Accelerate New Product Development in Chemicals

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Chemical Market Trends

With various segments of the global chemical market seeing growth rates as high as 5.5%, companies must continually seek new ways to keep up the trajectory.[i] Increased need due to urbanization and the rise of disposable income are fueling this growth — and show no signs of slowing. While R&D spending in more traditional chemical markets has increased roughly 3% after adjusting for inflation, interest in new markets and examining downstream opportunities to differentiate and add value is a newer trend.[ii] This diversification of product lines looks to meet growing, changing and evolving customer needs. According to Accenture, "over the past five years, funding for synthetic biology startups has increased threefold to more than $1 billion."[iii] Even familiar names outside of chemicals are weighing in: Google has been investing in synthetic food products and therapeutics since 2014.

However, simply investing in research does not guarantee a competitive advantage. Even after the market need, competitive landscape and business model are established, speed to market and first mover advantage is critical to capturing those customers with newly met, unique needs. Therefore, many companies are also rethinking how they execute R&D and new product development efforts, supplementing lab tests with artificial intelligence and trading expensive test batches for digital twin predictions.

Digitalization is a buzz word in many industries. Deloitte Global's inaugural Global Digital Chemistry Survey found that "more than 4 in 10 chemical executives expect their companies to be more digital than their competitors in the future."[iv] However, half of the executives reported that their organizations lack a digital transformation strategy.[v] This is evident when many companies have yet to succeed at revolutionizing how they do business through digitization.

Knowing the first steps to take, the people to have in place and what exactly digitalization means to the bottom line often seems too complex to tackle. Some companies are not sure where to start or which products best suit a digitalization strategy. Digital manufacturing, production optimization and efficiency examples are common, but generally only

yield benefits for ongoing operations after new products are in mass production. Successful examples that refer to new product introduction generally center around delivering new services and improving the customer experience, not making the *development* process itself more effective.

So what other role can digitalization play in new product development and increasing competitive advantage for batch industries? To answer this, we must first examine the factors impacting traditional new product development processes and speed to market.

Understanding What Impacts Speed to Market

In any industry, simply putting the best minds to work does not guarantee success. Even in agile organizations, technical development is not always the long pole in the tent; the steps before and after are what truly determine success. Even without considering requirements outside of an organization's control, such as regulatory applications, steps such as scheduling live test runs of an experiment can add to the overall cycle time.

Traditional new product development cycles may include total market value assessments, voice of the customer research and competitive analysis before the actual development starts. Technical development, innovation and invention may be a small piece of the puzzle compared to the other business processes that can often impact the critical path, such as:

▪ Delayed lab result; often 2 to 3 days' wait for data on a single 8-hour run

▪ The cost of time, materials and process disruption to conduct real-time experiments for new products

▪ Effort spent tracking various experiments that show no signs of reducing iterations to find ideal product design

Hidden Factors Impacting New Product Development

Going from first iteration to last is no easy feat. Even if there is an understanding on the direction of the desired recipe or output, variations in experiments may still arise. Even small variations can steer new product development experiments unknowingly off course. Without understanding this, a failed launch or major delays could result. Problems could come from:

- variations in raw material properties being used in the experiment
- small changes in procedure
- changing environmental conditions

Prevailing conditions and operating choices influence the outcome of each experiment. Small variations can steer a batch off course — but without understanding those exact variances, researchers can't easily forecast the outcome or effectively compensate, leading to an even more expensive test run.

Let Your Existing Data Improve Your Speed to Market

In most operating industries, mountains of data exist, including process data on temperatures and pressures, QA data on product outputs and non-process data such as ambient conditions. In addition, information such as maintenance work orders and compliance reports lives elsewhere in the organization, potentially separated from related material.

This division of data hasn't aided new product development. As digital transformation efforts increase, however, some companies are looking to this historical information to tell a story about what they could create in the future.

What is the first step in using insight on previous products to create new ones? With traditional data analytics methods, the directive would be to hire statisticians and data scientists to ramp up efforts. In addition to being unrealistic for most organizations, this approach neglects the other subset of data in companies' hands: the "hidden factories" or inherent knowledge of their process engineers and others who are intimately familiar with the ins and outs of the process itself.

