



INNOVATION, DESIGN AND MANUFACTURING

What is Innovation?

- ▶ Innovation and creativity are often used synonymously. While similar, they're not the same. Using creativity in business is important because it fosters unique ideas. This novelty is a key component of innovation.
 - ▶ For an idea to be innovative, it must also be useful. Creative ideas don't always lead to innovations because they don't necessarily produce viable solutions to problems.
 - ▶ *Simply put:* Innovation is a product, service, business model, or strategy that's both novel and useful. Innovations don't have to be major breakthroughs in technology or new business models; they can be as simple as upgrades to a company's customer service or features added to an existing product.
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What is Innovation?

- ▶ The definition of innovation addresses two important distinctions:
 - ▶ The innovation process comprises the technological development of an invention combined with the market introduction of that innovation to the end users.
 - and
 - ▶ The innovation process is iterative in nature and thus, automatically includes the first introduction of a new innovation and the reintroduction of an improved innovation.



What is Innovation?

- ▶ It is important to elucidate that an invention does not become an innovation until it has processed through production and marketing tasks and is diffused to the market place.

Innovation = Theoretical conception + Technical invention + Commercial exploitation



Invention vs Innovation

The first person to make a novel and prospectively useful product or process is an **inventor**
and

The first person or enterprise to exploit that innovation in a commercially viable product or service is an **innovator**



Example of Innovation



Sir Percy
Moreton Scott

Prior to 1898, gunnery accuracy at sea was miserable. Sir Percy Scott provided the basis for a process of continuous aim firing by adjusting guns on ships so that gunners could rapidly alter the positioning of guns to compensate for the roll of the ship.

Continuous aim firing was a process made up of components brought together by Percy Scott, none of which he invented individually guns, gears, telescopic sights – but he put them together in a highly successful way.

William Sims wrote to President Roosevelt to express his conviction about the value of continuous aim firing and in 1902 he was made Inspector of Target Practice. Scott's method was finally adopted by the US Navy over a period of about six years.

Why Innovation

Improves productivity

Improves process and organizational efficiency

Increase revenue

Increase market share

Faster speed to market for products and services

Enhances employee engagement and retention

Increase customer loyalty

Reduces risk of disruption by competitors



Types of Innovation

According to the focus of the innovation

Product Innovation

- New products and new characteristics of old products.
- The process that make them may be much the same but the product has changed incrementally or radically.

Process Innovation

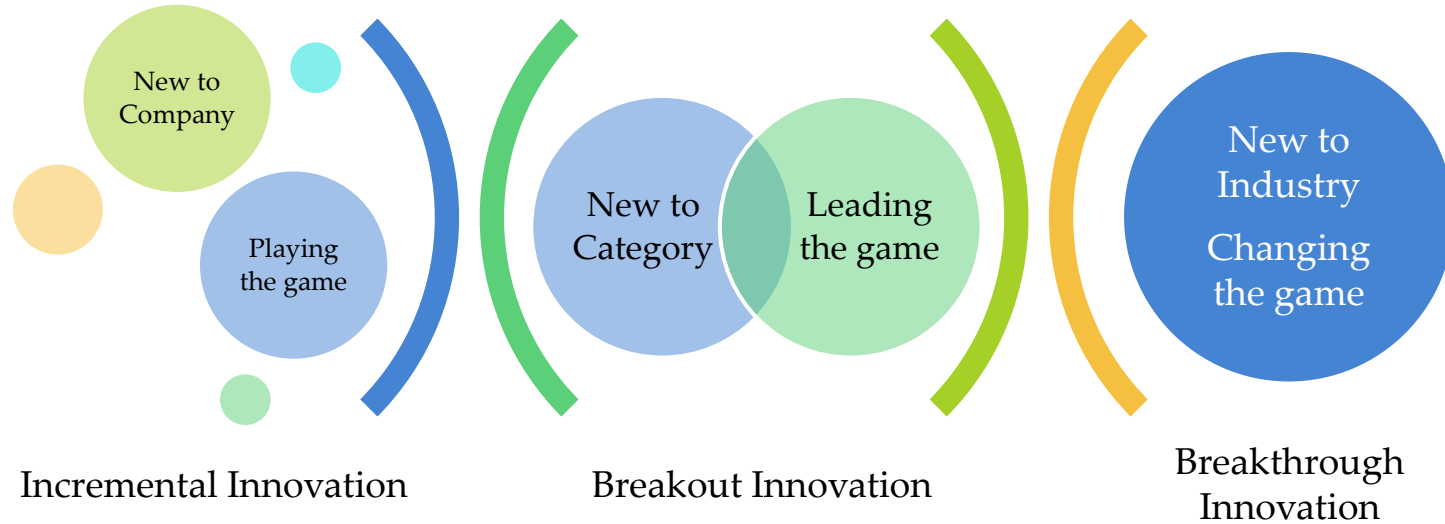
- New ways of doing something. The product may be the same but the way of producing is new, better, more efficient or more reliable.
- Computer-aided design and manufacture are process innovations.

