Chapter 7: Network and Positive Feedback

Introduction

The industrial economy was populated by oligopoly industries in which a few large firms dominate markets.

Examples of oligopolies include:
- Automobiles industry
- Steel industry
- Aluminum industry
- Various chemical markets

In contrast the information economy is populated by temporary monopolies because of rapid technology insolence as today's leading technology or architecture will, more likely than not, be toppled in short orders by an upstart with superior technology.

The difference is that the old industrial economy was driven by *economics of scale* while the new information economy is driven by the *economics of network*, called *positive feedback*.

Case: Apple's Big Mistake

Even though Apple's computers were clearly technologically superior to the alternatives well into the 1990s (devotees say they still are), they have always remained a small part of the market .

Apple failed to recognize the strength of the network externalities that caused many users to stick with an inferior product that was widely used, especially given the fact that the superior alternative was considerably more expensive. Apple has suffered because of positive feedback fueled by the competing system offered by Microsoft and Intel. Since the WinTel share of PC market grew, users found the WinTel system more and more attractive. It proves the essence of positive feedback: *success begat more success and failure breeds failure*.
Many information goods are also characterized by *network externalities*: the value of the good to an individual is greater when a large number of people also use the good.

Economic characteristics of network

"The value of connecting to a network depends on the number of other people already connected to it"

This fundamental value proposition is also known as ***network effect***, or ***network externalities***, ***or demand side economics of scale*** and essentially refer the same thing: other things being equal, it's better to be connected to a bigger network than a smaller one.

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One consequence of a network effect is that the purchase of a good by one individual indirectly benefits others who own the good - for example by purchasing a telephone a person makes other telephones more useful. This type of side-effect in a transaction is known as an externality in economics, and externalities arising from network effects are known as **network externalities**. The resulting bandwagon effect is an example of a positive feedback loop.

Economists say that a *network externality* exists when the amount that one party is willing to pay for access to a network depends on who or how many other parties are connected to it. Network externalities are the effects on a user of a product or service of others using the same or compatible products or services.

Some of the Hi-Tech networks include fax machines, e-mail, Internet Web browser, DVD player, ATM users, MAC users, Nintendo-64 entertainment system users etc. The value of a fax machine depends on how many other fax machines there are. The value of e-mail to me depends on how many other people who I correspond with have e-mail. The value of a Web browser depends on how many Web servers there are. The value of a DVD disk depends on how many DVD players there are and vice versa.

Many industries exhibit network externalities. Some examples are:

- The *Public Switched Telephone Network*, where the network externalities are direct in that the value that any user places on subscribing depends on the number of others with whom he can communicate.
- *ATM networks*, where the network externalities are indirect in that the larger the network the greater is the number of machines at which an ATM card can be used, and hence the greater is the value of the network to any user.
- *Networks of users of computers* that use the same operating system, e.g., the Mac network, where there are direct benefits associated with more efficient file transfers and indirect benefits associated with access to a wider range of applications software as the size of the network grows.

- *Networks of users of compatible videocassette recorders*, which exhibit what are probably small direct benefits from the ability to exchange cassettes and much larger indirect benefits from being able to purchase or rent a wider variety of pre-recorded cassettes that employ the same format.
- *Networks of drivers of diesel-powered automobiles*, who obtain the indirect benefit of having more widely available fuel and service facilities the larger the number of other drivers of such cars.
- *Network of widely used Computer Software.*

Case : Microsoft Office

For many people choosing an office suite, prime considerations include how valuable having learned that office suite will prove to potential employers, and how well the software interoperates with other users. That is, since learning to use an office suite takes many hours, they want to invest that time learning the office suite that will make them most attractive to potential employers (or consulting clients, etc), and they also want to be able to share documents.

Similarly, finding already-trained employees is a big concern for employers when deciding which office suite to purchase or standardize on. The lack of cross-platform standards results in a situation in which one firm is in control of almost 100% of the market.

Microsoft Windows is a further example of network effect. The most-vaunted advantage of Windows, and that most publicised by Microsoft, is that Windows is compatible with the widest range of hardware and software. Although this is true, it is in reality the result of network effect: hardware and software manufacturers ensure that their products are compatible with Windows in order to have access to the large market of Windows users. Thus, Windows is popular because it is well supported, but is well supported because it is popular. However, network effects need not lead to market dominance by one firm, when there are standards which allow multiple firms to interoperate, thus allowing the network externalities to benefit the entire market. This is true for the case of x86-based PC hardware, in which there are extremely strong market pressures to interoperate with pre-existing standards, but in which no one firm dominates in the market.