Even with sophisticated tools gathering and organizing key data, a challenging task remains: analysis to determine how best to adjust the batch process for each variable to accomplish the desired outcome. With many data visualization and analysis techniques, it may still be a daunting challenge for engineers and analysts to sift through all the data patterns to identify how best to adjust a new product experiment in a timeframe that surpasses an expensive real-world test run.

What If a New Product Was a Process Change Away?

A simple process change could help your company create its newest product -- but how would you know which portion of the process to adjust? This is where Aspen ProMV's Model Optimizer and Batch Alignment tools can help. ProMV helps the people most familiar with the process and inputs make sense of the data available – **meaning no new resources required.**

Using the capabilities of ProMV Optimizer, batch and continuous chemical manufacturers can not only determine the most critical ingredients and factors in developing a new product, they can test it virtually with the given constraints of a particular process. This reduces the number of iterations required virtually, as well as the number of real-life test runs.
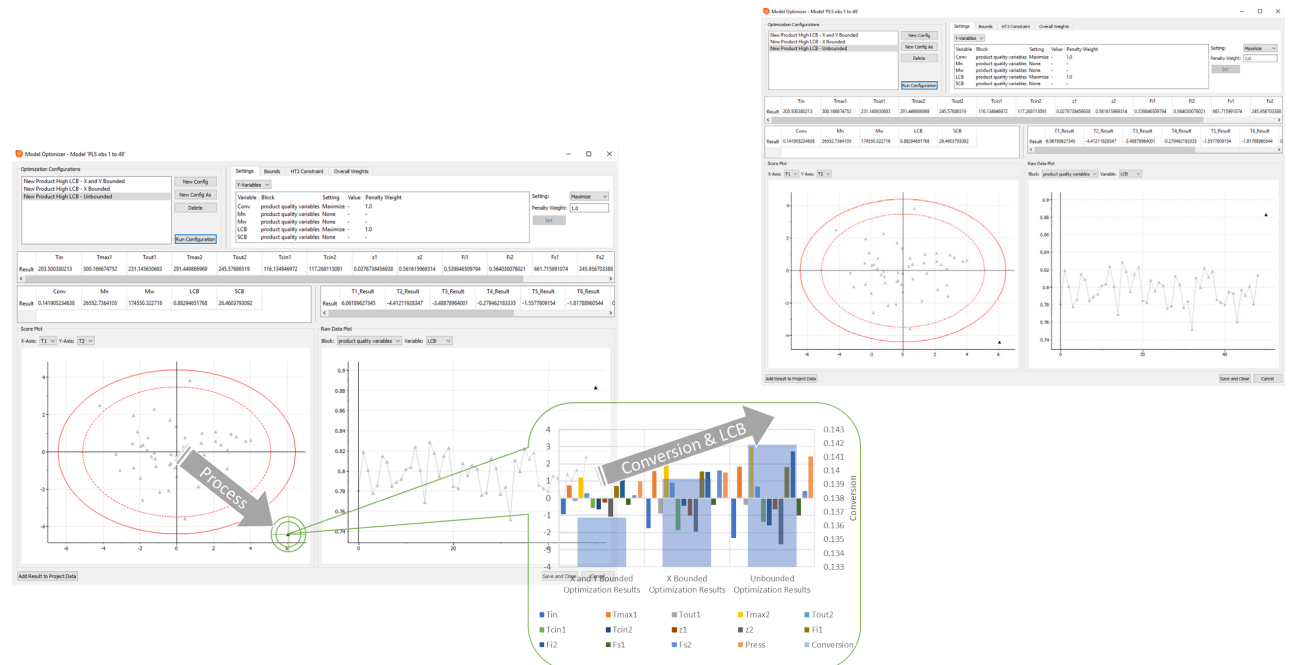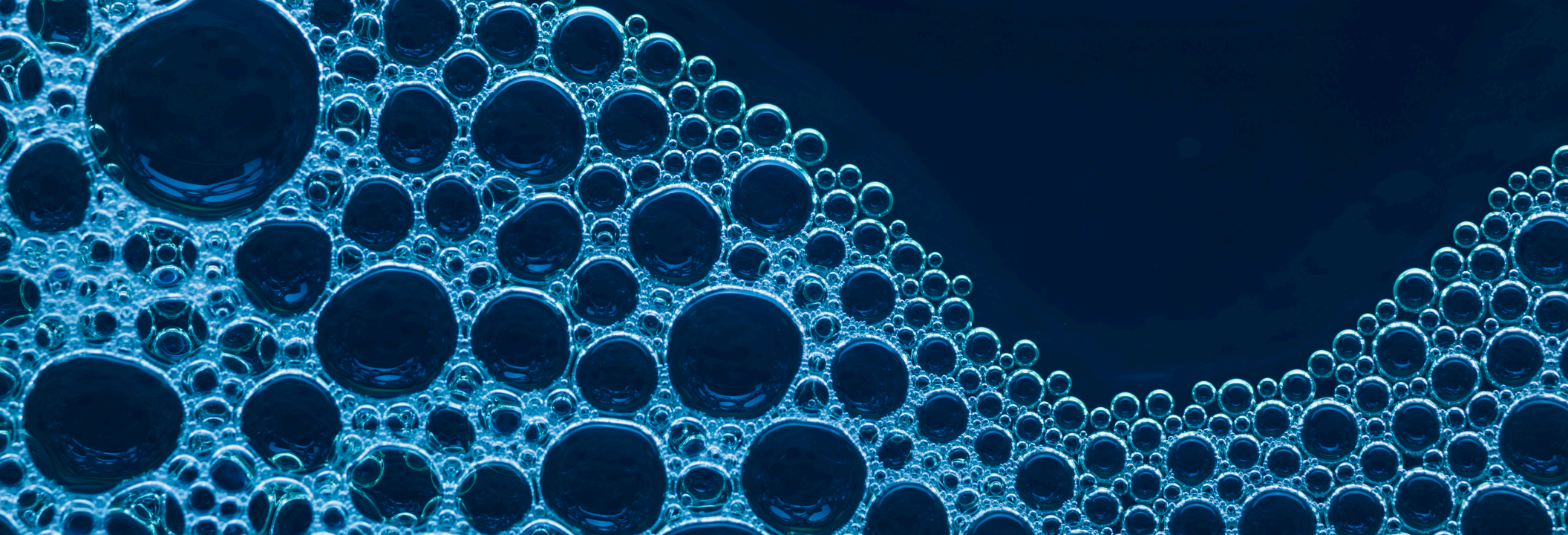
Extracting Meaningful Data Increases Speed to Market

