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How "Collaborative Outsourcing" helps bridge the gap between development and production in the chemical industry

by Larry Rosen, CEO, Pressure Chemical Company, (lrosen@presschem.com)

In a field such as specialty chemicals, outsourcing may sound appealing; but the real challenge is how to do it. The author lays out practical guidelines and examples of successful Product Development from his own vantage point as CEO of an independent firm that specializes in Process Development and product scaleup.

The chemical industry is one of the most influential drivers of innovation in New Product Development and innovation. There is a good reason for this. Almost all industries from electronic to textile and personal care products rely on advances in chemical products or technology. Many technological breakthroughs require advances in chemistry for their commercialization. Increasingly, the development of novel products relies on the chemical industry: electronic products, specialized polymers, modern textiles, personal care products, pharmaceuticals, and even renewable energy.

Despite the important role of chemistry in Product Development, companies continue to struggle with the transition from low volume production to increased volumes, requiring substantial capital investment. Many models that have been used in traditional product manufacturing have not adequately addressed the uniqueness of chemical product prototyping and pilot production. A revised form of the "test kitchen" model used in food Product Development may prove to be a viable solution.

Introduction

Although there are a number of drawbacks with each, the chemical industry has adapted many of the methods for NPD originally used by hardgoods companies. These include in-house development, skunk works, and outsourcing. An emerging model, *collaborative outsourcing*, addresses many of these issues and has the potential to dramatically improve flexibility and reduce time to market, risk, and cost. In a collaborative outsourcing arrangement, companies can often scale-up production without the risk of capital commitment for large-scale production. Additionally, collaborative outsourcing becomes quite valuable as a tool for open innovation when a company acquires intellectual property that is not among its core competencies.

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Some large multinational companies and high-tech startups employ collaborative outsourcing for "scaleup." Such firms combine interdisciplinary cooperation and a "test kitchen" facility, offering production capacity as well as design-enhancement capabilities. For example, a large multinational company wanted to produce a high-quality DVD but did not want to interrupt production at its plants. The company took the project to an independent chemical pilot plant to refine the product for mass production.

Similarly, a small high-tech startup company, founded by scientists from a major U.S. university, possessed the intellectual capital for a novel type of plastic but didn't have the lab facilities to scaleup the formula for commercial production. They found an outside facility with in-house technical expertise to add to its multidisciplinary development team. (Later in this article, an example of a collaborative outsourcing will illustrate the process in greater detail.)

A collaborative approach and use of a "test kitchen" facility allows a company to make improvements before committing to the capital investments needed for new equipment or for making large purchasing commitments under manufacturing agreements. At some point, unit cost becomes the driving factor. Collaborative outsourcing can provide managed growth in that it allows the company to gain the confidence needed to make a long-term commitment.

Problems with traditional methods of development

Historically, chemical Product Development has been undertaken in one of three environments: in-house, skunk works, or outsourcing. Although these models can be effective in many instances, each poses limitations in terms of cost, speed to market, market suitability, or the ability to make the leap from development to large-scale production.

In-house development

In-house development typically employs the materials and methods in current use, where the new products are evolutionary and are intended to be manufactured in existing facilities. The availability of known technology, the comfort of existing personnel with the known methods, and the direct introduction of the new products into existing manufacturing infrastructure are among the benefits of in-house development. The major problems with this traditional method, however, are opportunity cost, level of innovation, and pilot production.

By *opportunity cost* we mean that the use of existing facilities and personnel for development creates production downtime, adding to cost and increasing time to market. *Level of innovation* refers to the constraints of equipment and personnel, so that the level of novelty is limited by existing resources. *Pilot production* may be a limiting factor since there are often no intermediary production facilities that allow for market testing and process innovation.

Skunk works

Skunk works employ separate research and development units that work independently of operational-management oversight, usually in interdisciplinary teams. Although there is greater freedom to experiment and innovate, there are, nevertheless, a number of constraints, including innovation, flexibility, and pilot production.

When it comes to *innovation*, an implied or directed need to have the resulting products manufactured in existing facilities can limit the introduction of new ideas.

Skunk works can also have limited *flexibility*. This means that there may be a limited knowledge of available technology, or a team of personnel with a limited variety of differing perspectives can hinder the development process and limit the originality. Additionally, there may be limitations in *pilot production*. As with in-house development, there is often no intermediary production that allows for market testing and process scale-up or preliminary manufacture.

Outsourcing

Finally, we come to outsourcing. This technique employs non-captive entities to conduct development. This technique may allow for the introduction of new ideas, avoiding the in-house constraints of equipment and personnel; but because development performed by others is highly specialized and beyond direct control, the drawbacks may include cash cost, confidentiality, control, and, once again, pilot production.

