

Chapter 3

Types and Patterns of Innovation

**Strategic Management of
Technological Innovation, 7th Edition**
Melissa A. Schilling

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Strategic Management of Technological Innovation

SEVENTH EDITION



Melissa A. Schilling

The role of innovation in modern economy



Overview

Several dimensions are used to categorize innovations.

- These dimensions help clarify how different innovations offer different opportunities (and pose different demands) on producers, users, and regulators.

The path a technology follows through time is termed its *technology trajectory*.

- Many consistent patterns have been observed in technology trajectories, helping us understand how technologies improve and are diffused.

Product versus Process Innovation

Product innovations are embodied in the *outputs* of an organization – its goods or services.

Process innovations are innovations in the way an organization conducts its business, such as in techniques of producing or marketing goods or services.

Product innovations can enable *process innovations* and vice versa.

What is a *product innovation* for one organization might be a *process innovation* for another.

- For example, U P S creates a new distribution service (*product innovation*) that enables its customers to distribute their goods more widely or more easily (*process innovation*).



Radical versus Incremental - 1

The *radicalness* of an innovation is the *degree to which it is new and different* from previously existing products and processes.

Incremental innovations may involve only a minor change from (or adjustment to) existing practices.

The radicalness of an innovation is relative; it may change over time or with respect to different observers.

- For example, digital photography a more radical innovation for Kodak than for Sony.



Radical vs. Incremental - 2

Incremental innovation	Radical innovation
continuous (linear improvement of value acquired by the customer)	discontinuous (with or without predecessor; essential, nonlinear improvement obtained by the customer)
based on old technology	based on new technologies
dominant design unchanged	leads to a new dominant design
does not lead to a paradigm shift	can lead to a paradigm shift
implies a low level of uncertainty	implies a high level of uncertainty
improvement of existing characteristics	introduces a whole new set of performance features
existing organization and qualifications are sufficient	requires education, new organization and skills
the result of a rational response or necessity	result of chance or R & D policy, not necessity
driven by market pull (important in the advanced stage of technology)	driven by technology (important in the early stage of technology)



At the heart of capitalism
is creative destruction.

Joseph A. Schumpeter

“ quote fancy

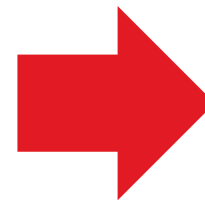
Competence-Enhancing versus Competence-Destroying Innovation

Competence-enhancing innovations build on the firm's existing knowledge base.

- For example, Intel's Pentium 4 built on the technology for Pentium III.

Competence-destroying innovations renders a firm's existing competencies obsolete.

- For example, electronic calculators rendered Keuffel and Esser's slide rule expertise obsolete.

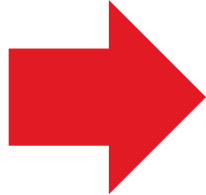


Whether an innovation is competence enhancing or competence destroying depends on the perspective of a particular firm.

Architectural versus Component Innovation

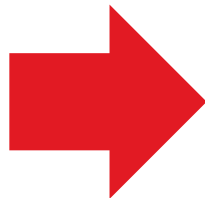
A **component innovation** (or modular innovation) entails changes to one or more components of a product system without significantly affecting the overall design.

- For example, adding gel-filled material to a bicycle seat.



An **architectural innovation** entails changing the overall design of the system or the way components interact.