Websites exhibiting Network effects

Many websites also feature a network effect. One example is web marketplaces and exchanges, in that the value of the marketplace to a new user is proportional to the number of other users in the market. For example, **eBay** would not be a particularly useful site if auctions were not competitive. However, as the numbers of users grows on eBay, auctions grow more competitive, pushing up the prices of bids on items. This makes it more worthwhile to sell on eBay and brings more sellers onto eBay, which drives prices down again as this increases supply, while bringing more people onto eBay because there are more things being sold that people want. Essentially, as the number of users of eBay grows, prices fall and supply increases, and more and more people find the site to be useful.
The collaborative encyclopedia **Wikipedia** also benefits from a network effect. The theory goes that as the number of editors grows, the quality of information on the website improves, encouraging more users to turn to it as a source of information; some of the new users in turn become editors, continuing the process.
Social networking websites are also good examples. The more people register onto a social networking website, the more useful the website is to its registrants. By contrast, the value of a news site is primarily proportional to the quality of the articles, not to the number of other people using the site. Similarly, the first generation of search sites experienced little network effect, as the value of the site was based on the value of the search results. This allowed **Google** to win users away from **Yahoo!** without much trouble, once users believed that Google's search results were superior.

Note that congested trains or roads are unattractive networks. Externalities are not always positive. However, the first fax machine was invented over a hundred years ago, yet they did not become popular till everyone believed everyone else would have one.

- Network externalities explain why there is a sudden switch to a new system when public opinion suddenly has confidence in the new network
- Network externalities cause *positive feedback*, in which either initial success or initial failure is self-reinforcing: success breeds success, failure breeds failure

Types of Feedback

In network externalities, two types of feedback generally known are of

- Positive feedback and
- Negative feedback

Positive feedback makes the strong get stronger and the weak get weaker, leading to extreme outcomes i.e. dominance of the marketplace by a single firm or technology. Positive feedback illustrates that success beget success and failure breeds failure. In its most extreme form, positive feedback can lead to a *winner-take-all* market in which a single firm or technology vanquishes all others.

Negative Feedback makes the strong get weaker and the weaker get stronger, pushing both towards a happy medium. For example, the industrial oligopolies exhibit negative feedback.

Positive network externalities exist if the benefits are an increasing function of the number of other users. Negative network externalities exist if the benefits are a decreasing function of the number of other users.

Sources of Positive Feedback

- Supply side economies of scale
  - Declining average cost
  - Marginal cost less than average cost
  - Example: information goods
- Demand side economies of scale – Network effects
  - In general: fax, email, Web
  - In particular: Sony vs. Beta, Wintel vs. Apple

Positive feedback translates into rapid growth: - virtuous cycle. When two or more firms compete for a market where there is a strong positive feedback, only one may emerge as a winner. Economists say that such a market is TIPPY, meaning that it can tip in favor of one player or another.

The biggest winner in the information economy, apart from consumers generally, are companies that have launched technologies that have been propelled forward by the positive feedback.

