

Innovation

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Introduction

The word innovation comes from the Latin words *in* and *novare* meaning: "to make something new, to change".

There are many published definitions of innovation, but a useful short working definition is that innovation is the sum of a bright idea and its implementation (Bessant J. 2009). It is a novel creation that produces value. Innovation is the creation of a viable new offering, a qualitative change or new combinations of products or services/processes.

The key concepts in the innovation field are:

- *The invention* (The concept (idea, model, finding etc.))
- *The Innovation* (adding development, providing functionality)
- *Business Creation* (building the business vehicle for commercialisation)

Innovation may relate to products, tools and services/processes and the innovation content may vary substantially depending on the application.

There are three phases in the innovation process:

- **Invention** - the creativity and ideas phase covering processes of inventing, finding or harvesting ideas, or recognising needs and opportunities.
- **Implementation** - turning ideas into products, new services or concrete changes for the organisation – making the shift from idea to action.
- **Diffusion** – Spreading of the innovation.

Disciplined implementation activities are key to successful innovation. Successful innovation delivers elegant solutions to the problems that matter, and it often involves turning complexity of the problem into simplicity of the solution.

Categories of innovation

Typically, innovation can be divided into incremental innovation and disruptive/radical innovation. Incremental innovation is characterised by small changes in impact, while disruptive innovation is characterised by large changes in impact mediated under certain conditions, and disruptive innovations very often constitutes game-changing developments in the industry (*Tushman M.L. 1997, Wessel M. et.al. 2012*) (see the figure below).

Incremental versus disruptive innovation

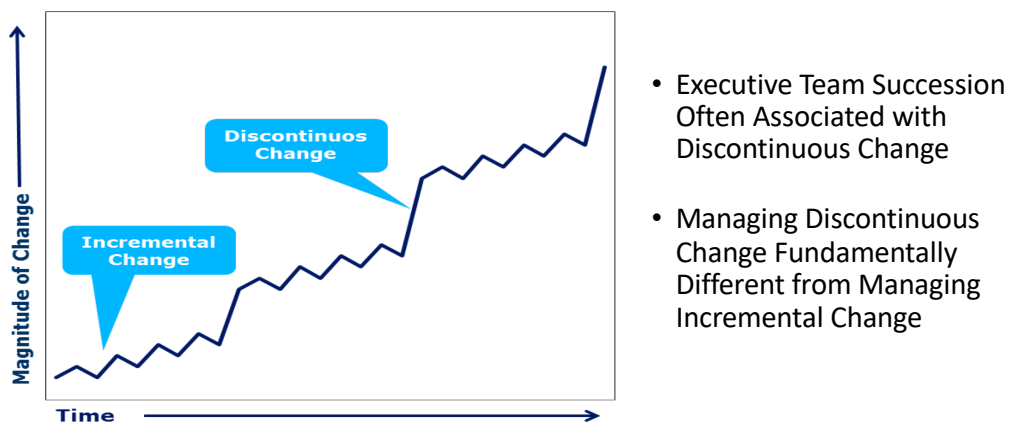


Figure. Incremental versus disruptive innovation (Source: ML Tushman. *Winning through Innovation*, 2002).

Incremental innovation reinforces capabilities of a company, becomes embedded in the ways of doing things, creates new products build on past products.

Incremental innovation addresses stable markets with familiar competitors and customers with products or services competing for small shifts in market share.

Many second-generation pharmaceutical products are examples of incremental innovation. Recent advances in type 2 diabetes product treatments have been incremental, relying on longer-acting dosage forms and/or combinations of existing drug classes. Several pharma companies are shifting their focus beyond pharmaceutical drugs and pens for injections, onto related services and adherence solutions, that can improve outcomes for patients.

Disruptive innovation may require different sets of engineering, scientific principles, technical and commercial skills. Disruptive innovation may create difficulties for established firms and open up opportunities for entry of new and different products or services and eventually disrupts an existing market and value network, displacing established market leading firms, products, and alliances. Disruptive innovation may open new markets and potential applications. A new 'dominant design' may emerge.