Organizational Innovation

- New ways of structuring and managing people.
- The product and process may be the same but the way of organizing people has changed.



Levels of Innovation



Incremental Innovation

Breakout Innovation

Breakthrough Innovation

- Mobile Phone
- Keypad phone to Smart Phone
- Upgraded versions of Mobile Phones
- Film based camera to digital camera
- Traditional market to Supermarket to Online Market

Causing a fundamental transformation in the resulting products or services and/or the process technology of an entire industry.

Create significant change in the market, often making old solutions and categories obsolete over the short or long term. Breakthrough innovations require new business models and whole new ways to serve customer needs.

The Importance of Innovation

- ▶ Unforeseen challenges are inevitable in business. Innovation can help you stay ahead of the curve and grow your company in the process. Here are three reasons innovation is crucial for your business:
- ▶ **It allows adaptability:** The recent COVID-19 pandemic disrupted business on a monumental scale. Routine operations were rendered obsolete over the course of a few months. Many businesses still sustain negative results from this world shift because they've stuck to the existing methods. Innovation is often necessary for companies to adapt and overcome the challenges of change.



The Importance of Innovation

- ▶ **It fosters growth:** Stagnation can be extremely detrimental to your business. Achieving organizational and economic growth through innovation is key to staying afloat in today's highly competitive world.
- ▶ **It separates businesses from their competition:** Most industries are populated with multiple competitors offering similar products or services. Innovation can distinguish your business from others.



Introduction to Product Development

- ▶ The economic success of most firms depends on their ability to identify the needs of customers and to quickly create products that meet these needs and can be produced at low cost.
- ▶ Achieving these goals is not solely a marketing problem, nor is it solely a design problem or a manufacturing problem; it is a product development problem involving all of these functions.
- ▶ There is a need to learn the methods intended to enhance the abilities of cross-functional teams to work together to develop products.
- ▶ A *product* is something sold by an enterprise to its customers.
- ▶ *Product development* is the set of activities beginning with the perception of a market opportunity and ending in the production, sale, and delivery of a product.



Product Development Process

Planning

- Opportunity identification guided by corporate strategy.
- Assessment of technology developments and market objectives.
- Output of the planning phase is the project mission statement, which specifies the target market for the product, business goals, key assumptions, and constraints.

Concept Development

- Needs of the target market are identified.
- Alternative product concepts are generated and evaluated, and one or more concepts are selected for further development and testing.
- A concept is a description of the form, function, and features of a product and is usually accompanied by a set of specifications, an analysis of competitive products, & an economic justification of the project.

System-Level Design

- Definition of the product architecture, decomposition of the product into subsystems and components.
- Preliminary design of key components, and allocation of detail design responsibility to both internal and external resources.
- Output of this phase usually includes a geometric layout of the product, a functional specification of each of the product's subsystems, and a preliminary process flow diagram for the final assembly process.



Product Development Process

Detail Design

- Complete specification of the geometry, materials, and tolerances of all of the unique parts in the product.
- Identification of all of the standard parts to be purchased from suppliers.
- Process plan is established and tooling is designed for each part to be fabricated within the production system.
- Output is the control documentation for the product—the drawings or computer files describing the geometry of each part & its production tooling, the specifications of the purchased parts, & the process plans for the fabrication and assembly of the product.
- Three critical issues that are best considered throughout the product development process, but are finalized in the detail design phase, are materials selection, production cost, & robust performance.

Testing and Refinement

- Construction & evaluation of multiple preproduction versions of the product.
- Alpha prototypes are tested to determine whether the product will work as designed and whether the product satisfies the key customer needs.
- Beta prototypes are extensively evaluated internally and are also typically tested by customers in their own use environment.
- The goal for the beta prototypes is usually to answer questions about performance and reliability to identify necessary engineering changes for the final product.