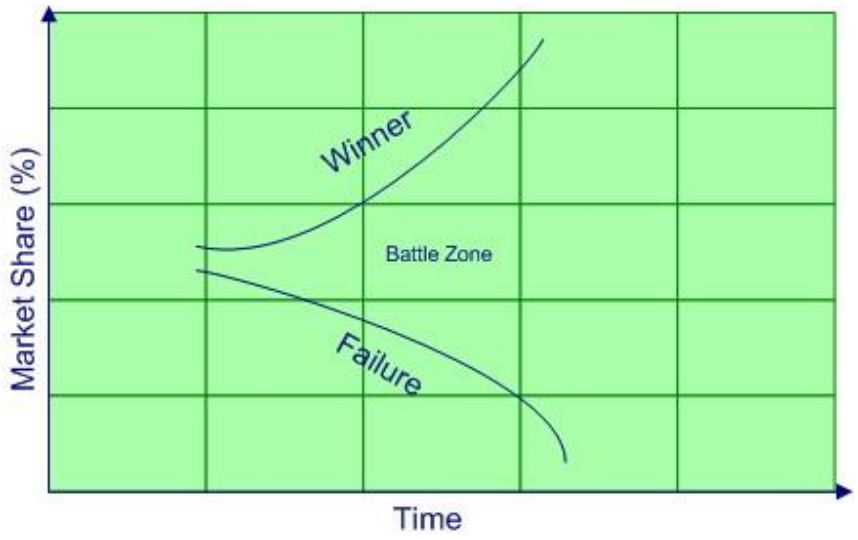


Fig: Positive Feedback

Example: Nintendo System

Nintendo entered the US market for home video games in 1995. By the time, the market was saturated and dominated by another firm named Atari. By Christmas 1986, the Nintendo Entertainment System (NES) was the hottest toy on the market as it became so much popular and enticed more game developers to write games to the Nintendo system, making the system yet more attractive. Nintendo managed that most difficult of high-tech tricks: to follow the positive feedback curve while retaining strong control over its technology. Every independent game developer paid royalties to Nintendo and even promised not to make their games available on rival systems for two years following their release.

Adoption Dynamics

Positive feedback system follows a predictable patter: adoption of new technologies follow s-shaped curve with the following three phases:

1. Flat during lunch
2. A steep raise during take off as positive feedback kicks in
3. Leveling off as saturation is launched

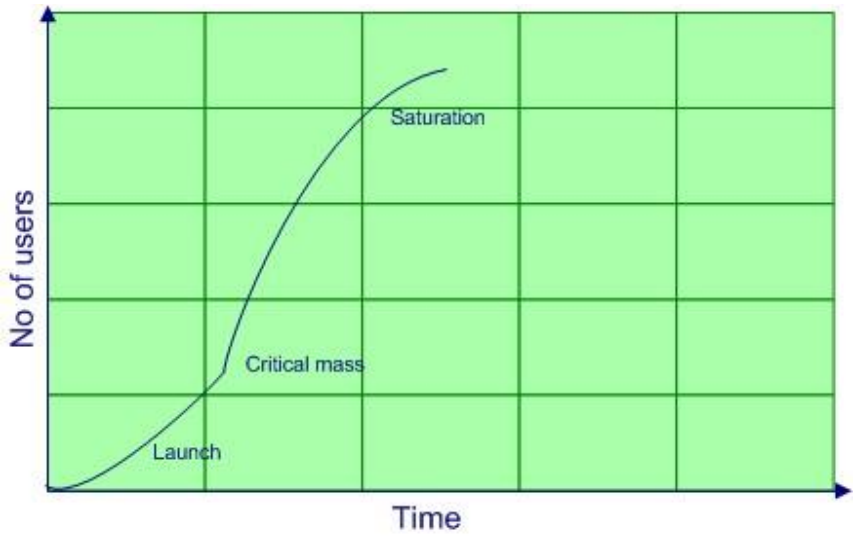


Fig: Critical Mass

In the information technology arena, the S-shaped pattern can be seen in the adoption of the fax machine, the CD, color TV, video game machines, e-mail, and Internet.

Demand side economies of scale

Traditional economies of scale is referred to as supply side economies of scale as larger firms such as General Motors, tend to have lower unit costs of production as compared to the smaller companies. Positive feedback, based on the supply side economies of scale limits the total market dominance and at that point, negative feedback begins. These limits arose out of the difficulties of managing enormous organizations where smaller companies with efficiency and superior technology ignite the positive feedback.

In the information economy, positive feedback has appeared in a new, more virulent form based on the demand side of the market, not just simply supply side. For example, Microsoft's dominance is based on the demand side economies of scale. Microsoft's customers value its operating system because they are widely used, the de facto industry standard. Rival operating systems just do not have critical mass to pose much of a threat. Unlike the supply side economies of scale, demand side economies of scale do not dissipate when the market gets large enough: more and more users uses Microsoft product, more incentive for others to use it too.

The following graph shows how popularity shows value in a network economy.

