A New Approach to Product Development

An iteration-based process allows for greater creativity.

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Product development is arguably one of the most important pump industry processes. For pump original equipment manufacturers (OEMs), it accelerates organic growth and complements mergers and acquisitions. For end users, product development presents new opportunities to solve problems and lower life-cycle costs. Despite these benefits, developing innovative new products can be daunting.

Successful product development, especially in today's dynamic process equipment industry environment, is more demanding than ever. It requires solving end-user problems with a compelling value proposition that drives down costs in tangible ways. It requires meeting new demands for greater energy efficiency and lower environmental impact while developing highly differentiated products that enable OEMs to gain competitive advantage and achieve targeted return on investment in record time.

To meet this challenge, many companies are modifying the traditional phase-gate product development structure to incorporate an iteration-based approach designed to drive innovation through rapid learning cycles. They are combining this approach with systematic ways to generate and develop ideas. For end users, these new approaches to product development are leading to more innovative product solutions.

Image 1. Visual displays used during a centrifugal pump brainstorming session *(Images and graphics courtesy of PeopleFlo Manufacturing)*

Traditional Phase-Gate Structure

In the traditional phase-gate development structure, a project is divided into phases and separated by gates. Each gate serves as a formal decision point for management to

History of Pump Innovation

2000 B.C. The shadoof is invented in Egypt. It uses a long suspended rod with a bucket at one end and a weight at the other.

200 B.C. The water organ is invented in Greece. It is an air pump with valves on the bottom, a tank of water in between them, and a row of pipes on top. This principal design is now known as the reciprocating pump.

200 B.C. Archimedes invents the screw pump, considered by some to be one of the greatest inventions of all time.

1475 A centrifugal pump design for lifting mud is published in Italy.

1588 A sliding vane water pump design is published.

1593-1636 Gear pumps are developed in France and Germany.

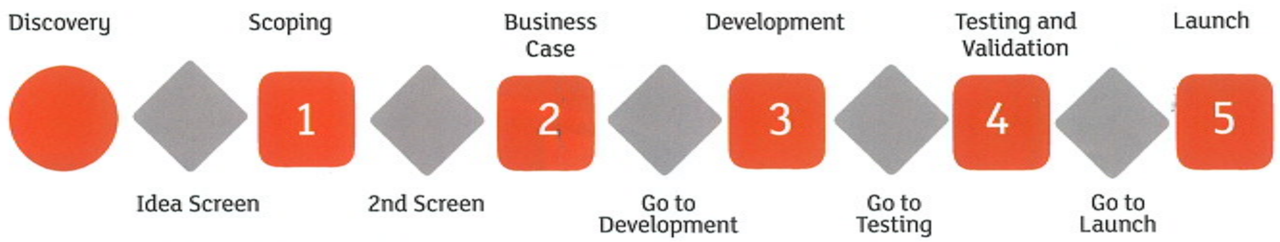


Figure 1. Traditional phase-gate product development structure

prototype shop is advantageous because of rapid part turnaround and the agility required to make quick changes. This end-to-end process drives learning through a hands-on experience that inspires creativity and often leads to valuable new, unforeseen innovation.

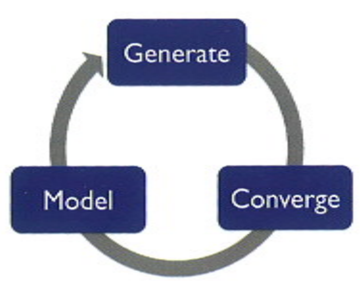
This learning-by-doing process is perhaps the best way to build critical innovation capabilities because it is based on experiential learning. Developing innovative new pump products is complex and loaded with tacit knowledge. This is hard to learn through traditional training and learning channels. Multiple iterations of idea generation and development help build critical skills in a rapid hands-on learning environment.

Holistic Iteration-Based Innovation

The opportunity to create value for both end users and pump OEMs through new product development goes beyond what is possible through innovative product design alone. How a product is made—the production technology—is just as important as how a product is designed.

End users not only want a new product that saves money, but they also want an affordable upfront price that provides quick payback and quick delivery lead times. Pump OEMs want to hit product gross margin levels that provide quick return on investment, and they aim to deliver quickly without inflated inventory levels.