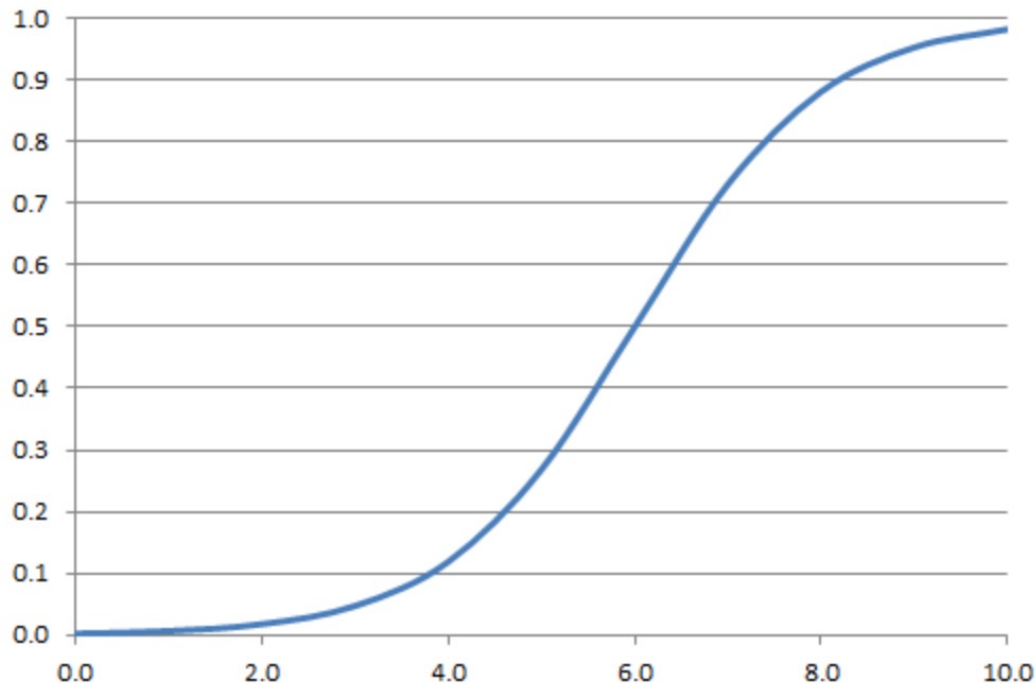
- For example, transition from high-wheel bicycle to safety bicycle.



Most architectural innovations require changes in the underlying components also.

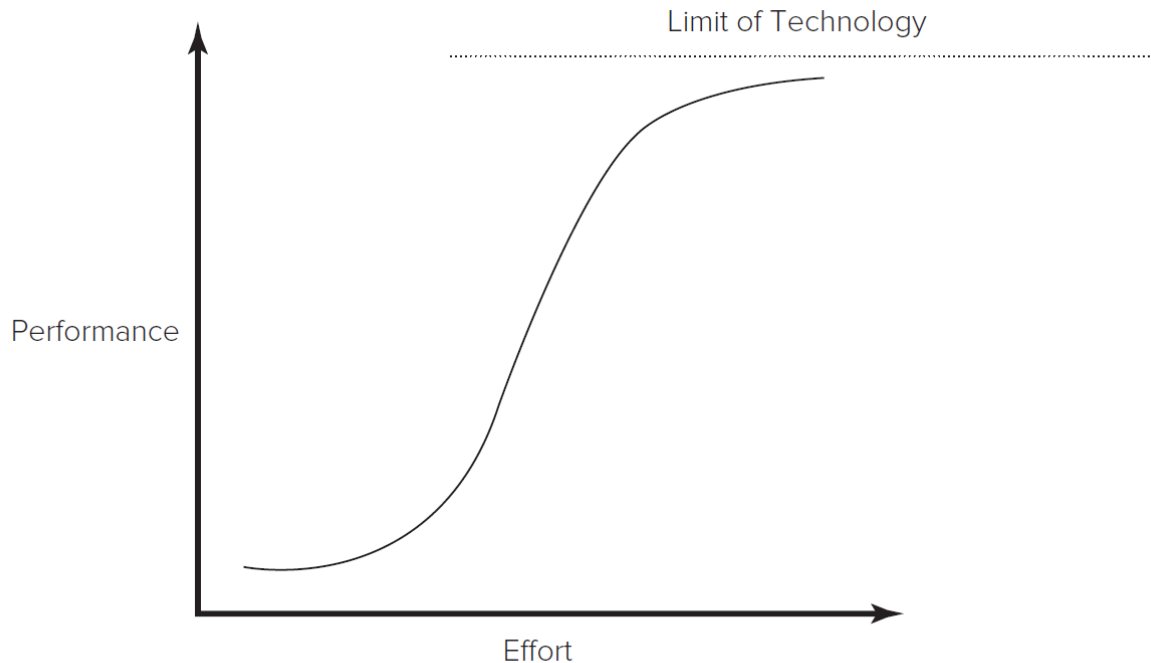
S-curves

Both the rate of a technology's improvement, and its rate of diffusion to the market typically follow an s-shaped curve.



