

Lean Product Development

Introduction

The ability to churn out new products at regular intervals is a critical success factor in many industries today. These products should appeal to customers and yet be cost effective. So companies should not only have a good understanding of the market but also they must be geared up internally. Indeed, product development involves various organizational challenges. Different departments such as design, vendor development, manufacturing and marketing must come together and work seamlessly if a company wants to count product development as one of its strengths. And the company must be able to leverage the knowledge which already exists within, to make the whole process more cost effective.

In this article, we discuss some best practices in new product development. We draw heavily from the automobile industry as no industry has faced greater challenges in the area of new product development than this one. The industry has also shown a remarkable ability to change with the times and respond to the needs of the market. Of course, some players like Toyota have done this better and gained a competitive edge while many others have struggled. We also take one example from the pharma industry to understand how the principles of lean product development can be applied in an industry where the uncertainty levels are very high, compared to the auto industry.

Background Note

The website www.lean.org gives a good account of how lean thinking has evolved over time. Henry Ford pioneered the assembly line system of mass production that helped cut costs dramatically. But he was unable to provide variety. The Model T was not just limited to one color but also limited to one specification. Indeed, all Model T chassis were essentially identical up through the end of production in 1926. Practically every machine in Ford worked on a single part number, and there were essentially no changeovers. When customers wanted variety, Ford seemed to lose his way. Other automakers responded to the need for many models but this led to complex production systems and long cycle time. It was left to Kiichiro Toyoda, Taiichi Ohno, and others to come up with a series of simple innovations that made it more possible to combine the best of mass and batch production.

The Toyota Production System shifted the focus from individual machines and their utilization, to the making the product flow smoothly through the total process. By right-sizing machines for the actual volume needed, introducing self-monitoring machines to

ensure quality, lining the machines up in process sequence, pioneering quick setups so each machine could make small volumes of many part numbers, and having each process step notify the previous step of its current needs for materials, Toyota strove to obtain low cost, high variety, high quality, and very rapid throughput times to respond to changing customer desires.

Toyota's continued success over the past two decades has popularized the philosophy of lean thinking. The tools and principles developed by Toyota have been applied even in non manufacturing sectors like logistics, retail, healthcare, construction, maintenance, and even government. This article covers the application of lean principles to product development.

Lean Principles

Before we come to lean product development, it would be good to understand the building blocks of lean philosophy. Lean thinking emphasizes creating precise customer value—goods and services with higher quality and fewer defects, using less resources. According to Womack and Jones, there are five lean principles.

- a) Specify value from the standpoint of the end customer by product family.
- b) Identify all the steps in the value stream for each product family, eliminating steps and actions which do not create value.
- c) Make the remaining value-creating steps occur in a tight and integrated sequence, making the product flow smoothly toward the customer.
- d) As flow is introduced, let customers pull value from the next upstream activity.
- e) Continue efforts to eliminate further waste and pursue perfection through continuous improvement.

The Honda Accord¹

The Honda Accord, launched in 1976, is today one of the most popular cars in the world. You can buy an Accord in India today provide you have money! In the late 1980s, Honda faced the challenge of developing a version of Accord that would be popular all over the world. Like any good marketer, Honda first studied carefully the requirements of

¹ “The Machine that changed the world,”

different markets. In the US, a two door coupe, a station wagon and a four door sedan were needed. In Japan, a four door hard top was needed along with the sedan and the coupe. Europe needed the sedan, the coupe and the station wagon. Honda could not afford to develop completely new vehicles for each region. The company decided to subdivide its development work into one Japanese team responsible for the basic car (including the four door sedan), one team in the US to develop the coupe and station wagon variants and one separate team in Japan for the four door hard top. The coupe and station wagons were to be produced only in the US, the sedan in both Japan and the US and the hard top in Japan only.

Once the blue print was finalized, Honda moved ahead at breakneck speed. Team members were involved in product development even as they continued to work closely with their functional departments. The Accord succeeded beyond all expectations. What Honda had done was lean product development, even though at that time, the term “lean” was not so much in use.

The Toyota Prius²

The Toyota Prius is a more recent example of innovative product development. The trigger for the project was a keen desire on the part of Toyota’s management to develop a new method for developing and manufacturing cars for the 21st century. Toyota’s engineers identified the following requirements for what they believed would be a truly breakthrough vehicle:

- a) roomy cabin space
- b) a relatively high seat position to facilitate getting in and out of the car
- c) an aerodynamic exterior
- d) a fuel economy of 20km per litre
- e) a small horizontally placed engine with a continuously variable automatic transmission (to improve fuel efficiency).