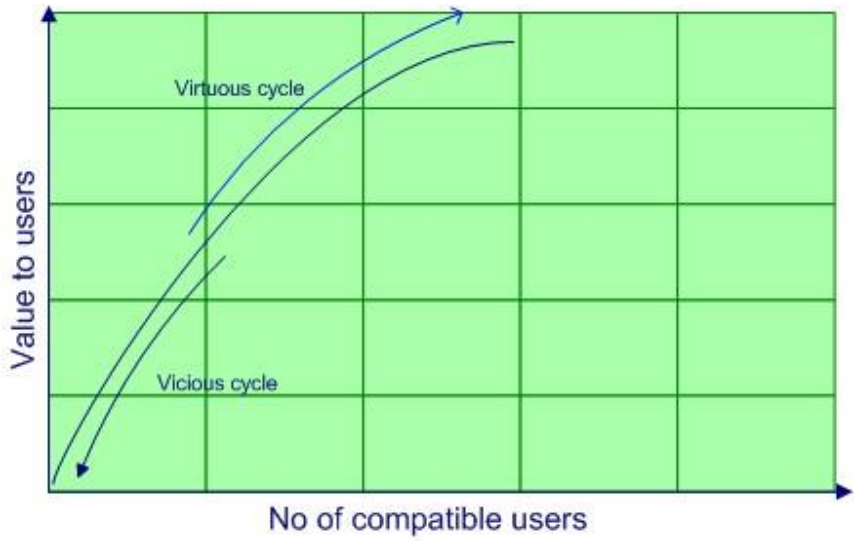


Fig: vicious and virtuous cycle

In a **virtuous cycle**, the popular product with many compatible users becomes more and more valuable to each user as it attracts even more users.

For example, **Lotus 1-2-3** with its superior performance, have the largest installed base of users among spreadsheet programs by the early 1980s. As PC become more faster and more companies appreciated the power of spreadsheets, new users voted overwhelmingly for Lotus 1-2-3, in part so they could share files with other users and in part because many users were skilled in preparing sophisticated Lotus macros. This process fed on itself in a virtuous cycle.

In a **vicious cycle**, the product loses its value as it is abandoned by users and switch to other compatible products. For example, VisiCalc, the pioneer spreadsheet program for PC, was stuck in a vicious cycle of decline. Unable to respond quickly by introducing a superior product, VisiCalc quickly succumbed.

Critical Mass and Industry takeoffs

- When network externalities are strong, a large proportion of consumers may not be willing to purchase a good unless the number of existing users exceeds a threshold network size

- This leads to the ***critical mass effect***, a sudden rapid increase in the network size. Critical mass effects change the quantity demanded over time of a good with network externalities. The quantity demanded grows slowly until critical mass is reached; once reached the quantity demanded suddenly explodes.