The more quickly you can turn raw data into actionable insights, the better – especially without the need for teams of new resources. Optimizing new product development for batch processes with multivariate analytics offers tremendous value. Whether increasing speed to market or producing fewer, higher-value batches, software that quickly diagnoses batch deviation to enable informed and timely action pays for itself many times over.

Aspen Technology offers a comprehensive suite of tools to effectively collect, organize and analyze batch process data, empowering a step change in your organization's ability to take hold of the promises of Industry 4.0.

Here are examples of organizations taking advantage of these tools to speed new product development.

Lowering the Risk of Entering the Customer Order Market

A large manufacturer of silicone antifoams began seeing an uptick in requests for custom specialty products. While many requests were indeed feasible, the silicone company didn't always know this at the time of the request. Responding to customers in a timely manner put the manufacturer in a risky position: say yes to orders that ultimately were not technically feasible or say no and lose future business. Accepting or rejecting orders was a concern before even considering if the plant could logistically meet the timeline of the requests given current orders, production scheduling and raw material availability.

This customer wanted to more quickly execute complex, dynamic business decisions on requests for custom specialty products. Armed with their historical production process and end product data, the manufacturer used ProMV to simultaneously examine historical raw material properties, formulation ratios and operating conditions during mixing in the past. This allowed them to not only build a database to reference as future requests came in, but to use the ProMV Optimizer to determine if they were technically capable of producing newly requested custom products.

