Network effects and standards

A premise

In traditional economic theory of demand, we generally assume that the value a consumer obtains from consuming a product is independent of whether others also consume the same product, or indeed how many others consume it.

This may be an appropriate assumption in many settings, but not in all..

Network Externalities

Many markets are characterized by **network externalities**, or **positive** consumption externalities.

- **network externalities** occur when the value of a good to a user increases with the number of other users of the same or similar good.
  - e.g. a telephone is not much useful if only a few people can be called with it—the amount of utility the phone provides is directly related to the size of the network.

Network Externalities

We can also find some similarities between demand for distinction and the idea of a **negative** network externality.

If a Premier League footballer seeks distinction by buying a Lamborghini sports car, then the value of that car as a mark of distinction requires that not too many others also own Lamborghini cars.

- ➢ we could say that if too many people own such cars then a negative network externality would apply: value as a source of distinction declines the more people own that type of car.

However, we will look at positive network esternalities.

Network Externalities

The number of users of a particular technology is often referred to as its **installed base**.

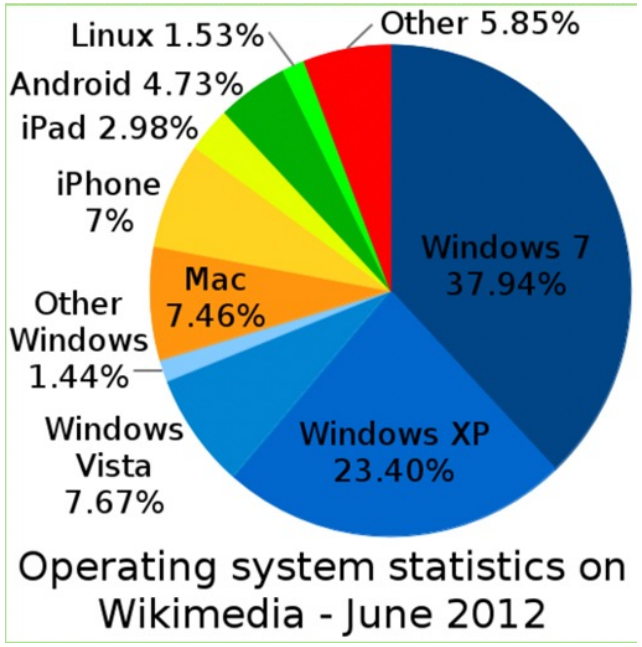
- The number of users of a particular good.
  - E.g. the installed base of a particular video game console refers to the number of those consoles that are installed in homes worldwide.

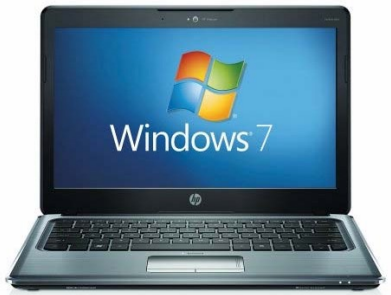
Network externalities also arise when **complementary goods** are important.

- Additional goods and services that enable or enhance the value of another good.
  - E.g. the value of a video game console is directly related to the availability of complementary goods such as video games, peripheral devices, and services such as online gaming.