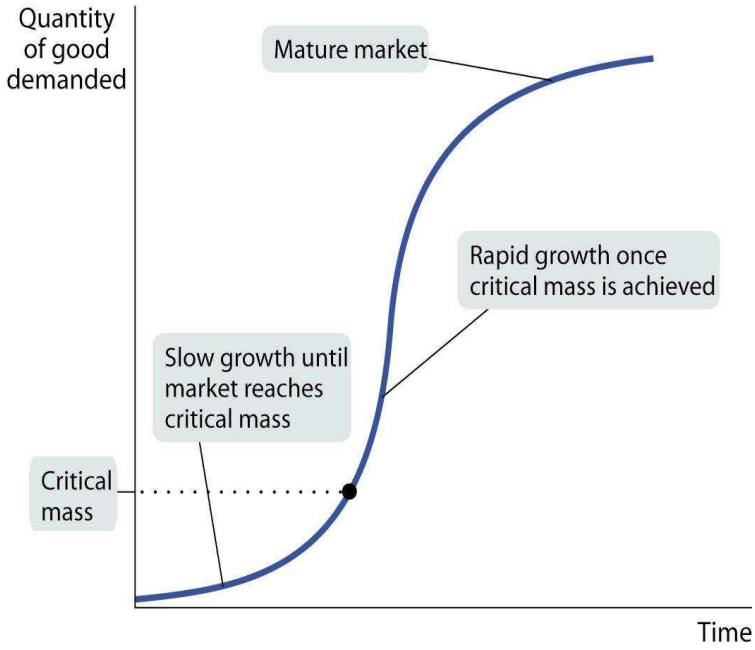
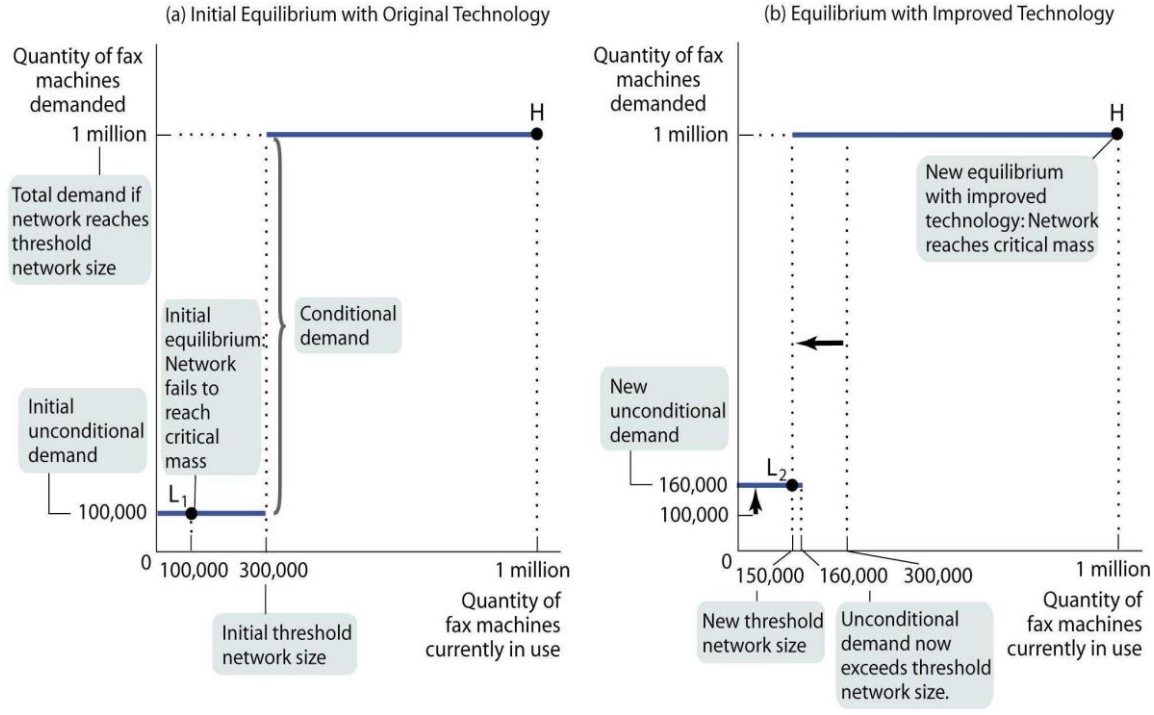


Fig: Critical mass in the adoption dynamics

Network Externality: Threshold network size



Metcalfe's law

First formulated by Robert Bob Metcalfe in regard to Ethernet, Metcalfe's law explains many of the network effects of communication technologies and networks such as the Internet and World Wide Web.

> "The value of a network is the square of the number of people connected to it or the value of network goes up as the square of the number of users."

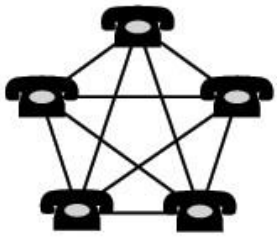
If there are *n* users in a network and the value of the network to each of them is proportional to the number of other users, then the total value of the network (to all the users) is proportional to $nx(n-1)=n^2-n$

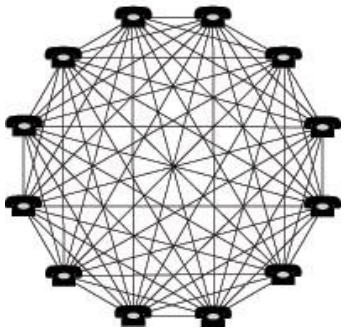
Example:

If the value of a network to a single user is $1 for each other user on the network, then a network of size 10 has a total value of roughly $100. In contrast, a network of size 100 has a total value of roughly $10,000 i.e. a tenfold increase in the size of the network leads to a hundred folds increase in its value

The law is often illustrated with the example of fax machines: A single fax machine is useless, but the value of every fax machine increases with the total number of fax machines in the network, because the total number of people with whom you may send and receive documents increases.

Applications of Metcalfe's law





Metcalfe's Law can be applied to more than just telecommunications devices. Metcalfe's Law can be applied to almost any computer systems that exchange data. Examples of devices include:

- Telephones
- FAXs
- Operating systems
- Applications
- Social networking Websites Metcalfe's Law frequently predicts whether a single vendor or interface standard will tend to dominate a marketplace. This has implications for whether an innovative solution can enter a marketplace that requires different interfaces.