Product Development Process

Production Ramp-up

- The product is made using the intended production system.
- The purpose of the ramp-up is to train the workforce & to work out any remaining problems in the production processes.
- Products produced during production ramp-up are sometimes supplied to preferred customers and are carefully evaluated to identify any remaining flaws. The transition from production ramp-up to ongoing production is usually gradual. At some point in this transition, the product is launched and becomes available for widespread distribution.
- A post-launch project review may occur shortly after the launch. This review includes an assessment of the project from both commercial and technical perspectives and is intended to identify ways to improve the development process for future projects.



Characteristics of Successful Product Development

- ▶ *Product quality:*

- ▶ How good is the product resulting from the development effort? Does it satisfy customer needs? Is it robust and reliable? Product quality is ultimately reflected in market share and the price that customers are willing to pay.

- ▶ *Product cost:*

- ▶ What is the manufacturing cost of the product? This cost includes spending on capital equipment and tooling as well as the incremental cost of producing each unit of the product. Product cost determines how much profit accrues to the firm for a particular sales volume and a particular sales price.



Characteristics of Successful Product Development

- ▶ *Development time:*

- ▶ How quickly did the team complete the product development effort? Development time determines how responsive the firm can be to competitive forces and to technological developments, as well as how quickly the firm receives the economic returns from the team's efforts.

- ▶ *Development cost:*

- ▶ How much did the firm have to spend to develop the product? Development cost is usually a significant fraction of the investment required to achieve the profits.



Characteristics of Successful Product Development

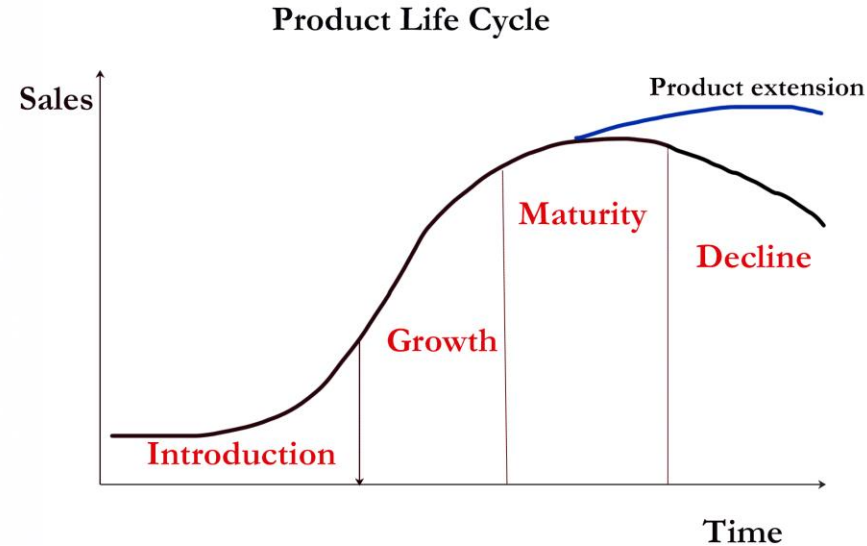
- ▶ *Development capability:*

- ▶ Are the team and the firm better able to develop future products as a result of their experience with a product development project? Development capability is an asset the firm can use to develop products more effectively and economically in the future.



Product Life Cycle

- ▶ A product life cycle is the amount of time a product goes from being introduced into the market until it's taken off the shelves.
- ▶ There are four stages in a product's life cycle—introduction, growth, maturity, and decline.
- ▶ This concept is used by management and by marketing professionals as a factor in deciding when it is appropriate to increase advertising, reduce prices, expand to new markets, or redesign packaging.
- ▶ The process of strategizing ways to continuously support and maintain a product is called product life cycle management.



How the Product Life Cycle Works

- ▶ The life cycle of a product is broken into four stages—introduction, growth, maturity, and decline.
- ▶ A product begins with an idea, and within the confines of modern business, it isn't likely to go further until it undergoes research and development (R&D) and is found to be feasible and potentially profitable.
- ▶ At that point, the product is produced, marketed, and rolled out.
- ▶ Some product life cycle models include product development as a stage, though at this point, the product has not yet been brought to customers.