By more quickly assessing the ability to produce materials, the company could focus on deciding if it was logistically feasible and strategic to fill custom product orders, allowing for timely customer responses and profitable business decisions.

Solving a Tough Design Challenge

A **Canadian research university** was challenged to design a polymer whose properties change with both temperature and light. Liquid at room temperature, the polymer needed to form a gel upon injection into the eye, without suffering from exposure to UV light.

Prior to using ProMV, 23 trial-and-error formulations failed to meet one or more of the design goals. Using data from existing products, as well as the previously failed iterations, the company used ProMV Optimizer to create iterations offline, without live experiments, varying formulations of new sets of ingredients and reaction conditions. Even a failed formulation wasn't bad news though. As iterations of polymer formulations failed to meet all the objectives, the new data was added to a database and the model was updated.

Adding different formulations made for a "smarter" model, with more combinations of ingredients and process conditions to test. The company didn't need many more tests, though – the second iteration of the ProMV Optimizer framework identified a successful formulation.

Including Process Engineers in New Product Development

The process engineers at a **global food processing and commodities trading corporation** initially used ProMV to determine the root causes for several quality issues that had gone undiagnosed for a long time. The cost of quality losses was approaching $500,000 USD per year; attempts to troubleshoot using traditional methods did not resolve the problem.

Additionally, the company could not catch and remedy off-spec product in a timely manner due to lag time for lab results after batch completion. One particular production line was costing the customer roughly $250,000 USD a year. ProMV distilled over 150 process variables across 3 production lines to demonstrate that the off-spec product was due to an unrelated production line, a condition the engineers had never considered.

Using ProMV Online, this customer can predict in real time whether an end product will be off-spec. With this knowledge, process personnel can intervene and not rely 100% on lab testing.

After successfully using ProMV to resolve quality issues, the company saw another benefit. Employing ProMV with existing process data and the engineers familiar with the process as part of new product development resulted in a faster R&D turnaround. By better defining which process areas were most critical to the final product output, the customer could then predict, offline, total mash flows for a given feed. This meant fewer live experiments for new feeds, reducing the cost of developing a new product.

Relating Multiple Dimensions of Data into a Single Model

A **Fortune 500 specialty chemicals company** manufacturing polyolefins was aiming to develop new and improved products. They wanted to build a single predictive model which related raw materials, blending ratios and operating conditions to product quality. The degrees of freedom and number of variables at play make creating such a model an enormous task for traditional statistical methods.

Additionally, while product quality is a combination of various inputs (materials, ratios and conditions), some play more important roles than others. Knowing which components to prioritize prevents redundantly testing too many parameters as predictors of product quality. By using the power of ProMV's multivariable analysis modeling, the customer built a model that effectively narrowed the design space and identified which parameters to vary in order to get the desired product improvements. This allowed researchers to narrow their analysis to only one or two process units, enabling faster new product development.

Identify New Product Opportunities in Your Current Data

For chemical companies, understanding how different variations to raw materials, recipes and operating conditions influence product outcomes presents a fast track to new product development. Organizations can drastically reduce R&D time with analysis of past product and process data, insight from current employees with deep process knowledge and the ability to quickly model various formulations. Spending less time and money on experiments to develop new products increases agility and provides a competitive advantage for chemical companies seeking ways to better meet their customers' changing needs.

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[i] IHS Markit, 34th Annual World Petrochemical Conference, 2019.

[ii] "**Research Spending Continues on an Upward Trajectory.**" Mark S. Reich, Chemical & Engineering News, 9 June 2019.

[iii] "**Living Business in Chemicals: Reshaping Customer Focus for the Digital Age.**" Dr. Inna Baigozina-Goreli and George Evans, Accenture, 8 February 2018.

[iv] "**Global Digital Chemistry: Survey Quantitative Findings.**" Deloitte Global, 2016.

[v] "**The Chemical Multiverse 4.0**." Deloitte Global, 2017.