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S-curves in Technological Improvement.



Technology improves slowly at first because it is poorly understood.

Then accelerates as understanding increases.

Then tapers off as approaches limits.

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S-curves in Technological Improvement.

Technologies do not always get to reach their limits.

May be displaced by new, *discontinuous technology*.

- A discontinuous technology fulfills a similar market need by means of an entirely new knowledge base.
 - For example, switch from carbon copying to photocopying, or vinyl records to compact discs.
- Technological discontinuity may initially have lower performance than incumbent technology.
 - For example, first automobiles were much slower than horse-drawn carriages.

Firms may be reluctant to adopt new technology because performance improvement is initially slow and costly, and they may have significant investment in incumbent technology.

S-Curves in Technology Diffusion.

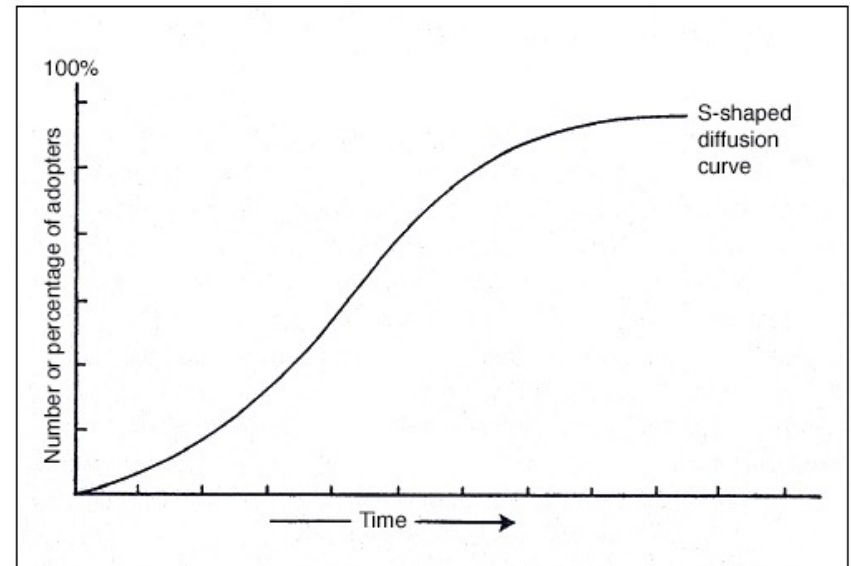
Adoption is initially slow because the technology is unfamiliar.

It accelerates as technology becomes better understood.

Eventually market is saturated and rate of new adoptions declines.

Technology diffusion tends to take far longer than information diffusion.

- Technology may require acquiring complex knowledge or experience.
- Technology may require complementary resources to make it valuable (for example, cameras not valuable without film).



S-Curves as a Prescriptive Tool.

Managers can use data on investment and performance of their own technologies or data on overall industry investment and technology performance to map s-curve.

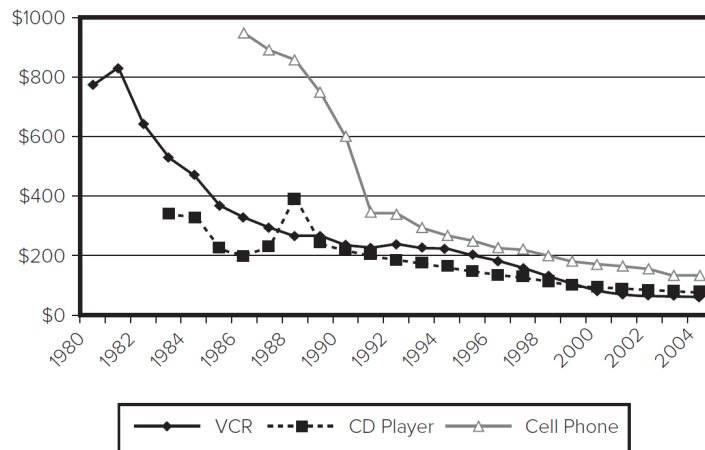
While mapping the technology's s-curve is useful for gaining a deeper understanding of its rate of improvement or limits, its use as a prescriptive tool is limited.

