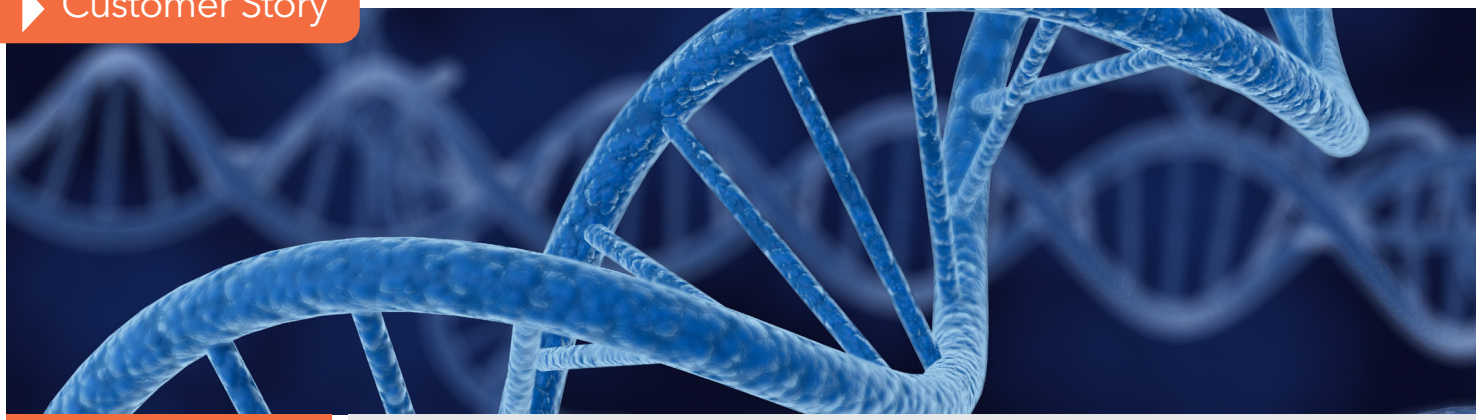
Customer Story



SynbiCITE

Challenge

To improve the reproducibility of data obtained from engineered biological systems for translation of research and ideas into commercial opportunities.

A new ecosystem for commercializing biology research

Statistical analysis brings discipline to state-of-the-art research at Imperial College's synthetic biology accelerator SynbiCITE

In academia today, the lines between scientific disciplines have become increasingly blurry. One of the newest of these intersectional disciplines is synthetic biology, a field that unites biology, chemistry and engineering. Synthetic biology is radically changing how we engineer biological systems; moving beyond the confines of academic research, it is now responsible for creating new products and services with industrial, technology and biomedical applications. Synthetic biology is today what molecular biology was 40 years ago – and generating a new wave of applied biological innovation that is driving a modern scientific economy.

Established in the UK in 2013 with a £28 million (US$39 million) commitment from government, private and academic partners, SynbiCITE, a synthetic biology accelerator, seeks to connect emerging biological research with commercial opportunities. The organization's core facility is the London DNA Foundry, located at Imperial College. Here, scientists have access to cutting-edge robotics equipment that enables the design, construction and validation of gene constructs from end to end. Beyond access to equipment, the Foundry provides educational programs, mentoring and engineering and commercialization support through a diverse staff with a wide range of expertise.

This expertise starts at the top. The CEO of Imperial College SynbiCITE, Dr. Stephen Chambers, is a serial entrepreneur who holds a PhD in molecular biology, an MS in bioengineering and a BS in biochemistry. He also leads the teaching faculty for the Lean LaunchPad for Synthetic Biology at Imperial College, an entrepreneurial training program, and maintains ongoing research in the advancement of engineering biology through automation and design of experiments (DOE). More than just an invaluable resource, Chambers provides the entrepreneurial vision that keeps SynbiCITE on the forefront of engineering biology commercialization.

From biologist to designer to entrepreneur

Synthetic biology also marks a shift in how biology is performed. "The traditional biologist is no longer a wet lab scientist. They are now more like a designer," Chambers explains. "Essentially, these biologists – or designers – are programming organisms through DNA code to make things." However, validating and scaling these experiments can be complicated and require expensive equipment and financial resources far beyond the means of most startups and small to medium-sized enterprises.