Ignition Positive Feedback: Performance vs. Compatibility

There are two basic approach of dealing with the problem of consumer inertia and igniting positive feedback.

- The evolutionary strategy of compatibility.
- The revolutionary strategy of compelling performance.

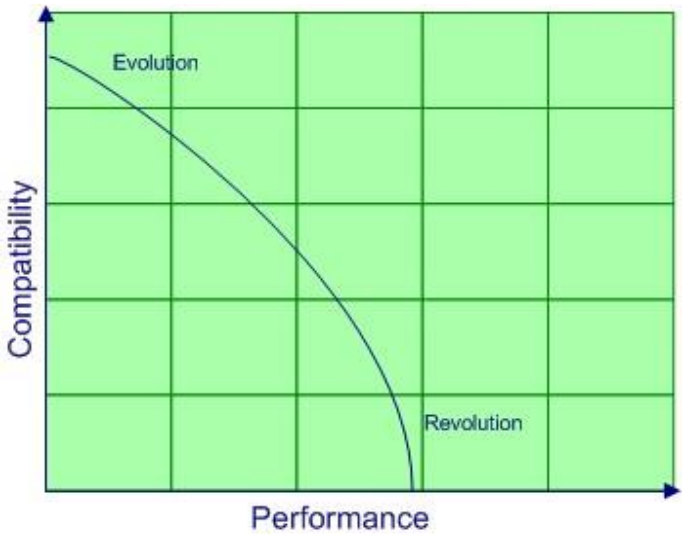


Fig: Performance vs. compatibility

The **evolution strategy** gives up some performance to ensure compatibility, thus easing consumer and offers a smooth migration path. High compatibility with limited performance improvements characterizes the evolution approach.

The **revolution strategy** offers compelling performance. Improve performance at the cost of increasing customer switching cost or vice versa. An outcome of little or no compatibility but sharply superior performance characterizes the revolution approach.

Evolution: Offer a migration path

When compatibility is critical, consumers must be offered a smooth migration path to a new information technology by reducing switching costs. For example Borland copying certain command from Lotus 1-2-3.

In virtual networks, the evolution strategy of offering consumers a migration path requires an ability to achieve compatibility with existing products. In real networks, the evolutionary strategy requires physical interconnection to existing networks. In either case, interfaces are critical. The key to the evolution strategy is to build new network by linking it to the old one.

The risk associated with this evolutionary strategy is that competitor may try a revolutionary strategy for its product. Compromising performance to ensure

backward compatibility may leave a door open for a competitor to come up with a technologically superior product. For example. DBase vs. Access.

In order to execute the evolutionary approach of smooth migration to a new technology, the following two obstacles need to overcome: Technical and legal

- **Technical Obstacles** means the need to develop a compatible technology that is superior to the existing products so that customer switching costs can be minimized, by offering backward compatibility with improved performance. For example, Microsoft's Window 95 run old DOS applications, Office 97 reading file format of Office 95.

– The following three strategies are followed to overcome the technical obstacle in smooth migration to new technologies.

- Use Creative design
- Think in terms of system
- Converters and bridge technologies
- **Legal Obstacles** illustrates the need to have or obtain the legal right to sell products that are compatible with the established installed base of products. – Example: Sony and Philips CDs license to CD seller

Revolution: offer compelling performance

The revolutionary strategy comes up with the best product possible by attracting customers who care for the performance.

Groves's law: "10X rule" suggests that the offered performance need to be "ten times better" than the established technology to start a revolution.

The revolution strategy is inherently risky. It can not work on a small scale and usually requires powerful allies.

Ignition Positive Feedback: - openness vs. control

Another fundamental trade-off is to choose an " open " approach by offering to make the necessary interfaces and specifications available to others or to maintain control by keeping the system proprietary.

Proprietary control will be valuable if product or system takes off and the value of network can be raised by controlling the ability of others to interconnect with the

existing network. The best strategy, whether openness or control, to follow depends upon the strength of igniting the positive feedback. The strength in network markets is measured along three primary dimensions: existing market position, technical capabilities, and control of intellectual property such as patents and copyrights.