- True limits of technology may be unknown.
- Shape of s-curve can be influenced by changes in the market, component technologies, or complementary technologies.
- Firms that follow s-curve model too closely could end up switching technologies too soon or too late.

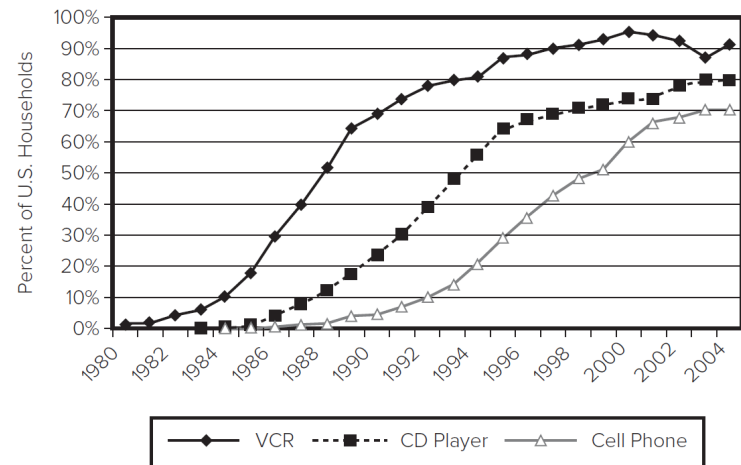
Technology S-Curves ⁵

S-curves of diffusion are in part a function of s-curves in technology improvement.

- Learning curve leads to price drops, which accelerate diffusion.



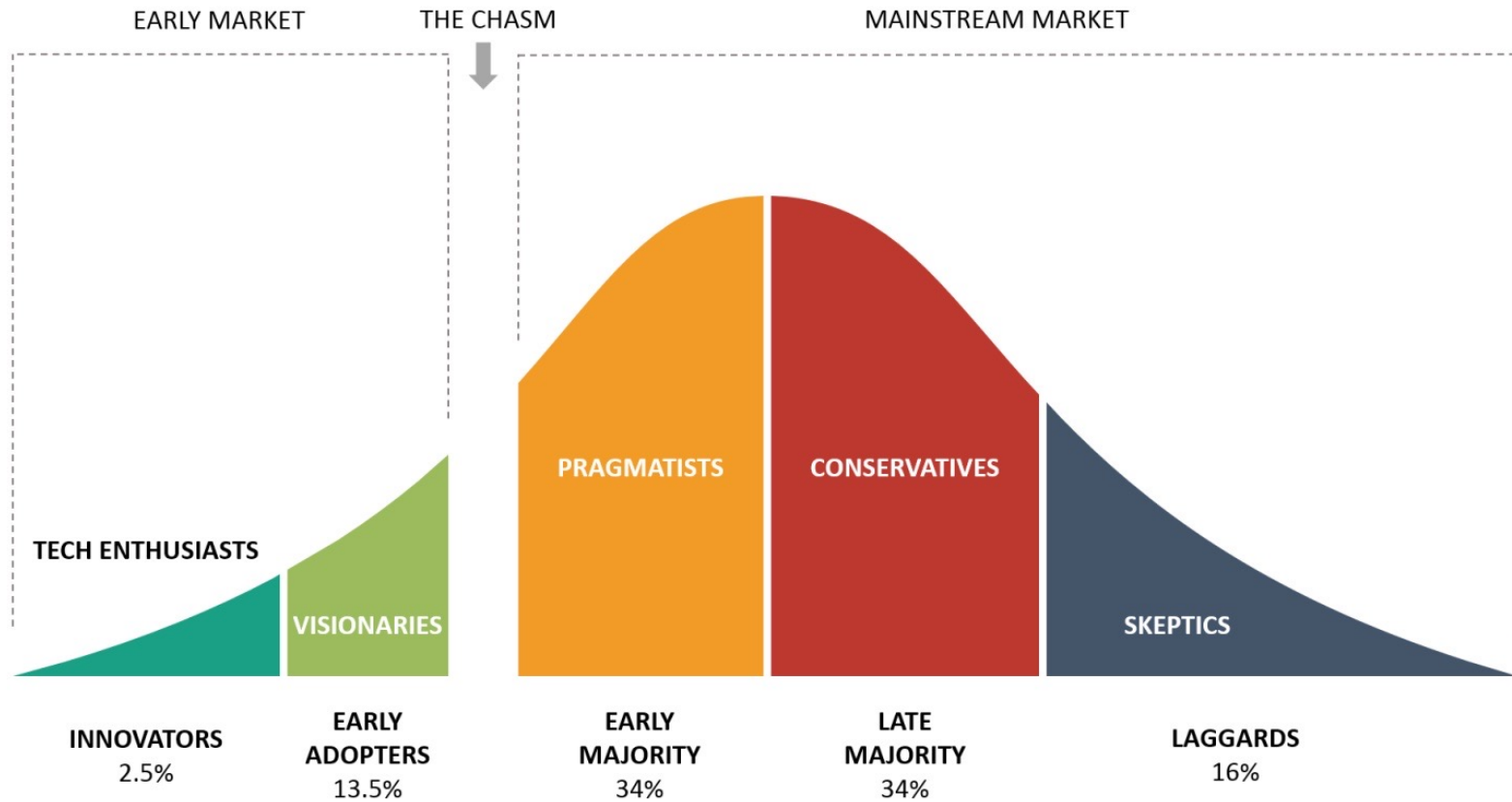
Source: Consumer Electronics Association.