Network Externalities

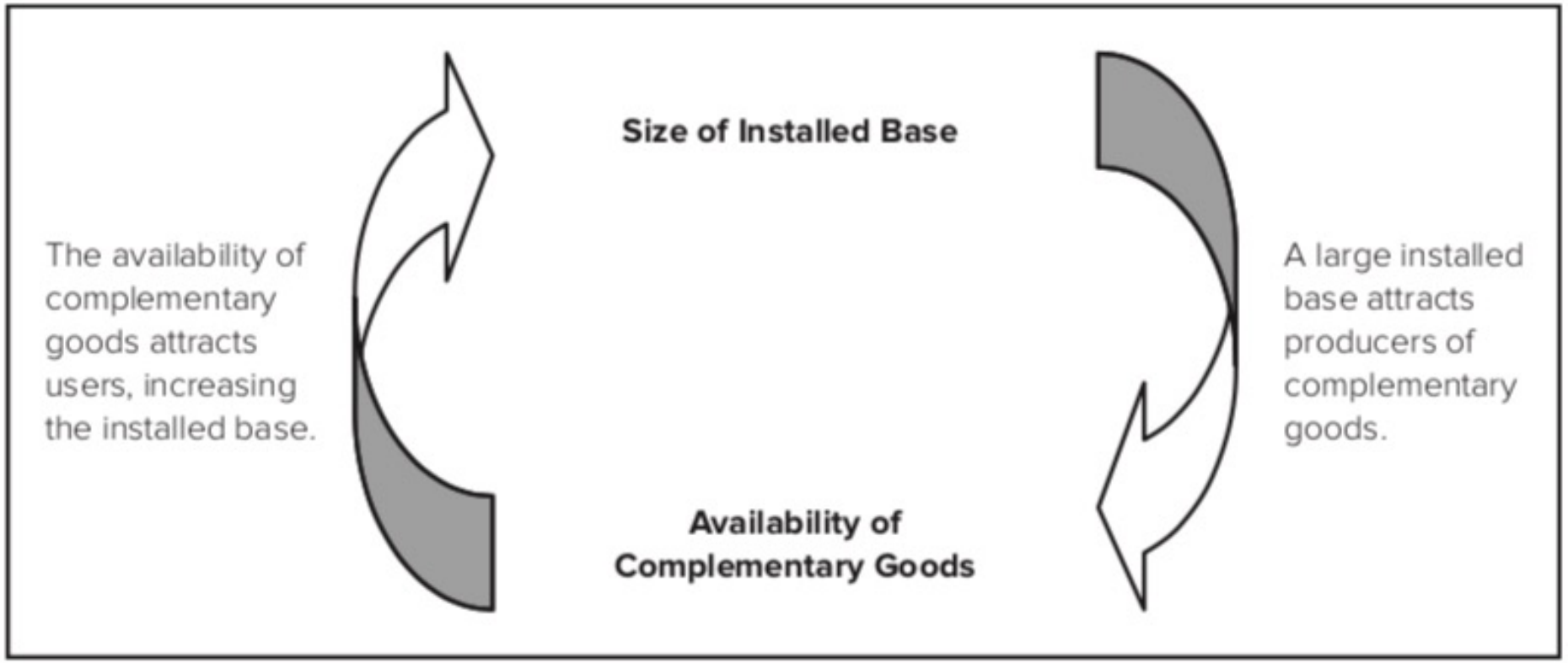
Installed base





Complementary good

The Self- Reinforcing Cycle of Installed Base and Availability of Complementary Goods



SWITCHING COSTS

- In the traditional economic theory of demand, we generally assume that the consumer continually selects the best combination of price and quality.
- If competition or innovation means that a new product offers better value for money than any of the existing products, then the customer will switch without difficulty to the new.
- In short, we assume that there are no significant switching costs.
- That is a reasonable assumption in some contexts. For example, suppose that I am in the habit of buying a particular brand of caster sugar from the supermarket, because it is generally the best value for money. Suppose then a new brand becomes available, which is clearly better value for money.
- While I may have some residual brand loyalty, there is no large switching cost in selecting the new brand in place of the old.

SWITCHING COSTS

In many contexts the assumption of low switching costs is unrealistic. There are two main reasons:

1. First, the act of switching may involve me in more work than keeping the same supplier. Even if we know that our existing supplier does not offer the best value for money, and we have no brand loyalty to the existing supplier whatever, we may be disinclined to go to the bother of switching because it requires several hours of searching on the Internet and a sequence of letters, emails and phone calls with old supplier and new.
2. Second, I may be reluctant to switch when I am familiar with a particular system, or if I have made large investments in it. So, for example, if I am familiar with a particular software package, I may be reluctant to switch to a new package – even if it is better and cheaper.

SWITCHING COSTS

When switching costs are important, customers will not continually select the product or service offering the best value for money.

This does not mean, at the other extreme, that consumers exhibit total inertia, or a complete reluctance to switch supplier.