However, there is no one right choice between control and openness. A single company might well choose control for some products and openness for others. For example, Intel has maintained considerable control over the MMX multimedia specifications for its Pentium chips. At the same time, Intel promoted new, open interface specifications for graphics controllers, its Accelerated Graphics Port (AGP). Thus, Intel followed the control strategy for MMX, but openness for AGP.

In choosing between openness and control, the ultimate goal is to maximize the value of technology, not to control over it.

Your reward = total value adds to industry x your share of industry value.

Strategies to achieve openness emphasis on the total value added to industry. Value added to industry depends on P*roduct and S*ize of network.

- Strategies to achieve proprietary control emphasis to the share of industry value and Industry share depends on its openness.

The fundamental trade-off between openness and control is shown in figure below. Out of the two extremeness, choose the optimal value that maximizes the total reward.

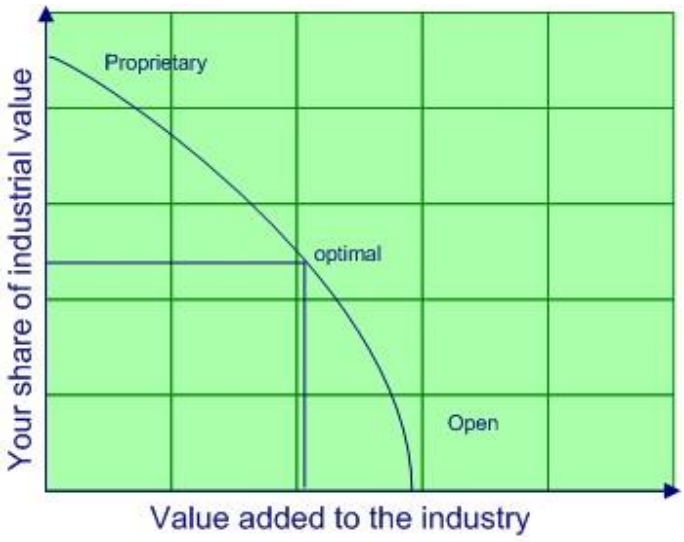


Fig: Openness vs Control

Openness arises naturally when multiple products must work together, making coordination in product design essential. Within the openness category, there are full openness strategy and an alliance strategy for establishing new product standards.

- Under the Full openness strategy, anybody can make the product complying with the standard, whether they contributed to its development or not. The underlying problem is there is no champion.
- Under an alliance approach, each member of the alliance contributes towards the standard, and in exchange, each is allowed to make products comply with the standard. The underlying problem is to hold these alliances together.

Control strategy is best suited to those who hold the strongest position to exert strong control over newly introduced information technologies. For example, AT&T, Microsoft, Intel, TCI and Visa all follow the control strategy. If several companies try this strategy, it may lead to standards wars.

Generic strategies in network market

	Control	**Openness**
Compatibility	Controlled migration	Open migration
Performance	Performance play	Discontinuity

1. Performance play

It is the boldest and riskiest of the four generic strategies that involve the introduction of a new, incompatible technology over which the vendor retains strong proprietary control.

Example
a) introduction of Nintendo Entertainment System in mid 1980s
b) VS Robotic with the palm pilot devices
c) Iomega with the zip drive

Performance play strategy is most attractive
- If primary advantage is based on the development of a striking new technology that offers users substantial advantages over existing technology.
- To firms that are outsiders, with no installed based customers because new entrants and upstarts with compelling new technology can more easily afford to ignore backward compatibility and push for an entirely new technology.

2. Controlled Migration

In controlled migration, consumers are offered a new and improved technology that is compatible with their existing technology.

Example
a) Windows OS and Intel chipset.
b) Pentium
c) Upgrade and updates of software programs, like the annual release of TurboTax by Intuit. Such upgrades are offered by a single vendor, they can read data files and programming created for earlier versions and rely on many of the same skills that users developed for earlier versions

If you have secured domination in your market, you can introduce the new technology as a premium version of the old technology, selling it first to those who find the improvements most valuable. Controlled migration often is dynamic form of the versioning strategy.

3. Open Migration

Open migration is very friendly to consumers: the new product is supplied by many vendors with compatible technology and requires little switching cost.

Example

- Multiple generations of modems and fax machines, each generation conforms to an agreed-upon standard communicate smoothly with earlier generations of machines.

Open migration makes the most sense if your advantage is primarily based on manufacturing capabilities. In total case, you will benefit from a large total market and an agreed-upon set of specifications, which will allow your manufacturing skills and economies of scale to rise.