The team leader, Takeshi Uchiyamada decided to emphasise the Japanese management principle of Nemawashi, i.e., decision making by consensus, after considering all options. Uchiyamada gathered the group of experts in a big room (obeya) to discuss, review and make key decisions. This way communication among the team members improved significantly. Uchiyamada decided against quickly building a prototype to avoid getting bogged down in the details of improving the vehicle. He wanted to discuss multiple alternatives first. Uchiyamada also asked the team to focus more on the software, i.e.,

² “The Toyota Way,”

the customer needs, than the hardware, i.e., the engineering. Brainstorming sessions resulted in key words such as “natural resources” and “environment.” In their search for a fuel efficient car that would minimize environmental pollution, the product development team came up with the idea of a hybrid engine. Hybrid technology promised the optimum blend of fuel economy, low emissions feasibility and convenience. Electric motors would be used for acceleration while gas engines would be efficient when a certain speed was achieved. When the gas engine ran, the batteries would recharge. Computers could determine which of the two engines was most efficient, based on speed, road conditions, etc.

Having finalized the concept, Toyota developed a three year plan. In the first year Toyota decided to concentrate on developing a prototype, the second on working out details and the third on finalizing the production version and the manufacturing set up.

Later, the new Toyota president, Hiroshi Okuda wanted the launch time to be crashed by one year. Rising to the challenge, Uchiyamada refused a suggestion to go for a compromise approach: “We are trying to build a car for the 21st century, and our work isn’t about applying the hybrid system on existing models. If we take the conventional method of first trying out the system in a large car, we would end up making too many compromises in terms of cost and size. There would be less waste if we worked with a smaller car from the beginning.”

Toyota’s engineers worked hard and diligently, canceling all their vacations. They started work on commercializing the prototype after the clay model was selected in July 1996. The Prius was launched in October 1997, two months ahead of the December target date. The car was launched in Japan, followed by the US. Today, Toyota is a clear leader in the hybrid car segment.

The Prius project demonstrated Toyota’s world class capabilities in concurrent engineering, which is a hall mark of lean product development. The manufacturing people were involved very early in the design process. Toyota had been using simultaneous engineering even before the Prius but Uchiyamada gave a new thrust to it. Unparalleled cooperation across divisions was the result.

Fiat³

Fiat, the Italian car maker came under pressure to streamline its product development activities in the 1980s when it realized that engineering and manufacturing costs were

³ Thinking beyond lean

going out of control. Fiat began to use platform teams, each consisting of the platform director, product managers, engineering managers, platform manufacturing managers, plant general manager, purchasing manager and controller. The functional engineering departments began to staff the platform team with engineers who worked on the chassis, body, electrical and electrical components as well as engine and power train integration. Fiat decided to emphasize simultaneous engineering, i.e, doing work in parallel to speed up problem solving and reduce cycle time. Specialists outside the platform teams continued to work on new technologies so that new platforms would replace existing platforms as they started looking old and jaded. Fiat made great progress in reducing lead times and development costs. The company launched several successful designs, including the Palio, “world car” for developing countries. As the platform structure matured, Fiat began to look for ways to make more distinctive products from the same platforms.

Eli Lilly

Compared to the auto industry, the pharma industry is more volatile. Heavy investments have to be made in product development and the odds of success of a new product are not that high. According to Eric Bonabeau, Neil Bodick, Robert W, Armstrong⁴, companies often view new-product development as a monolithic process. Instead they should divide it into two distinct stages: an early stage, focused on evaluating the prospects for new products and eliminating bad bets, and a late stage, focused on maximizing the value of products considered suitable for development. This ensures effective utilization of financial and human resources and also reduction of the product development cycle time, which incidentally are two key attributes of lean product development. In 2001 Eli Lilly designed and piloted Chorus, an autonomous experimental unit dedicated solely to early-stage drug development. Chorus started to look for the most likely winners in a portfolio of molecules, recommending only the strongest candidates for costly late-stage development.

By the end of 2007, Chorus had completed work on seven molecules, recommending that four be taken up for full-scale clinical development and the other three be dropped. Chorus absorbs just one-tenth of Lilly's investment in early-stage development. Yet, it has recently delivered a substantially greater fraction of the molecules slated for late Phase II trials - at almost twice the speed and less than a third of the cost of the standard process. In some cases the usual development time has been reduced by 12-24 months.

⁴ A More Rational Approach to New-Product Development, Harvard Business Review, March 2008.