Source: Consumer Electronics Association.

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The technology adoption life cycle



Research Brief ¹

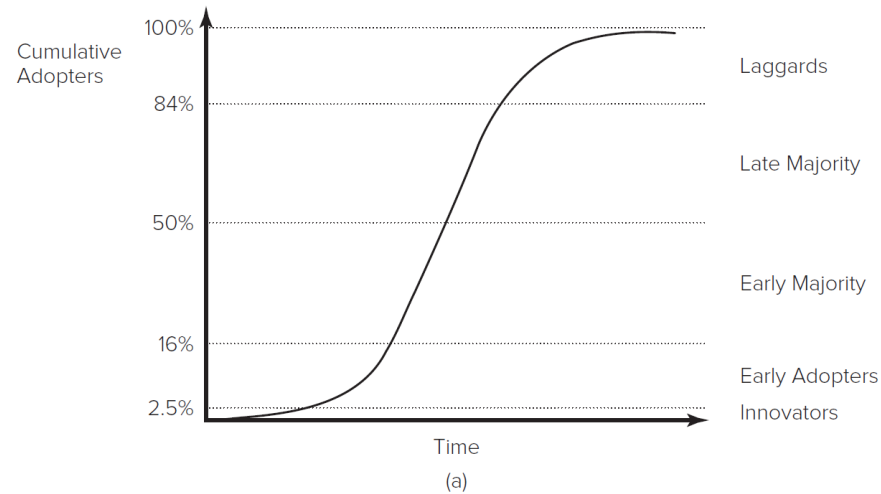
Diffusion of Innovation and Adopter Categories.

Everett M. Rogers created a typology of adopters:

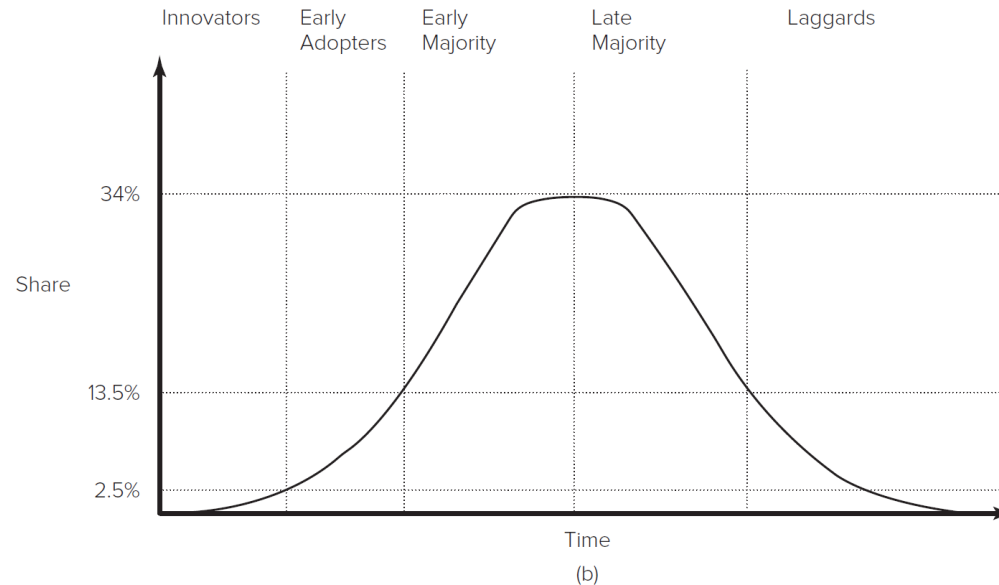
- **Innovators** are the first 2.5% of individuals to adopt an innovation. They are adventurous, comfortable with a high degree of complexity and uncertainty, and typically have access to substantial financial resources.
- **Early Adopters** are the next 13.5% to adopt the innovation. They are well integrated into their social system and have great potential for opinion leadership. Other potential adopters look to early adopters for information and advice, thus early adopters make excellent "missionaries" for new products or processes.
- **Early Majority** are the next 34%. They adopt innovations slightly before the average member of a social system. They are typically not opinion leaders, but they interact frequently with their peers.
- **Late Majority** are the next 34%. They approach innovation with a skeptical air and may not adopt the innovation until they feel pressure from their peers. They may have scarce resources.
- **Laggards** are the last 16%. They base their decisions primarily on past experience and possess almost no opinion leadership. They are highly skeptical of innovations and innovators and must feel certain that a new innovation will not fail prior to adopting it.

Diffusion of Innovation and Adopter Categories

S-Curve of Cumulative Adopters



Normal (Bell-Shaped) Curve of Market Share

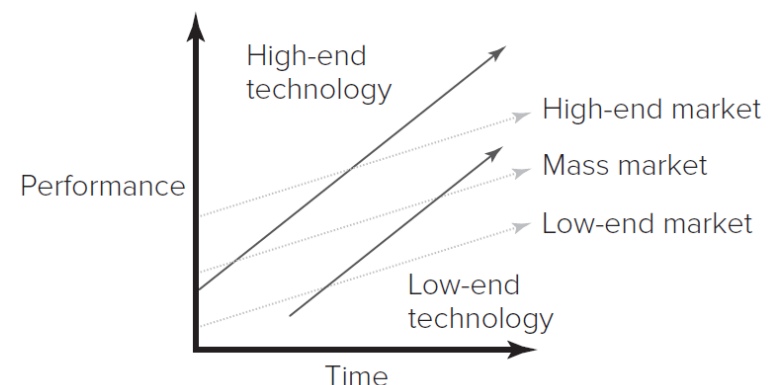
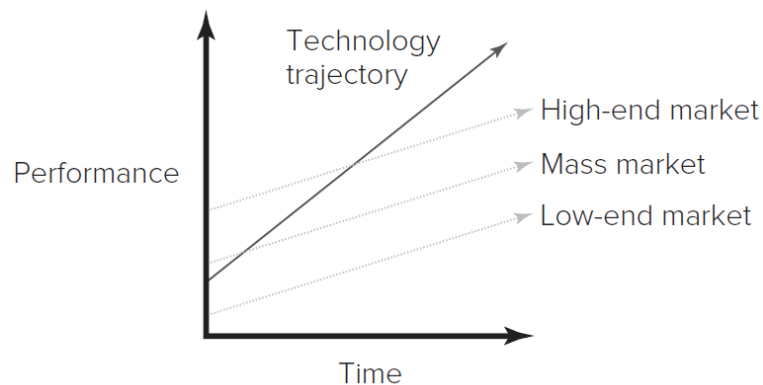


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Theory In Action ¹

“Segment Zero” – A serious threat to Microsoft?

- Technologies often improve faster than customer requirements demand.
- This enables low-end technologies to eventually meet the needs of the mass market.



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Theory in Action ²

From 1980 to 2011, Microsoft was the dominant personal computer operating system. However, operating systems for smartphones and tablets were improving to the point where they could replace many personal computer functions.

In 2015, Apple's iPhone operating system and Google's Android collectively controlled over 90% of the market for smartphone purchases. Microsoft's Windows Phone held a share of only 3%.

As tablets based on these systems became fully functional computers, would Microsoft's dominance evaporate?