But it means that such switches are occasional rather than continuous.

THREE ‘LAWS’ OF THE ECONOMICS OF NETWORKS

We said that network effects refer to the case where the value a user obtains from a particular product or service is an increasing function of the number of others using the same product or service.

It is useful to summarise three ‘rules of thumb’ that have emerged from the literature and which describe the relationship between the value derived from a network and the size of that network.

These are known, respectively, as:

- Sarnoff’s Law,
- Metcalfe’s Law
- Reed’s Law.

THREE ‘LAWS’ OF THE ECONOMICS OF NETWORKS

Sarnoff’s Law states that **the aggregate value (V) of a network** (to all those in the network) **is proportional to the number of members in the network (N)**:

$$V = cN$$

This means that the average value of network membership to any individual member (u) is a constant:

$$u = V/N = c$$

This ‘law’ was proposed to describe the value of **some broadcast networks**. The total value that an audience obtains from watching the broadcast is proportional to the number of viewers. This seems like a reasonable assumption in the context of what we might call ‘private’ viewing – that is, where the value that one person obtains from watching a programme is unrelated to how many others watch it. This might apply to watching the weather forecast, for example. But the assumption would not be appropriate for ‘social’ viewing, where the value from watching a programme depends on the fact that others are also watching.

- Eg.‘soap operas’ and certain types of ‘reality TV’ where the programme is a topic of discussion with friends and colleagues, and hence the value of watching is not independent of how many others choose to watch.

THREE ‘LAWS’ OF THE ECONOMICS OF NETWORKS

A second law is Metcalfe’s Law. This asserts that the aggregate value (V) of a network (to all those in the network) is proportional to the square of the number of members in the network (N):

$$V = cN^2$$

This means that the average value of network membership to any individual

member (u) is proportional to the number of network members:

$$u = V/N = cN$$

In other words, the value to an individual (u) of a telephone connection depends on the number of people he can call.

The rationale is that the value of such a network is proportional to the number of different phone calls between different pairs of callers that it can support.

We can show that this is approximately proportional to N^2.

Metcalfe’s Law - criticisms

- Metcalfe’s Law may exaggerate because it assumes that an individual caller is equally likely to call any other.
- In practice, caller networks are not like that.
- There are a group of friends and associates that I am likely to call, and then everyone else who I am not likely to call.
- As my friends and associates join the network then I gain value from that but as others outside that group join the network then I do not gain from their joining the network.
- In practice, this often means that the first members of a network add the most value, while later entrants add less value.
- For that reason, individual value is not proportional to n, but grows less than proportionately and eventually reaches a ceiling.
- More generally, the user will pay more attention to the composition of the network of other users and not just the number of users per se.

THREE ‘LAWS’ OF THE ECONOMICS OF NETWORKS

The third law is Reed’s Law. This asserts that the aggregate value (V) of a network is an exponential function of the number of members in the network (*N)*:

$$V = c2^N$$

The rationale for Reed’s Law is that is based on the assumption that the total value of a network is proportional to the total number of distinct groups or teams of size 2 and above that can be formed within that network. For large *N*, the answer is approximately proportional to 2*N*.

Reed’s Law may be especially relevant to the formation of creative teams where the required competencies are uncommon and the ability of team members to work with each other cannot be taken for granted.

The key here is to form a team with the required competencies and the ability to work together.

Reed’s Law - criticisms

- If Metcalfe’s Law is an exaggeration, then Reed’s Law is even more of an exaggeration.
- Reed’s Law assumes that each user attaches equal value to every potential group he could belong to.
- In practice, it is most unlikely that the network user would attach equal value to each and every possible group.
- Nevertheless, Reed’s Law captures an important idea in creative networks, and may also offer an explanation of why it is relatively easy to form creative teams that work well in large clusters.

IMPLICATIONS OF NETWORK EFFECTS

The existence of network effects can have a variety of implications for economic behaviour.

We can group these effects into three categories:

1. Implications for **consumers of products** with network effects
2. Implications for **sellers of products** with network effects
3. Implications for **companies** that wish to exploit the fact that they are part of a network.