What makes an innovation disruptive? Three factors seems to be important

Performance Push

- *An overwhelmingly superior technology/process (mass production, penicillin)*

Customer Pull

- *New customers care about different measures of performance (wireless phones, personal computers)*

Organizational Competencies

- *Incumbents cannot do what the innovators can (Dell supply chain)*

Innovation may also be classified according to the novelty of customers' markets (Y axis) and the novelty of the company's offerings (X axis). The figure below illustrates this classification using watches as an example.

Types of Innovation and Innovation Streams

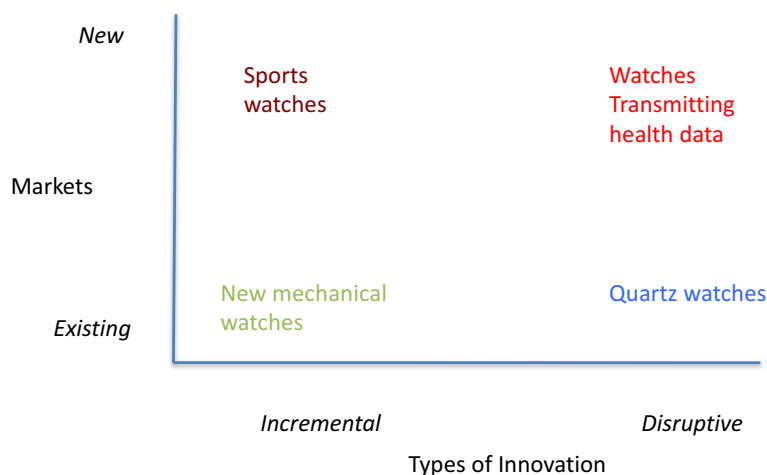


Figure. Types of innovation and innovation streams.

Innovation may be characterised further by looking at different dimensions. The extent of innovation may be outlined in relation to the source of new technology (internal versus external), as seen in the figure below, which uses the pharmaceutical industry as an example.

Innovation and source of technology

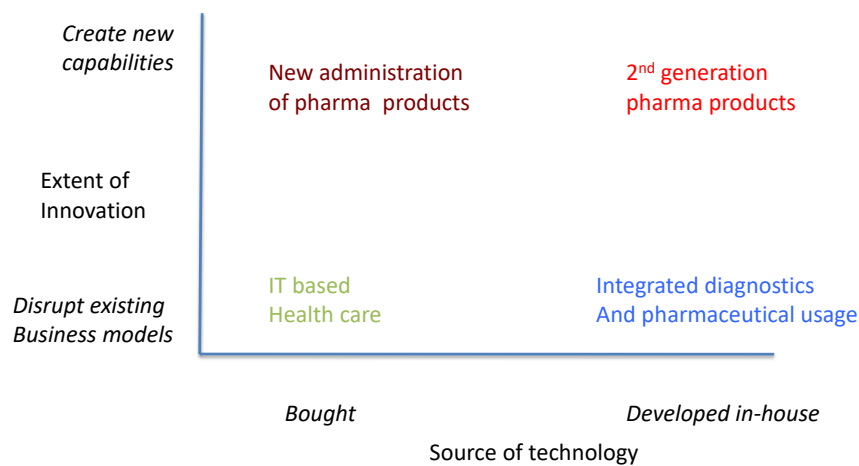


Figure. Innovation and source of technology.

Innovation within the biotechnology sector may include pharmaceutical drugs (whether they are small molecules such as Citalopram, replacement proteins such as insulin, monoclonal antibodies or other types), diagnostic improvements, delivery devices and scientific tools for the research and development process. Innovation within the pharmaceutical industry normally takes place in a regulated environment that sets a clear frame for the implementation process.

Applications of innovation

Innovation may lead to new products, tools or services, but a new business model may also be a new innovation. Business model innovation address new markets (who is your customer?) and/or new offers (what do you offer your customers?) and/or new ways of doing business (how do you do this?).