Frequently, outside costs appear high because the internal burden is overlooked when comparing expenditures and because the internal costs are primarily non-cash. Opportunity costs, as a single example, are usually overlooked totally when considering a "make or buy" decision. This is what we mean by *cash cost* limitations. There may also be *confidentiality* concerns. The partnering company must share proprietary and confidential information when dealing with an outside entity. For reasons only a trained psychologist might comprehend, the risks are perceived to be greater than when dealing with one's own employees.

There may also be *control* issues. The business model for outsourced development firms usually does not permit the close collaboration required for cost-effective, rapid new-product/process development. *Finally, we come to pilot production* again. The paucity of development facilities with intermediary production capabilities often requires independent preliminary manufacture and disclosure of the new product concept, and can severely hinder market testing and process scale-up efforts.

Collaborative Outsourcing
What is necessary for success

- Variety of resources
- Devoted team
- Mobile equipment
- Rapid prototyping capability

Collaborative outsourcing for product scale-up

The new model that has emerged—collaborative outsourcing—provides a bridge between development and commercial production. This form of outsourcing is prevalent at the critical juncture at which a new product's promise meets the prospect of large-scale production challenges and costs. A "test kitchen" method is employed, offering a broad range of technology and personnel to test and "pilot" various products and processes, yielding an optimized set of reaction conditions that can be employed in large-scale production. Unlike traditional outsourcing, a test kitchen method fosters participation of the company's own personnel in the development process in a facility adapted to both experimentation and pilot production.

In addition, collaborative outsourcing can augment new sources and outlets for Intellectual Property in open innovation. For example, when a manufacturer buys a new idea that is not supported by its core competencies, that manufacturer has to find expertise and, most likely, external facilities for Product Development.

In the chemical industry, a company with an idea for developing a new product or process submits laboratory scale processes or simply molecular structures to an outsourced facility, such as a pilot plant. The product's feasibility of manufacture and cost estimates are evaluated; and, if appropriate, a series of tests are conducted, delivering small batches, refined estimates and proposed specifications and/or the formulations, protocols, technology recommendations, and processes that enable the new product to be produced in larger quantities.

Collaborative outsourcing has been applied in a number of cases in recent years. It has successfully allowed iterative Product Development to take place more efficiently than it could have been using corporate facilities, skunk works, or traditional outsourcing. The adjacent case study illustrates the effectiveness of this arrangement.

Larry Rosen is chairman and CEO of Pressure Chemical Company, a chemical pilot plant in Pittsburgh, Pennsylvania. For a free copy of the "Guide to Chemical Product Development," visit www.pressurechemical.com. (lrosen@presschem.com) (800) 722-5247.

Case Study of Rapid Prototyping

A chemical plant was involved in developing a novel specialized polymer intended for high-quality, high-density DVDs for a major transnational company. Although this company had substantial assets, it opted for collaborative outsourcing because of the diversity of equipment, capabilities, and personnel available at the pilot facility. The challenge was to arrive at a prototype that could be produced efficiently to gain improved performance and meet the economic demands of the product marketplace within a short time frame. The client had identified the product need and had a specific polymer architecture in mind, but did not have the capability in-house to produce samples rapidly or test the various process parameters.

The prototype development involved a number of novel issues, not the least of which was that the base polymer the client supplied to the pilot plant was a modification of a commercial polymer produced by the client in large production systems. It was not feasible to interrupt production to produce small quantities of additional prototypes for testing and product enhancement.

Unlike the typical "gated" innovation process, in which development proceeds from one discipline to the next in a rigid, linear fashion, collaborative outsourcing integrates rapid prototyping and multidisciplinary teams to create multiple prototypes that are refined through numerous and, sometimes, nearly simultaneous iterations. In this instance, the teams included catalyst, polymer, and hydrogenation experts, as well as marketing and manufacturing professionals. All these experts were integrated into the aspects of the process as follows:

- *Variety of Resources.* All required disciplines were represented.
- *Devoted Team.* An interdisciplinary team of specialists was selected and assigned to the project, based on the particular technical requirements of the project.
- *Mobile Equipment.* Much of the required equipment was portable and could be set up in a variety of configurations.
- *Rapid Prototyping Capability.* A variety of specialized systems were developed to enable early-stage configurations to be created and quickly modified.

There were several rounds of testing, as feedback from laboratory and market experts informed later iterations. While the precursor polymer was developed and tweaked, process conditions were modified to deal with the changes in each iteration. Through a process of successive approximation, each iteration in the process created additional data that informed the next phase. Several critical factors—continuous review, multidisciplinary teams, the iterative process, and the expansion of options—can all be credited for defining and achieving the desired polymer and process in a fraction of the time anticipated.