A holistic development strategy that applies the iteration-based innovation approach to production technology with as much rigor as it is applied to product design leverages the value creation opportunity. This can be done without compromising seemingly conflicting interests of OEMs and end users. Creating an innovative make-to-order production cell, developed concurrently with and tailored to the new product line, has resulted in significant breakthroughs—up to 50 percent lower cost, 65 percent less upfront capital, 75 percent less floor space and outstanding delivery lead times with relatively low inventory levels. ■



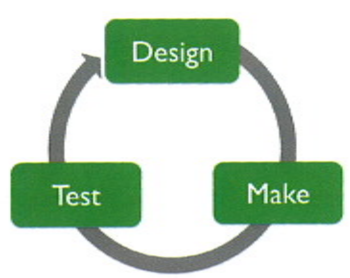


Figure 2 (left). Three-step idea generation model: 1. Generating ideas. 2. Converging these ideas to the best alternative. 3. Modeling the top ideas.

Figure 3 (right). Three-step idea development model: 1. Design using computer-aided design (CAD). 2. Make a prototype product. 3. Test the product rigorously.

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decide if and how the project will progress to the next phase. The traditional phase gate provides structure to the product development process, helps managers select the best projects and reveals major problems so they can be addressed before further investment.

But in many cases, the traditional phase-gate structure can stifle the creativity needed to develop innovative products. The time allocated for creativity comes early—and only once—in the process before it shifts to the next phase. However, opportunities to generate high-impact ideas are available throughout the entire project.

Iteration-Based Approach

An iteration-based approach combines the best elements of a phase-gate structure—high-level structure and management review points—with an iteration strategy. This combination enables development projects to become a series of mini-project cycles that includes comprehensive idea-generation activity with a design-make-test cycle of the complete product.

Each iteration builds on the in-depth learning, discoveries and results of the previous iteration. The lessons learned from one iteration are used as a starting point for the next iteration to drive improvements and spark new ideas. In the early project phases, these iterations are quick and typically involve creating concept prototypes from materials such as wood, plastic, cardboard, clay or other inexpensive quick-build materials. As the product design advances to the next iteration, the developers build prototypes with more refined and functional features that converge with higher resolution to the final design. When combined with a systematic way to generate and develop ideas, the iteration-based approach becomes a powerful way to compete based on innovation.

Idea Generation

Each iteration provides a structured yet flexible way to generate ideas, converge these ideas to the best alternatives and model the top ideas to bring them to life with further clarity.

The idea-generation process should begin with establishing the core product development challenge that will solve major end-user problems and enable OEMs to accelerate profitable growth. Only by raising the bar to seemingly impossible levels across several key success drivers can the idea-generation process provide the foundation and context necessary for product line breakthroughs.

Image 2. The computerized numerical control (CNC) machining section of a make-to-order production cell designed concurrently with a new centrifugal pump product line. Innovations included a flexible work-holding system combined with parametric CNC programs that enable production of high-mix, low-volume pump products.

Image 3. Prototypes from four iterations involved in designing a sealless hygienic centrifugal pump. From left to right: cardboard and tape concept prototypes, aluminum concept prototype, aluminum functional prototype and stainless steel functional prototype

Developers can design an idea-generation process, tailored to engineered machinery, to systematically find innovative solutions to the product development challenge. The process can be applied across a wide range of development activities—from high-level product design architecture to specific component design—and throughout all iterations of product development. The result is an ongoing flow of ideas that continuously improves the product's design, performance and cost in creative ways and allows the incorporation of late-breaking ideas. Brainstorming activity fuels the idea-generation process, and a visual environment—sketches, pictures and engineering drawings—displays ideas in full view so new ideas are inspired through cross-pollination.

Idea Development

Each iteration also provides the ideal environment for an idea-development process to bring the best ideas to life through a complete design-make-test cycle of a product. A design team co-located with a comprehensive

1650-1675 Piston pumps are developed in Germany and England.

1687 The first true centrifugal water pump is developed.

1830 The modern screw pump is introduced.

1849 All-metal pump construction is introduced in the U.S.

1859 The diaphragm pump is introduced.

1874 The vane pump is introduced.

1900 The liquid ring vacuum pump is developed in Germany.

1901 The vertical turbine pump is developed in the U.S.

1905 Multistage centrifugal pumps are developed.

1911 The internal gear pump is introduced in the U.S.

1916 Submersible pumps are invented in Russia.

1921 The use of corrosion-resistant alloys for pumps in the chemical industry is commercially introduced.

1926 The first inducer design is patented for use with centrifugal pumps.

1930 A progressive cavity pump design is patented.

1936 The metering pump is invented in the U.S.

1949 The magnet drive centrifugal pump is invented in the U.K.

1955 Air-operated double diaphragm pumps are invented in the U.S.

1962 High-speed centrifugal pumps are introduced in the U.S.