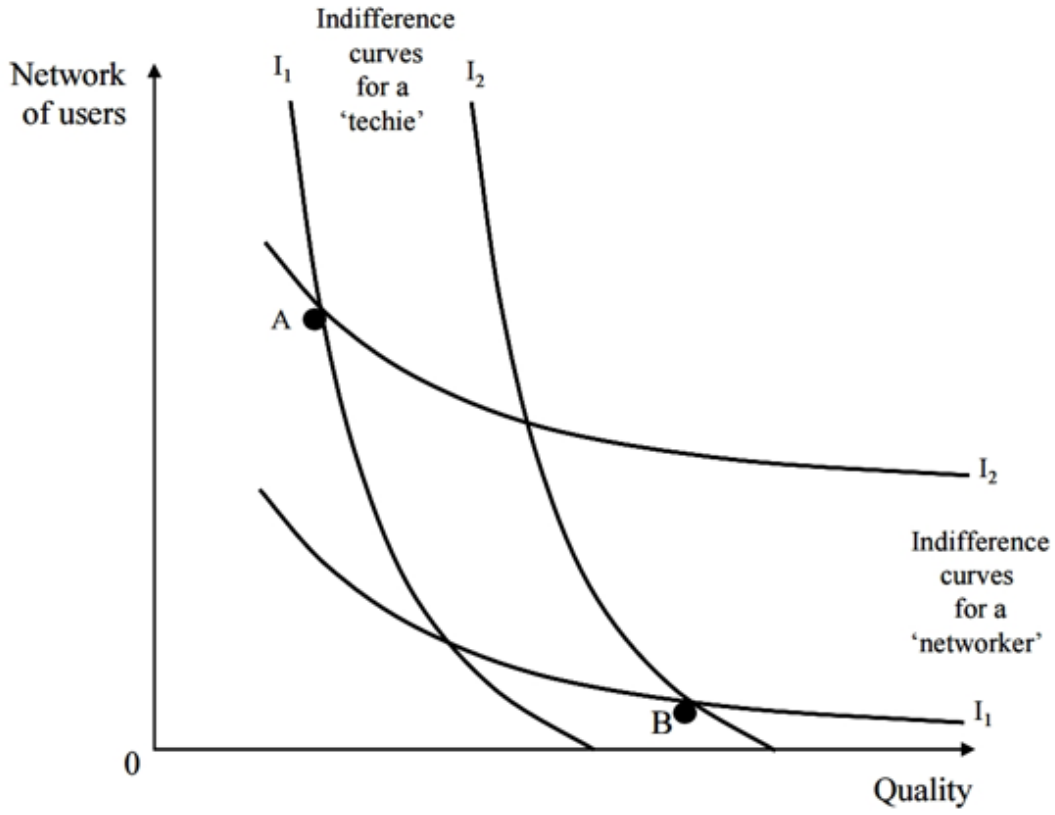
IMPLICATIONS OF NETWORK EFFECTS: Implications for Consumers

When there are network effects in the consumption or use of a particular product or service, then consumer behaviour may change in some important ways.

1. **The consumer no longer makes his choice decisions only with reference to the price and intrinsic quality of available products.** The consumer will also want to take account of the size of the network of others who use the same product or service.
2. **When network effects influence choice, buyers may prefer an inferior technology to a superior technology because the former has a large network of users while the latter doesn't.** This explains why superior new technologies may not displace inferior but established technologies.
3. **A group of consumers for whom network effects are important will try to coordinate their choices.** This is sometimes called a 'consumption economy of scale'.
   - One familiar example is that members of a family often coordinate their choice of mobile phone operator.

IMPLICATIONS OF NETWORK EFFECTS: Implications for Consumers

- Figure shows the indifference curves for two different types of consumer.
- The '**techie**' is primarily interested in the intrinsic quality, or technological sophistication of the software package, and is not so concerned if only a few others use the product. As a result, the 'techie' has rather steep indifference curves, as shown.
- The '**networker**' is less concerned about intrinsic quality, or technological sophistication, but is more concerned to ensure that he buys the same product as is used by friends and colleagues. As a result, the 'networker' has rather flat indifference curves, as shown.



