Xaar

Understanding – and advancing – the fine print

CHALLENGE

Make better use of data across the enterprise to improve manufacturing production and quality, innovate new industrial printing technology, and remain at the forefront of a competitive industry.

SOLUTION

JMP® and JMP Pro deliver robust statistical capabilities that have enabled Xaar's engineering teams to save time on data queries and act more proactively to introduce cost-saving improvements. The software's interactive data visualization features – in particular, Graph Builder – have democratized basic industrial statistics to technical and nontechnical users alike.

RESULTS

Xaar has applied JMP functionality and the data insights it delivers to save time, reduce costs, improve quality and innovate new solutions. Just as important, the company has attained a single version of data truth and is nurturing a culture that recognizes the business value of data.

When leadership at Xaar, an innovator in industrial printing technology, recognized the potential of a more data-centric engineering culture, Six Sigma champions turned that vision into a reality.

Xaar industrial print heads render color and shape in extraordinary detail – from synthetic flooring that looks remarkably like milled wood to ceramic tile indistinguishable from genuine marble; from photorealistic images of animals printed on glass to complex and interwoven three-dimensional objects. Based in Cambridgeshire, UK, Xaar is best known for its piezoelectric drop-on-demand inkjet technology, which can deposit precise volumes of inks and other fluids with pinpoint accuracy. The company's innovations are used in manufacturing applications that include product labeling, direct-to-shape packaging, home décor, high-end graphics and 3D/additive manufacturing.

But the industrial printing market is highly competitive, and no industry player can sit still for long. That's why Xaar has renewed its focus on technology innovation – including with the introduction in 2020 of an entirely new printhead platform, ImagineX. To sustain similarly high levels of innovation for the future, the company has reimagined its approach to data access and management.

The inflection point came when key stakeholders at Xaar recognized the business potential of a more proactive approach to industrial statistics. Underutilized data streams are costly both in terms of unproductive engineering time and the real costs of missed opportunities to optimize product and process quality.

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A single source of 'data truth'

Xaar's leadership had long recognized the potential of data to drive continuous improvement and other value-adding activities. Yet when he joined the company some years ago, Cachaco explains, that data-driven mindset hadn't yet permeated throughout the organization. Cachaco began his tenure at Xaar providing quality engineering and Six Sigma support to various teams as well as the shop floor and, over time, those responsibilities evolved into a tripartite role as practitioner, teacher and coach within Six Sigma. He had become a de facto change agent with a mandate to transform Xaar's data analytics culture.

"As a go-to person already involved in this field, I felt a lot of flexibility and freedom to do whatever was appropriate to lead that journey," he explains. "Part of my role is to acquire new knowledge from outside the company and identify where we can apply it internally."

The first challenge was to overcome data access barriers and achieve what Cachaco describes as "a single source of data truth." Data was being pulled from multiple nonparallel sources, and both time and potentially valuable insights were being lost in the process of querying and wrangling disparate data streams.

"I brought to Xaar experience with another statistical software: Minitab," he explains. "At the time [it was first introduced], it went really well, and I think helped people get onboard and on this journey of data analytics." Minitab was a significant improvement over engineers' previous go-to tool, Excel, and they learned how to incorporate data visualization into standard workflows.

As Cachaco's mindset shifted from "firefighting" to proactive analysis, however, Minitab's limitations became more apparent. When a colleague in Xaar's R&D group showed him JMP, a software that could manipulate graphics and reanalyze data on the fly, he was excited. "I started exploring JMP and having conversations about it, particularly with regards to the Graph Builder. I thought, wow, this is new. This is different, and it seems very flexible and interactive." After signing up for a webinar to learn more about JMP, he says, "from there I didn't stop!"

With JMP in hand, even those without programming skills can use the software's Query Builder interface to directly query data from a range of data sources. "That was a really, really big step for us," Cachaco emphasizes. "Because then you're not relying on IT to give you access to the data." Gaining one platform for accessing, analyzing and acting on data has been transformational and, he says, "It's starting a journey of digitalization."

Optimizing early experimentation

When it comes to analytics, Xaar's culture can be understood with a simple analogy: A pyramid of data interaction. At the bottom are data sources, everything from machine inputs to Excel spreadsheets. Above that is data access – the ability to capture and aggregate those data sources. Higher up still is data manipulation, analysis and visualization. And at the top are data-driven operational and business decisions.

JMP helps not just Six Sigma experts like Cachaco, but also engineers with an array of different levels of statistical skill move between the bottom of the pyramid and the top. Convincing colleagues to learn a new tool, however, required both sustained support from Xaar's leadership and early proofs of concept to win over the skeptics. "The best way is to demonstrate the value in small projects," Cachaco explains.

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Vasco Cachaco
Principal Six Sigma Process Champion

One of the key value-adding features of JMP is its suite of tools for design of experiments (DOE), including the definitive screening designs (DSD) platform, which is optimized for early-stage experimentation. "This technique is very useful in the first exploration of the operational range of your possibilities, when you have lots and lots of factors," Cachaco explains; something that can't be done in Minitab.

A typical project at Xaar may have 20 or more factors, and DSDs are superior to standard designs in that they provide a middle point between high and low settings for situations in which curvature exists. This innovation avoids the need for costly additional experimentation to resolve ambiguity from the initial results of standard screening designs. "You would have to do additional runs to get the same answer," Cachaco says. "So [DSD] saves a lot of time. It's brilliant."