Introduction Stage

- ▶ The introduction phase is the first time customers are introduced to the new product.
- ▶ A company must generally includes a substantial investment in advertising and a marketing campaign focused on making consumers aware of the product and its benefits, especially if it is broadly unknown what the item will do.
- ▶ During the introduction stage, there is often little-to-no competition for a product, as competitors may just be getting a first look at the new offering.
- ▶ However, companies still often experience negative financial results at this stage as sales tend to be lower, promotional pricing may be low to drive customer engagement, and the sales strategy is still being evaluated.



Growth Stage

- ▶ If the product is successful, it then moves to the growth stage. This is characterized by growing demand, an increase in production, and expansion in its availability.
- ▶ During the growth phase, the product becomes more popular and recognizable. A company may still choose to invest heavily in advertising if the product faces heavy competition. However, marketing campaigns will likely be geared towards differentiating its product from others as opposed to introducing the goods to the market. A company may also refine its product by improving functionality based on customer feedback.
- ▶ Financially, the growth period of the product life cycle results in increased sales and higher revenue. As competition begins to offer rival products, competition increases, potentially forcing the company to decrease prices and experience lower margins.



Maturity Stage

- ▶ The maturity stage of the product life cycle is the most profitable stage, the time when the costs of producing and marketing decline. With the market saturated with the product, competition now higher than at other stages, and profit margins starting to shrink.
 - ▶ Depending on the good, a company may begin deciding how to innovate its product or introduce new ways to capture a larger market presence. This includes getting more feedback from customers, and researching their demographics and their needs.
 - ▶ During the maturity stage, competition is at the highest level. Rival companies have had enough time to introduce competing and improved products, and competition for customers is usually highest. Sales levels stabilize, and a company strives to have its product exist in this maturity stage for as long as possible.
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Decline Stage

- ▶ As the product takes on increased competition as other companies emulate its success, the product may lose market share and begin its decline. Product sales begin to drop due to market saturation and alternative products, and the company may choose to not pursue additional marketing efforts as customers may already have determined whether they are loyal to the company's products or not.
 - ▶ Should a product be entirely retired, the company will stop generating support for it and will entirely phase out marketing endeavors.
 - ▶ Alternatively, the company may decide to revamp the product or introduce a next-generation, completely overhauled model. If the upgrade is substantial enough, the company may choose to re-enter the product life cycle by introducing the new version to the market.
 - ▶ The stage of a product's life cycle impacts the way in which it is marketed to consumers. A new product needs to be explained, while a mature product needs to be differentiated from its competitors.
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Advantages of Using the Product Life Cycle

- ▶ The product life cycle better allows marketers and business developers to better understand how each product or brand sits with a company's portfolio.
- ▶ This enables the company to internally shift resources to specific products based on those products' positioning within the product life cycle.
- ▶ For example, a company may decide to reallocate market staff time to products entering the introduction or growth stages. Alternatively, it may need to invest more cost of labor in engineers or customer service technicians as the product matures.
- ▶ The product life cycle naturally tends to have a positive impact on economic growth, as it promotes innovation and discourages supporting outdated products.
- ▶ As products move through the life cycle stages, companies that use the product life cycle can realize the need to make their products more effective, safer, efficient, faster, cheaper, or better suited to client needs.



Product Specifications

- ▶ Customer needs are generally expressed in the “language of the customer.”
- ▶ The primary customer needs are typical in terms of the subjective quality of the expressions; however, while such expressions are helpful in developing a clear sense of the issues of interest to customers, they provide little specific guidance about how to design and engineer the product. They simply leave too much margin for subjective interpretation.
- ▶ For this reason, development teams usually establish a set of specifications, which spell out in precise, measurable detail *what* the product has to do. Product specifications do not tell the team *how* to address the customer needs, but they do represent an unambiguous agreement on what the team will attempt to achieve to satisfy the customer needs.



Product Specifications

- ▶ For example, in contrast to the customer need that “the suspension is easy to install,” the corresponding specification might be that “the average time to assemble the fork to the frame is less than 75 seconds.”
- ▶ We intend the term *product specifications* to mean the precise description of what the product has to do. Some firms use the terms “product requirements” or “engineering characteristics” in this way. Other firms use “specifications” or “technical specifications” to refer to key design variables of the product.
- ▶ A *specification* (singular) consists of a *metric* and a *value*. For example, “average time to assemble” is a metric, while “less than 75 seconds” is the value of this metric.
- ▶ The *product specifications* (plural) are simply the set of the individual specifications.