Doblin and Keeley have suggested ten types of innovation, related to: profit or business model, network, organisation, process, product performance, product system, service, channel, brand, and customer experience/engagement (Keeley L, 2013) (see figure below).

Ten types of Innovation (Doblin)

Finance	Process	Offering	Delivery
Business model How the enterprise makes money	Enabling process Assembled capabilities you typically buy from others	Product performance Features and functionality	Channel How you connect customers to your offering
Networking How your value chain and partners make your offering distinctive	Core process Proprietary processes that add value	Product system Extended system surrounding an offering	Customer experience How you create an integrated experience
		Service How you service customers	Brand How you express your value to customers

Figure. Ten types of innovation.

These types of innovation are described in more detail.

The profit-model innovation involves innovations in the way a company makes money, or innovations to the value model for other institutions, like Non-Government Organisations. Examples of profit-model innovations include premium prices of products, auctions and subscriptions to magazines.

Network innovation involves innovations in the way a company connects with others to create value. Examples of networks to inspire innovation include open innovation, prizes in open competitions and crowd-sourcing.

Structural innovation involves innovations in the way a company or institution organizes and aligns talents and assets. Examples of innovation of

structures include talent management, incentive systems, standardizing assets and corporate universities.

Process innovation involves using signature or superior methods to do your work. Examples of innovation affecting processes include lean production, process standardisation and predictive analytics.

Product performance innovation involves development of distinguishing features and functionality of products or services. Examples of product performance innovations include simplification, sustainability and customization.

Product system innovation involves creating complementary products and services, modularity and integration. Examples of innovations in product systems include product bundling, app stores, and product and service combinations.

Service innovation involves supporting and amplifying the value of a company's offerings and providing additional support around core offerings. Service deliveries may be optimized by having the right interactions and tasks within the right boundaries and with the right location (physical or electronically) in relation to the customer. Examples of service innovations include maintenance plans, customer support and warranties.

Channel innovation involves finding innovative ways to deliver offerings to customers and users. Examples of channel innovations include e-commerce and physical stores creating special experiences, such as flagship stores with signature venues.

Customer engagement involves fostering compelling interactions. The social media space offers opportunities to engage customers, and some companies offer elegant and intuitive packaging of products.

Brand innovation relates to how you represent your offerings and your business. Such innovations may include designing and communicating about brands in ways that are both distinct from competitors and relevant to customers. Brand innovations help to ensure that customers and users recognize, remember and prefer company offerings to those from competitors or substitutes. Extensions of offerings and establishing a sense of common values among customers are examples of brand innovations.

Companies using a combination of these innovation types tend to generate better returns. Typical innovators use an average number of 1.8 of these kinds of innovations, while top innovators use an average of 3.6 of these innovations.

Open and closed innovation

Access to innovation can be orchestrated via open or closed innovation.

Open innovation is a business concept developed by Henry Chesbrough in 2003, which encourages companies to explore and exploit outside sources of innovation in order to improve product lines and shorten the time to bring products to the market.

Open Innovation **combine internal and external ideas as well as internal and external paths to market to advance the development of new technologies.**