Consumer choice with network effects

IMPLICATIONS OF NETWORK EFFECTS: Implications for Consumers

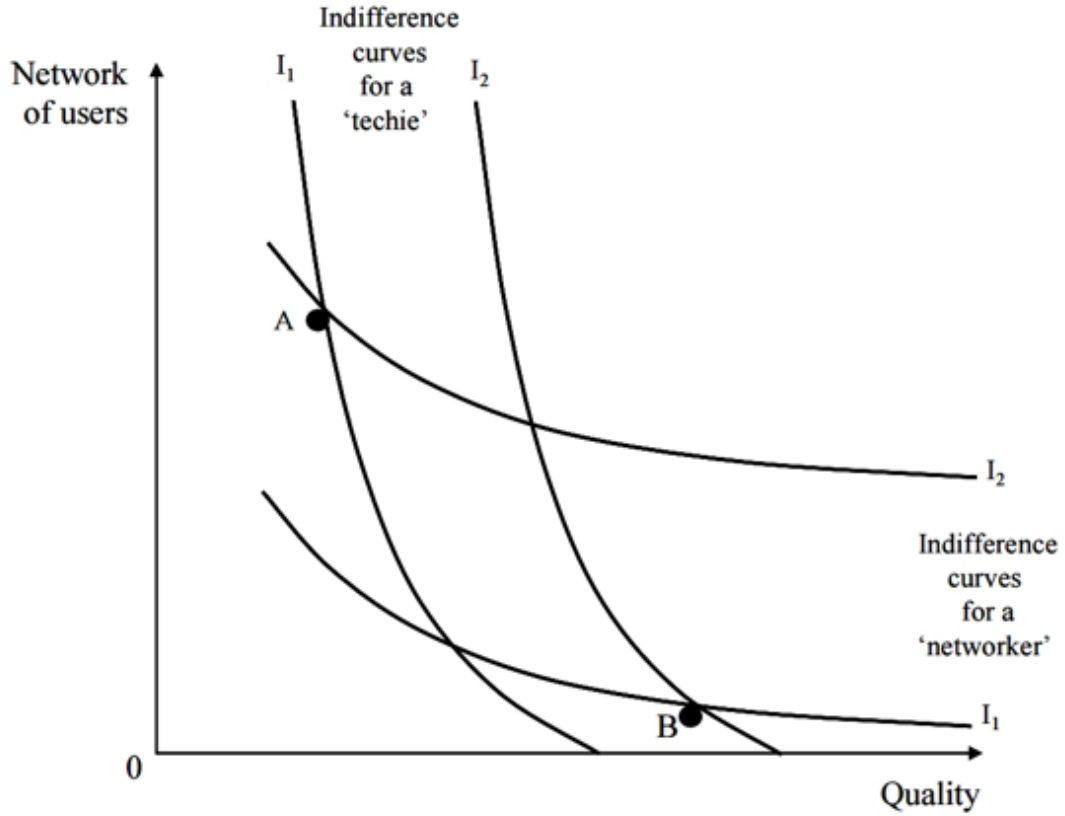
Suppose that the consumer faces the choice between two software products with the same price as shown in the graph.

One of these (A) is of relatively low quality but a large number of other consumers already own this product. The other (B) is of higher quality, but only a small number of other consumers own this product.

If network effects did not exist, then since the prices of A and B are the same, the sensible consumer should prefer B.

But when network effects are important, then the choice is not so straightforward.

The consumer will need to weigh up the relative importance of quality and network effects.



Consumer choice with network effects

Implications for Suppliers

The supplier must try to build up a network of users as soon as possible if consumer choice depends on network effects as well as intrinsic quality.

The firm that is successful in quickly building a network of users will find that their system is more attractive to subsequent users.

As these users join the network that makes the product even more attractive to the next wave of consumers.

In the absence of network effects, different products may co-exist in different segments of the market.

But when network effects are important, it is unlikely that many products can survive together.

The existence of this positive feedback means that competition with network effects often tends to produce one winner.