4. Discontinuity

It refers to the situation in which a new product or technology supplied by many vendors and is incompatible with the existing technology but is available from multiple suppliers.

Example
- CD – audio system
- 3 ½ "FD

It favors suppliers that are efficient manufacturers (in hardware) and that are best place to provide value added services or software enhancement (in software).

Lesson learned

- Positive feedback means strong get stronger and weak get weaker
- Consumers value size of network
- Works for large networks, against small ones
- Consumer expectations are critical
- Fundamental tradeoff: performance and compatibility
- Fundamental tradeoff: openness and control
- Generic strategies
- Performance play
- Controlled Migration
- Open Migration

Summary

This chapter highlights "network externalities"—a fundamental economic characteristic of real and virtual networks—which occurs when the value of a

product or service to one user depends on how many other users there are (ie: phone, Internet, e-mail, modems). The pattern such technologies follow results from "positive feedback": as the installed base of users grows, more and more users find the product useful to adopt. The authors identify four generic strategies for igniting customer feedback, which follow logically from two basic tradeoffs: whether the company will base their strategy on improved performance or enhanced compatibility; and whether the product will be open or proprietary. How these concepts and strategies work in practice is illustrated through a series of historical case studies ranging from the early days of the telephone industry to the introduction of color television.

Company Examples: Apple, Nintendo, Philips, Westinghouse, AT&T, RCA, CBS

References

1. **Carl Shapiro and Hal R. Varian.** *Information Rules: A Strategic Guide for the Network Economy*. Harvard Business School Press, Cambridge, MA, 1998. (www.inforules.com)
2. http://www.stern.nyu.edu/networks/site.html

Assignment Questions

[Q1] "The old industrial economy was driven by economics of scale; the information economy is driven by the economics of network." Illustrates with an appropriate example.

[Q2] Network externalities are normally positive, not negative. Explain.

[Q3] "Information goods and information infrastructure often exhibit both demandside and supply-side economies of scale." Illustrate this statement with a relevant example of your own.

[Q4] Explain in detail the basic principles of network economics and also map out their implications for market dynamics and competitive strategy.

[Q5] Explain the basic concept of positive feedback. Why is positive feedback so important in high-technology industries? What kind of predictable pattern

positive feedback system follows in the adoption of new technologies?

[Q6] "Positive feedback makes the strong get stronger and the weak get weaker, leading to extreme outcomes." Explain in terms of network externalities.

[Q7] Do you think that the supply side and demand side economies of scale combine to make positive feedback in the network economy especially strong? If yes, justify with your own example,

[Q8] In a network economy, what does it take for a new technology to succeed in the market? How can a new technology get into a virtuous cycle rather than a vicious cycle?

[Q9] What is network externality? How can you make network externalities work for you to launch a new product or technology? How can you overcome collective switching costs and build a new network of users?

[Q10] What are the two basic approaches to deal with the problem of consumer intertia? Explain each in details.

[Q11] In the positive feedback, explain the trade off between
a. Performance vs. compatibility
b. Openness vs. Control

[Q12] What are the two obstacles normally encountered while offering customers an attractive migration path to a new technology? Explain. Also explain the three strategies for helping to smooth migration path to new technologies.

[Q13] What are the three primary dimensions of strength in network markets? Explain.

[Q14] What are the various generic strategies in network market? Explain.

[Q15] In a new market with network externalities, how is the relative leverage of buyers and sellers likely to shift as the market evolves?

[Q16] Explain the four generic strategies for companies seeking to introduce new information technology into the marketplace.

[Q17] What are the two obstacles to execute the evolution strategy which offers consumers a smooth migration path?

[Q18] Explain how controlled migration is often being considered as a dynamic form of the versioning strategy.

[Q19] What do you mean by Critical mass in the network markets? Why critical mass is important to ignite the positive feedback even more stronger.

[Q20] "Consumer expectations are vital to obtaining the critical mass necessary to fuel growth." Justify this statement with reference to expectation management in the network externalities.

[Q21] "Firms introducing new products and technologies face a fundamental trade-off between openness and control." Explain. In the oligopoly market, which strategy do you follow, if your company especially provides value added services?

[Q22] What are the three key assets that govern ability for information industries to ignite positive feedback?

**** The End ****

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