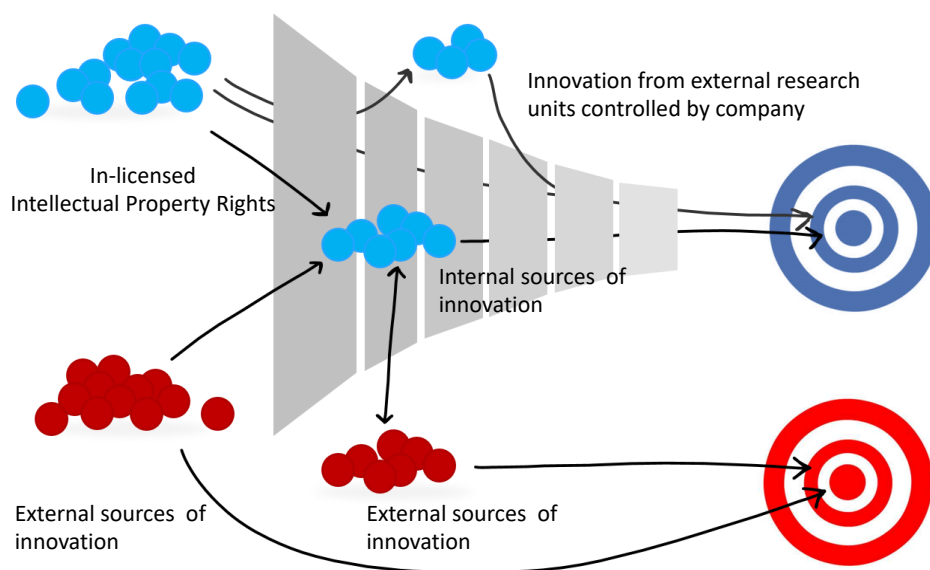


Figure. Open innovation.

Closed innovation relates to companies exploring and exploiting internal sources of innovation or in-licensed intellectual property rights in a typically very controlled process.

Closed Innovation

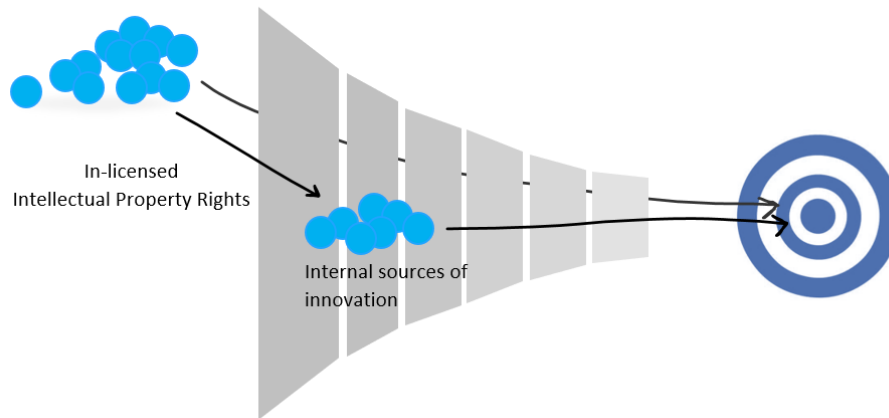


Figure. Closed innovation.

The advantage of open innovation is that it may generate a large number of solutions and/or a broader range of interesting ideas from a wide variety of domains or knowledge sources.

Open innovation models also have their disadvantages. The main challenge is attracting several ideas from a variety of domains and screening them. Open innovation is not as effective as closed approaches in attracting and identifying the best players in the innovation process.

Open innovation approaches are effective only under certain conditions: It must be possible to evaluate proposed solutions at a low cost and participation must be easy. Open source processes may work only in certain kinds of endeavors or for limited windows of time.

The advantage of closed participation is that solutions may be generated from the best experts in a selected knowledge domain. The challenge is identifying the right knowledge domain and the right experts.

When you use a closed innovation model, you are making two implicit bets: that you have identified the knowledge domain that will yield the best solution to your problem, and that you can pick the right collaborators in that field. The advantage of the closed innovation model is that confidentiality and governance of the intellectual property rights can be more easily controlled. Traditional licensing deals, investments and acquisitions rely on closed innovation.

Companies can work with different governance structures when involving external innovation and with both open and closed participation, as outlined in the figure below (Pisano G.P. 2008).

Types of innovation platforms

(Pisano and Verganti, 2008)

Hierarchical governance	Flat governance	
Innovation mall. A place where a company can post a problem, anyone can propose solutions, and the company chooses the solutions it likes best.	Innovation community. A network where anybody can propose problems, offer solutions, and decide which solutions to use.	Open participation
Elite circle. A select group of participants chosen by a company that also defines the problem and picks the solutions.	Consortium. A private group of participants that jointly select problems, decide how to conduct work, and choose solutions.	Closed participation

Figure. Types of innovation platforms.