The rollout of even standard DOE in JMP has had a significant impact on the typical experimentation workflow. "Historically, people made changes individually, without understanding the whole picture," he explains. With JMP, engineers have moved away from one-factor-at-a-time experiments to data-driven methods that reduce the total number of experimental runs needed to arrive at a solution.

Cachaco recalls a particular quality issue that had persisted at Xaar for a period of time. A complex DOE in JMP helped Cachaco and his colleagues to understand interactions among the processes and drive the right response. It was a challenging undertaking, because he had to carefully coordinate with both planning and production to create an appropriate DOE design with a meaningful sample size – and work with live production, because running a pilot production line would be cost-prohibitive.

"But the benefits were very rewarding," he says. "We definitely saw a return on investment. We also gained confidence that applying statistical methods to real-life problems can benefit the company in the long term."

Functional Data Explorer addresses challenges in product testing

While JMP has promoted the uptake of statistical applications like DOE across Xaar, the company has also made JMP Pro available to its key analytics champions. For Cachaco, advanced features like Functional Data Explorer (FDE) justify the upgrade as they enable him to provide additional support for some of the company's more complex challenges; for example, in product testing.

With piezoelectric materials, printing occurs when an electric current distorts material in the print head to eject a tiny droplet of ink via a nozzle. In some of Xaar's products, there can be as many as 2,000 nozzles ejecting droplets, therefore device testing involves 2,000 electrical responses per unit, as each print head comes off the production line. One factor of concern is the velocity with which ink droplets are deposited on a surface. "We capture the individual velocity for the 2,000 channels, but that data resolution is difficult to handle when multiple units are analyzed, leading to hundreds of thousands of data points. So we tend to look at just the average – one summary parameter," Cachaco explains. "Behind the scenes, however, we have a function defined by the individual measurements of each droplet; for example, the velocity of each of the 2,000 droplets is on the Y axis, and the number of channels is on the X axis."

This functional data is recorded for each electrically tested print head where a set of measurements forms a curve or image. With FDE – a platform specially designed to analyze functional or series data – Cachaco can look at deviations of individual functions from the average function. "And rather than missing important information by looking at averages, FDE lets you use the actual rule data and increase the resolution of your analysis," he says.
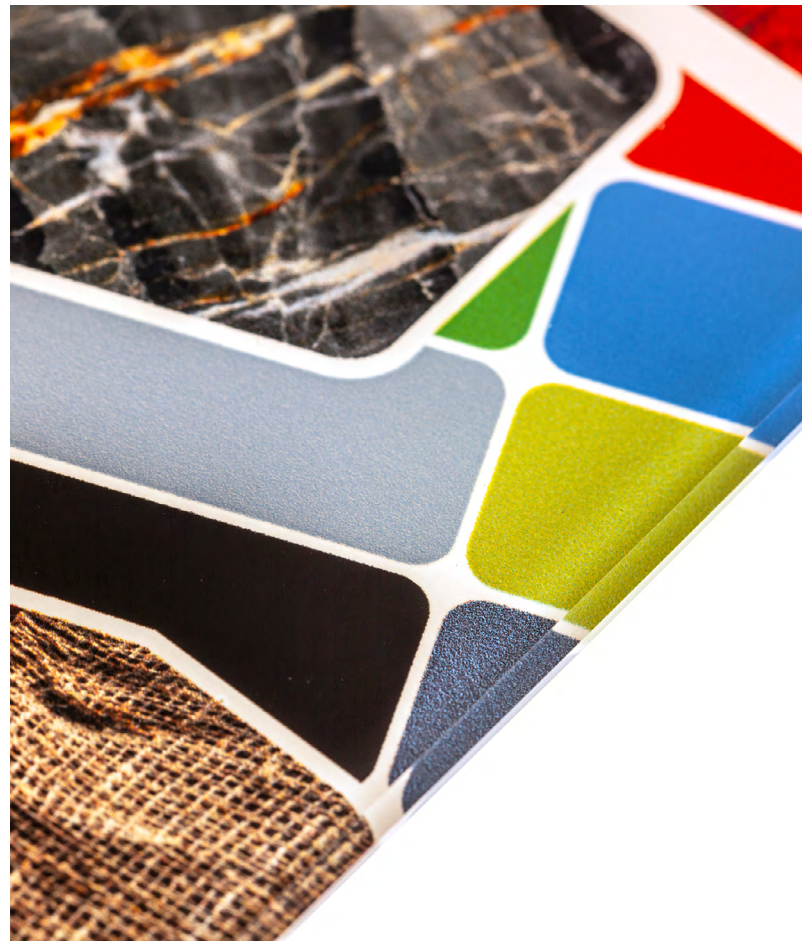
Even with the more advanced tools in JMP Pro, Cachaco still spends a majority of his time working with colleagues using the tools available in the standard JMP package. And that is by design: Accessible tools have helped raise the statistical literacy of the entire company, empowering individuals across Xaar to deploy data in value-adding ways.

"People used to often ask, 'Can you crunch these numbers for me?'" he says. "Now they're doing it themselves. That saves me time. But it also means we're spending less time on accessing the data, and more on what's really important – decision making."

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