Implications for ‘Network Firms’

- By a ‘network firm’ we don’t necessarily mean a firm that produces products for consumers who value network effects. Rather, we mean a firm that makes it an explicit part of strategy to exploit being part of a network.
- Network firms are firms that specialise in a very narrow part of the vertical chain, and outsource most other activities.
- Such network firms are common in strong industrial clusters. In that context, the network firm can use some of the many firms in the cluster to carry out many parts of the value chain, while keeping to itself those activities in which it has a particular skill or expertise.
- This strategy works best when the network firm can draw on a large network.

STANDARDS AND DOMINANT DESIGNS

- One of the implications of network effects for the consumer is that there are incentives for those who live and work together to standardise on a common product or service.
- When network effects are important in the demand for a particular product, the supplier of that product faces a ‘standards race’ to try to achieve market success for his product.
- It is generally recognised that the idea of network effects and the idea of a standard are quite closely related,
  - we will define some of the different uses of the term ’standard’.

STANDARDS AND DOMINANT DESIGNS

The most important distinction is between ‘formal’ and ‘informal’ standards.

- **formal** standards are called ‘institutional’ standards or ‘de jure’ standards,
- **informal** standards are called ‘market’ standards or ‘de facto’ standards (or even ‘dominant designs’, so avoiding the use of the term ‘standard’).

Formal standards

- Formal standards are public documents written by a standard institution (such as ISO, CEN, BSI or DIN) or consortia established with the purpose of writing a specific standard for a specific technology.
- As these documents are public and open, any company is at liberty to produce a product or service that adheres to the standard.
- These formal standards are defined by a committee within a standards institution and emerge as a result of a process of consensus or compromise.
- It can be time-consuming to reach agreement on a formal standard, but at the end we have an open document, and that openness can be important for innovation.
- In addition, standards professionals believe that this institutional standard produces a result of higher quality than would emerge from competition in the market.

Some examples of a standard ISO

- For example, ISO standards ensure that:
- thermometers are calibrated the same way in different hospitals (ISO 80601),
- that food safety hazards are minimized (ISO 22000),
- that personal and sensitive data is protected (ISO/IEC 27000).

Informal standards

- By contrast, informal standards are not public documents and are generally not open.
- Most usually, these are proprietary designs owned by one or more companies, and their claim to be a ‘standard’ derives from the fact (‘de facto’) of their market success rather than institutional endorsement.
- These ‘dominant designs’ have emerged successfully from a standards race and have emerged as a standard through use.
- Allowing such standards to be defined by market competition has several disadvantages.
- It can be a very costly process, especially for the losers, but also for consumers. This market process of reaching a standard may increase the risk of lock-in to an inferior outcome.
- Moreover, the end result is a proprietary standard rather than an open standard and that introduces an undesirable element of monopoly. But set against these disadvantages, the market process is generally quite quick at producing a ‘winner’.

A dominant design

The technology cycle almost invariably exhibits a stage in which the industry selects a **dominant design**.

- Once this design is selected, producers and customers focus their efforts on improving their efficiency in manufacturing, delivering, marketing, or deploying this dominant design, rather than continue to develop and consider alternative designs.

Why industries experience strong pressure to select a single technology design as dominant and the multiple dimensions of value that will shape which technology designs rise to dominance?