"This is where the London DNA Foundry has a role, by providing a maker space for synthetic biologists," Chambers says. "The London DNA Foundry allows them to rapidly build and test a prototype to see whether it works without making a huge investment." Engineers at the Foundry work alongside "designers" to execute on these ideas, facilitating a faster, systematic, reproducible process or prototype. With these working prototypes in hand, biologists can more clearly demonstrate the viability of results to investors, attracting capital and developing scalable infrastructure.

The role of the London DNA Foundry has taken on more significance with the increase in startup activity that is driving much of the innovation in synthetic biology. Traditionally, technology was developed at a university and spun out into new companies. "The people involved would typically be heads of departments, professors, etc.," Chambers says, and these spinouts would be supported and nurtured by the universities. "What we are now seeing, especially in synthetic biology,

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>
> Stephen Chambers, CEO

is the growth of startups still founded by university personnel, but also student and graduates, who no longer license technology from the universities. These startups do not have the same support or resources available to university spinouts, and it is these companies that are flocking to the Foundry.

Preaching the importance of reproducibility

To facilitate consistent quality and success – and in some cases, regulatory approvals – well-designed and reproducible experiments are key. "As we scale, we do a lot of quality by design … it's all about having confidence in the data and the rigor of that data so that you can present to other people and convince them that what we talk about is real," Chambers says.

Biology is complex with various factors to consider in the course of experimentation, making it sometimes difficult to identify the source of issues and to reproduce outcomes. Often, biologists lack the statistical expertise or foresight to implement a Quality by Design approach from the outset of a project, forcing them to rely on a combination of best guesses and conventional wisdom in their experimental design.

As CEO of SynbiCITE, Chambers preaches the importance of statistics to his biologists and engineers, as he has personally learned their value from his own previous experience in the lab. As Chambers well knows, not all scientists are knowledgeable about, or interested in, robust statistical analysis. "When you introduce [statistics] into a biological setting, there's an initial resistance to it," he explains. "They don't like the constraints of design of experiments. But when you see the results, they start buying in."

JMP offers a statistical package that is accessible to statistics-naive biologists while still providing powerful analytics and visualization tools. With guidance from DNA Foundry staff, these biologists can be up and running with JMP within a few days, allowing them to build their research on standardized methodologies and achieve the type and quality of outcomes they require to grow their new ventures.

Furthermore, the flexibility and visualization capabilities of JMP allow these scientists to understand what is happening with their data and rapidly adjust models based on new findings. "The visualization really helps. That's the key part," Chambers says. "Scientists can then start visualizing their experiments and understanding them." For biologists inexperienced with design of experiments and other statistical techniques, JMP gives them the tools to bring their ideas to life and show investors their potential.

Changing the conversation

While there is understandable reticence around some of these biological innovations, such as the release of genetically modified organisms, increased scientific rigor and reproducibility across the synthetic biology research landscape can only help change attitudes. Even more promising, as new products arrive on the market, advocates for synthetic biology can show real solutions to serious problems. "For example, the recent approval of Novartis' new gene therapy, Kymriah, which used engineered CAR T-cells to successfully treat childhood leukemia, is transforming the way that we treat cancers. Now we have real-life products that we can point to and appeal to people." These success stories help breed consumer and investor confidence.

Since their inception, SynbiCITE and the London DNA Foundry have shown a significant return on investment from public funding with economic benefits through the translation of research, the creation of new startups, jobs and private investment in synthetic biology companies. Going forward, SynbiCITE is now increasingly looking toward the private sector with industrial collaborators and customers, both large and small, who want to exploit the synthetic biology in the London DNA Foundry.

Solution

SynbiCITE uses JMP to deliver a systematic approach to experimentation that helps research scientists achieve the data quality necessary to validate and scale successful commercial applications.

Results

New products and services are now reaching the marketplace. These successes have led to the creation of new companies, jobs and return on investment of public funding.

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