the company. Huang explains that

companywide analytics capability has enabled DuPont to extract maximum data insight from its digitized facility. And JMP, he says, is a sharp tool that empowers engineers to achieve "twice the result in half the time."

In an era where competitors are investing heavily in technology for a fully digitized manufacturing environment, many have overlooked the equally important investment in developing workforce capability. Cast in that light, DuPont's dual investment in both technology and its engineers seems prescient indeed and poised to carry the company's competitive edge well into the future.