In the hierarchical form of governance, a specific organisation has authority, which provides it with the advantage of being able to control the direction of the innovation efforts and to capture more of the innovation value. The advantage of hierarchical structures is that you control the direction of innovation, and who captures the value from it, while the challenge of these structures is the need to choose the right direction.

In the flat form of governance, decisions are either decentralized or made jointly by some or all collaborators. The advantage of this model is the ability to share with others the costs, risks and technical challenges of innovating. The advantage of flat structures is that you share the burden of innovation, and the challenge of such an approach is getting contributions to converge on a solution, that will be profitable to you.

With any of the four models of collaboration, designing incentives – both financial and nonfinancial – that attract external collaborators is crucial. Financial compensation can be replaced or complimented with nonfinancial rewards, like high visibility in the job market, an enhanced reputation among a

peer group, the psychological fulfilment of pursuing a strong interest and the chance for a collaborator to use solutions in their own businesses.

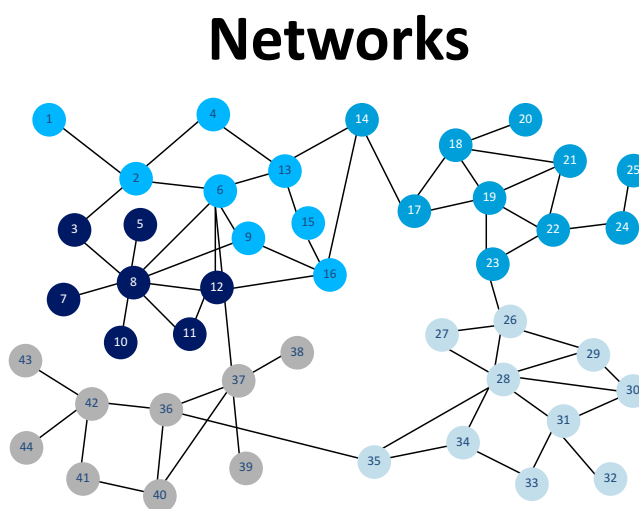
Open innovation research is often applied to front-end research, like investigations of new technologies and models. Closed innovation research is often applied to core knowledge and business areas, like product candidates in the later part of the research and development pipeline.

Innovation in networks

Social networks can be leveraged to accelerate behavioural change, improve organisational efficiency, enhance social change, and improve dissemination and diffusion of innovations (Valente T.W. 2012).

Network mapping may identify individuals who might be opinion leaders, or they might be bridges between different groups of people.

The figure below provides an example of a network structure.



Network segmentation, with each group represented by a distinct color. Each group has a leader, and that leader influences the other group members. Different colors represent mutually exclusive groups.

Figure. Network segmentation.

The innovation process

A technology push implies that a new invention is *pushed* through Research and Development, production and sales and enters onto the market without proper consideration of whether or not it satisfies a user need.

In contrast, an innovation based upon market pull has been developed by the R&D in response to an identified market need, an unmet customer need.



Figure. Technology push versus market pull.

Technology push approaches within biotechnology are common, and innovation proceeds linearly from scientific discovery to creation of new drugs to manufacturing to marketing (Yock P.G. et.al. 2015).

Market Pull approaches are common within medtech, and innovation originates with unmet customer needs. The needs-driven market pull approach is not well understood or practiced by academia. The biodesign innovation process is uncommon in many academic organisations

The market pull innovation process phases would typically include:

- *Identification of user needs*
- *Health Technology Assessment*
- *Competitive analysis*

- *Value capture*

The identification of user needs is thus in line with the market pull approach to innovation in contrast to the technology push approach to innovation. Interview and observation of customers are often used tools to identify user needs. In the IDEO design innovation process, the first step is to listen to potential customers, who can define unmet needs. This may be followed by an idea phase and outlining of a concept. A unique value proposition outlines how the concept product or service solve the customer unmet needs and is distinguished from competing concepts. The next step may be to create a prototype or a detailed design. Then, the subsequent step may be testing and validating the prototype or design, followed in the end by launch and marketing of the innovative product or service (Sutton R.I. 2002).