The Chorus model is well suited to drug development. Although it may postpone the scale-up of successful products, it reduces risk in an environment where development costs are phenomenal and failure rates are extremely high. Indeed, any company that needs to absorb a lot of risk in early-stage development like the biotechnology, medical devices and semiconductor industries - could probably benefit from adopting the Chorus model. The model would make less sense for companies that have low development costs and failure rates and are therefore well served by concurrent engineering or rapid-prototyping approaches that promote fast scale-up at relatively low risk.

The building blocks of lean product development

Based on the four examples given, it is useful to identify the building blocks of lean new product development.

Balancing Type I & Type II errors

Just as in Statistics, we have two types of errors, rejecting a null hypothesis when it is true and accepting it when it is false, there are two classes of decision-making errors that can impede new-product development in general. One type occurs when managers ignore evidence challenging their assumption that a project will succeed. The other occurs when a project is terminated prematurely for lack of evidence that it could succeed.

As Bonabeau, Bodick and Armstrong mention⁵, any company in an industry that relies on launching new products for growth must avoid both kinds of errors. This requires encouraging what may seem like contradictory instincts: a willingness to kill a product early and a willingness to persist until its potential is realized. Most organizations promote both kinds of errors by focusing disproportionately on late-stage development. The late-stage model imposes a rigid bureaucracy that encourages large-scale experiments, conducted to maximize the likelihood of launch. For many large companies, this approach comes naturally. Their new product development objectives, incentives, processes, and workflows are geared toward seeking success. But this makes it hard to understand accurately risky prospects quickly and cost-effectively. Because a late-stage mind-set dominates most product development efforts, creating an early-stage organization requires an entirely different mindset.

Simultaneous development

Lean product development involves working in parallel, not sequentially. This is necessary to cut cycle time. Take the case of dies. In the traditional approach, the

⁵ A More Rational Approach to New-Product Development, Harvard Business Review, March 2008.

factory waits to make dies till the precise specifications for the stamped product are available. Total development time from the first day that product designers order a new set of dies until the dies begin to stamp panels, can run into years. In contrast, the manufacturers committed to lean development begin die production at the same time as they start body design. The die designers begin to make rough cuts in the steel so that it is ready to move to final cutting as soon as the final panel designs are released.

Knowledge management

Cusumano and Nobeoka mention in their book, "Thinking beyond lean," that cross functional product project teams and heavyweight project managers are only the starting point in lean product development. Companies must change their mindset and move into a multi project mode to accelerate knowledge sharing across projects. As they mention, "Multi project management requires conscious, planned efforts to link a set of projects strategically through product portfolio planning, technologically through the design of common core components and organizationally through overlapping the responsibilities and work of project managers and individual engineers." This kind of an approach will ensure that firms strike an optimal balance between developing completely new products (developing new knowledge) and sharing existing components (sharing knowledge) across projects.

Leadership

Companies serious about lean product development like Toyota empower their team leader. The "Shusa" or the leader of the design team enjoys tremendous prestige and power. The Shusa plays the role of orchestrator, bringing together all the skills involved in making a complex manufactured product. The project, in companies like Toyota, is often identified with the Shusa himself. The best engineers in Toyota aspire to be Shusas.

High performance teams

A tightly knit team holds the key to the success of a new product development initiative. Team members come from different functional departments to which they continue to owe allegiance but they are very much controlled by the Shusa. The Shusa will evaluate the performance of team members and will control their next assignment. Team workers work hard and with great commitment. As a result, the team becomes high performing.

Communication

If we were to draw a lesson from Japanese companies like Toyota, it is that team members must resolve conflicts and set priorities early on in the project. Then they must commit themselves to formal targets. In many Japanese projects, a large number of people are involved at the outset. Trade-offs are confronted and difficult choices made. As development proceeds, the number of people involved drops. The lean producer resolves problems upfront and spends less time on correcting problems later in the development lifecycle.

Make long term calculated bets

An excessively short term orientation is in general, not good for new product development. Toyota is a good example. When the Prius project was initiated, the future of hybrid vehicles was not clear. Toyota decided to be the first mover. The best people were assigned to the project. Top management support was always forthcoming. The company decided that the project made a lot of sense in the long run even if short term profits were hard to come by. Lean product development calls for a long term orientation focused on customer needs and robust internal processes, not short term fixes.

Decision making by consensus

The hallmark of a high performing team is ownership. Team members must have a sense of ownership for the project to succeed. Toyota's Prius project is a good example. Despite the time pressures, the team moved slowly, after considering all options. From time to time, the team would reflect and examine the implications. As Liker puts it, "Go slow, build on the past, and thoroughly consider all implications of decisions, yet move aggressively to beat the competition to market with exceptional products that break the mold. This is the Toyota Way."

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