Technology Cycles ¹

Technological change tends to be cyclical:

Each new s-curve ushers in an initial period of turbulence, followed by rapid improvement, then diminishing returns, and ultimately is displaced by a new technological discontinuity.

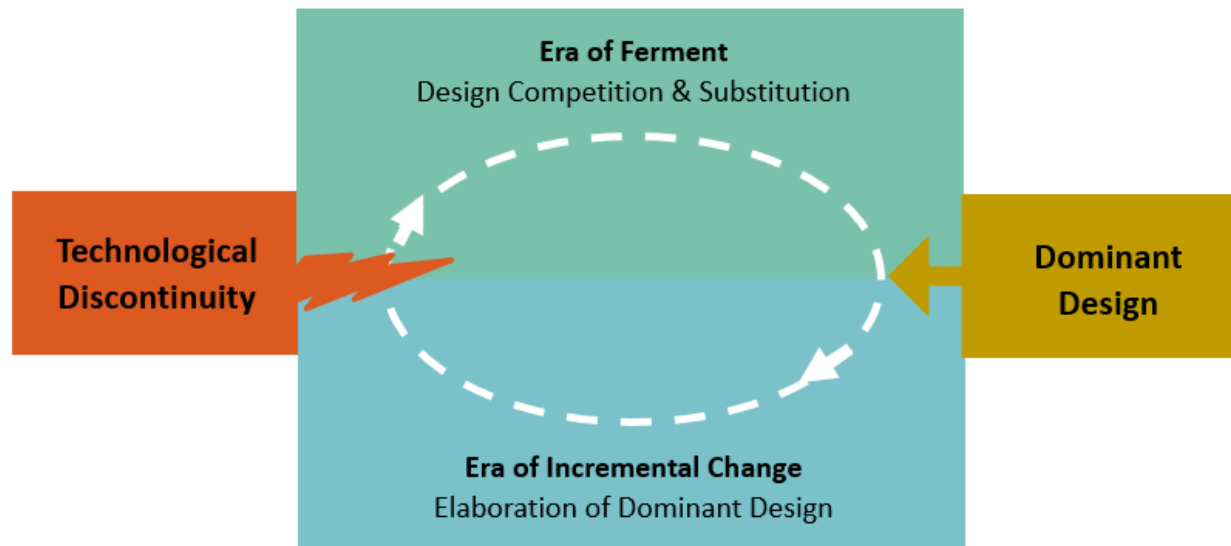
Utterback and Abernathy characterized the technology cycle into two phases:

- The *fluid phase* (when there is considerable uncertainty about the technology and its market; firms experiment with different product designs in this phase).
- After a **dominant design** emerges, the *specific phase* begins (when firms focus on incremental improvements to the design and manufacturing efficiency).

Technology Cycles ²

Anderson and Tushman also found that technological change proceeded cyclically.

- Each discontinuity inaugurates a period of turbulence and uncertainty (era of ferment) until a dominant design is selected, ushering in an era of incremental change.



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Technology Cycles ³

Anderson and Tushman found that:

- A dominant design always rose to command the majority of market share unless the next discontinuity arrived too early.
- The dominant design was never in the same form as the original discontinuity but was also not on the leading edge of technology. It bundled the features that would meet the needs of the majority of the market.

During the era of incremental change, firms often cease to invest in learning about alternative designs and instead focus on developing competencies related to the dominant design.

This explains in part why incumbent firms may have difficulty recognizing and reacting to a discontinuous technology.

Discussion Questions

1. What are some of the reasons that established firms might resist the adoption of a new technology?
2. Are well-established firms or new entrants more likely to a) develop and/or b) adopt new technologies? What are some reasons for your choice?
3. Think of an example of an innovation you have studied at work or school. How would you characterize it on the dimensions described at the beginning of the chapter?
4. What are some of the reasons that both technology improvement and technology diffusion exhibit s-shaped curves?
5. Why do technologies often improve faster than customer requirements? What are the advantages and disadvantages to a firm of developing a technology beyond the current state of market needs.
6. In what industries would you expect to see particularly short or long technology cycles? What factors might influence the length of technology cycles in an industry?

Supplementary Video

A short video on:

Innovation Strategy: Patterns of Innovation

<https://youtu.be/bvjvo6M2zRI>



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