The health technology assessment includes an economic evaluation. Cost and benefit of an innovation are compared to alternatives. Health technology assessment aims to provide decision makers in health care with complete and reliable information about the impact of a new technology

The competitive analysis includes drawing a competitive landscape and evaluating differentiation and pricing strategies. The value capture will be described in more detail elsewhere.

Ideation

Getting the right idea is key to developing successful innovation. Ideas may arise from problem solving activities, but they can also arise from basic research exploring new features/characteristics etc.

Albert Einstein once said that "imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world." According to Louis Pasteur, new ideas may come by chance, but chance favours the prepared mind. Thomas Edison's inventions were not wholly original. Like most creative acts and products, they were extensions and blends of existing knowledge. The original concepts produced through Edison's approach were due to his willingness to look for ideas in interesting settings and then combine them into something new. (Boynton A et.al. 2011).

Teams working with innovation processes may benefit from having persons with different personal profiles within the teams. When assembling a team, you need to consider enhancing diversity of the team, in order to get people with different backgrounds and expertise to work together.

Talent, determination, practice and coaching are all factors that can foster an innovation process. Talent results from an interaction of heredity and environment. The subconscious also has a vital role in generating ideas.

Increased specialisation required for professional credentials makes the broad thinking harder to develop. The astonishing amount of complex knowledge that must be mastered to become an expert today prevents most researchers from making deep connections between disciplines. More and more, cross-disciplinary work requires teams.

The culture of academia can also hamper genius. Highly creative work that does not fit existing academic paradigms tends to be dismissed. Many great scientists have related how most of their original ideas were repeatedly rejected by their peers (Boynton A. et.al. 2011).

Universities have however been the originators of many great concepts, because they encourage the free interchange of ideas. To maximize creativity, you need both the availability of a network and the random collision of ideas within it. Few great scientific breakthroughs were the direct results of laboratory experiments. Instead, groundbreaking ideas usually arose during discussions after the experiments.

There are different types of creativity, and the rules that apply to one type do not necessarily follow for others.

Brainstorming and establishment of cross-cultural or cross-disciplinary teams are often used as tools for idea generation. Brainstorming originated half a century ago in Alex Osborn's Applied Imagination in 1957.

Prototyping is the process of rapidly assembling a working model (a prototype) to test various aspects of a design, illustrate ideas or features, iterate the content of the design and gather early user feedback. "I decided that no harm could come from spending a few days building backbone models," said 1962 Nobel Prize winner James Watson, referring to the metal prototypes he and fellow geneticist Francis Crick used to model and test their hypotheses. Watson and Crick's freethinking style and openness to two-dimensional and three-dimensional prototyping helped guide them toward the momentous discovery of the structure of DNA (Boynton A. et. Al. 2011). By sketching ideas and making things, you are likely to encourage accidental discoveries. Tangibility is the essential quality of any prototype.

Normally several prototypes are created in a development. Their levels of complexity increase with project maturity from virtual Prototypes to prototypes for validation of principles and testing manufacturing.

Customers or Users have a deep understanding of their own needs, and motivation to fulfil them. Innovation and co-creation with users may lead to more innovative products and services. Commercialisation of innovation may be improved by identifying early adopters of new innovation and getting them to advocate use of the new innovation, by ensuring a strong feedback process, and by understanding concerns of slow adopters.

S curves, macro trends in innovation

Each industry evolves at a different clockspeed rate, depending in some way on its product clockspeed, process clockspeed and organization clockspeed.

Clockspeed grew out of Charles Fine's study of the strategic impact of supply-chain strategy on competitive advantage (Fine C. 1998). Fine decided that instead of monitoring the supply chains of slowly evolving businesses, he would speed things up by studying the industrial equivalents of fruit flies, which have a life span under two weeks and can reveal much about successive generations in a short period of time. Thus, the concept of fast-clockspeed industries (industrial "fruit flies") was born and the premise that industries with very rapid evolutionary rates can be examined for information that will benefit businesses of all kinds. When industrial fruit flies are observed, several patterns in industry dynamics can be discerned. Understanding these dynamic processes helps companies develop principles to guide their own choices in the value chain. In addition, by observing dynamic processes in the evolution of industry structures, firms can also develop insights into how an industry's future may unfold. Companies and individuals must learn to focus directly on two distinct sets of priorities: exploiting their current capabilities and competitive advantages while also consciously and purposefully building new capabilities for the inevitable moment when the old ones no longer provide an advantage.

S curves (see the figure below) are a type of curve that shows the growth of a performance variable in terms of another variable, often expressed as units of time. An S curve of the growth of sales for a new product would show a rapid, exponential increase in sales for a period of time, followed by a tapering or leveling off. The tapering occurs when the population of new customers declines the innovation. At this point, growth is slow or negligible, and is sustained by existing customers who continue to buy the product.

S curves

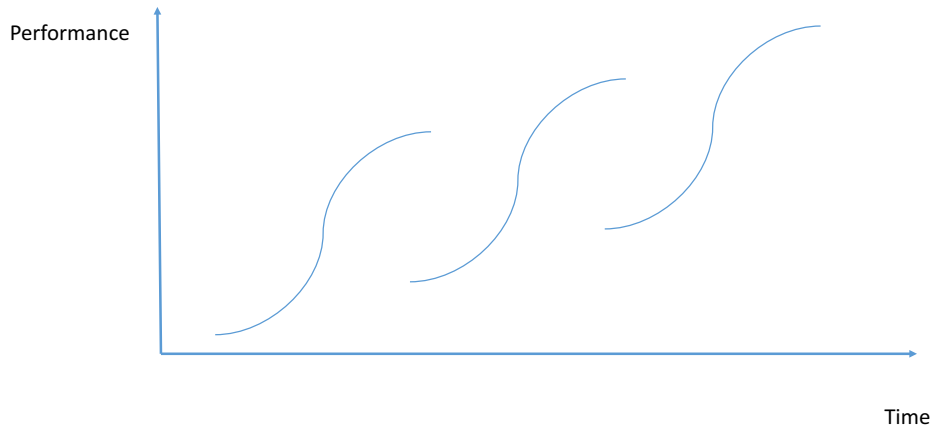


Figure. S curves.

Key industry areas have evolved with S curves of different shapes and time patterns

Many companies can have success in stable environments but fail, when the environment shifts. They may face the “innovators’ dilemma”. The innovators dilemma can occur when well-run companies, responding to their most demanding customers, tend to hyper-improve the known products and systematically under-attend to the emerging needs of other customers – especially those who require less sophisticated functionality.

The most successful firms are able to capture the benefits of short-term advantage even as they build organizational capabilities for long-term strategic renewal (Tushman M.L. et.al. 1987).

Organisational innovation structure

The most successful firms are able to capture the benefits of short-term advantage even as they build organizational capabilities for long-term strategic purposes. Incremental changes are needed to increase the fit among strategy, structure, people and culture in the short term, while incremental change may not be sufficient for long-term success.

Companies should map out what is important and what is not important in the market (ie. price, quality, fast delivery, delivery reliability, design and frequent

product changes), how well the company performs and how well the company's best competitors perform. Among the evaluation parameters companies should consider are: market analysis, competitors, why the innovation will work, rewards, costs, risk factors and project management for implementation.

Innovation within companies may be competency-destroying (*rendering firms' competences obsolete*) or competency-enhancing (*building on firms' existing knowledge base*). Firms obviously struggle to generate competence-destroying innovations, even though they may be required for long-term profitability and survival.

Related terminologies are complementarity and substitutability.

Complementarity is "a set of variables that tend to move in the same direction because increasing any one of them increases the payoff to increasing the others"

Substitutability is a set of variables that tend to move in the opposite direction because increasing any one of them decreases the payoff to increasing the others"

There are four components of innovation capability: approach, organisation, resources and competencies, and metrics and incentives.

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