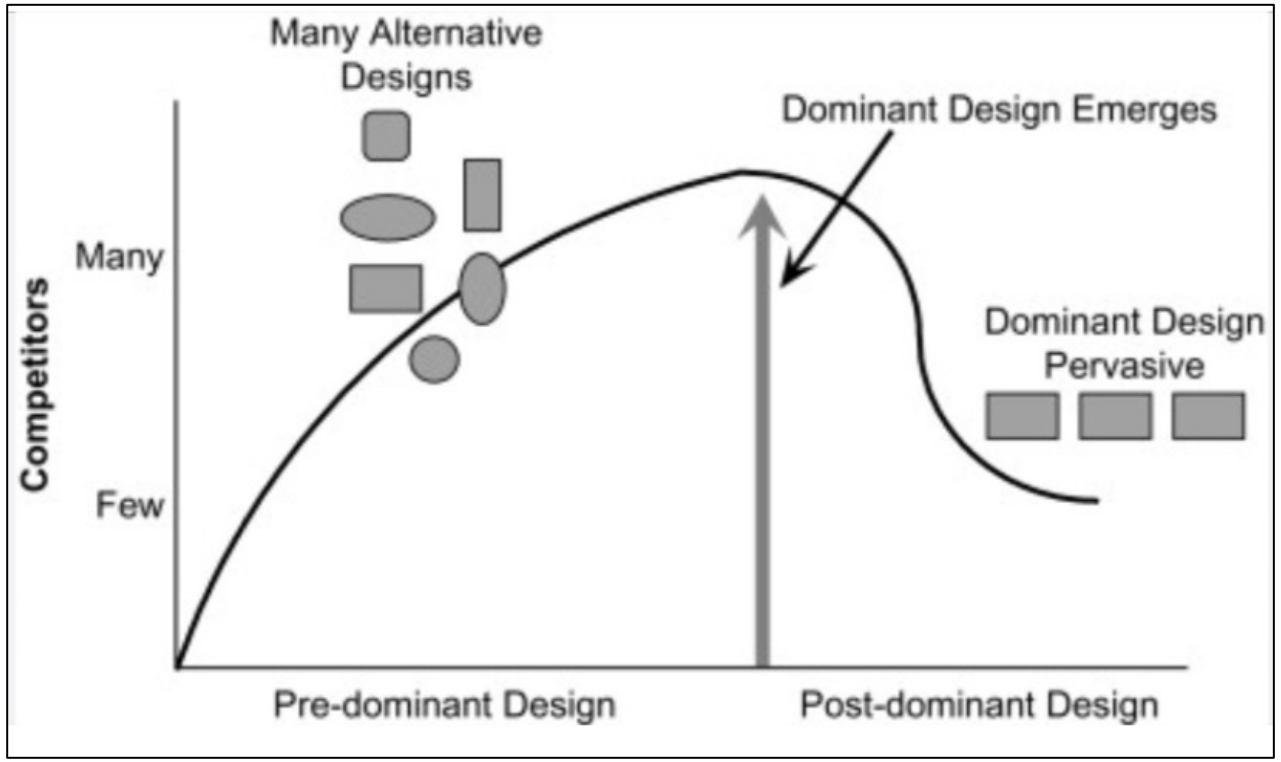
Why and how modularity and platform competition emerges in some industries?

A Dominant design

A single product or process architecture that dominates a product category—usually 50 % or more of the market.

While it may not be officially enforced or acknowledged, it has become a standard (de facto) for the industry.

A dominant design



Alternative Definitions of a Dominant Design in the Extant Literature

Source	Definition of a Dominant Design	Empirical Method to Identify a Dominant Design
Abernathy and Utterback (1978)	A dominant design is a single architecture that establishes dominance in a product category.	Conceptual paper.
Anderson and Tushman (1990)	A dominant design is a single architecture that establishes dominance in a product category.	A design is dominant if it acquires more than 50% market share of the product category and maintains it for four consecutive years.
Utterback (1994)	The dominant design in a product category is the one that wins the allegiance of the marketplace; it is the one that competitors and innovators must adhere to if they hope to command significant market following. A dominant design is a product in a product category that gains general acceptance as the standard on technical features that other market players must follow if they wish to acquire significant market share.	No details provided.
Suaréz and Utterback (1995)	The dominant design is a specific path along an industry's design hierarchy that establishes dominance among competing design paths.	Industry experts were used to classify dominant designs in typewriters, automobiles, televisions, picture tubes, transistors, and electronic calculators.
Christensen, Suaréz, and Utterback (1998)	A dominant design emerges in a product category when one product's design specifications (consisting of a single or a complement of design features) define the product category's architecture.	Industry experts were used to identify the emergence of the dominant design in the rigid disk drive industry based on the technical elements of the product category evolution over time.

WHY DOMINANT DESIGNS ARE SELECTED

Why there is a single dominant design rather than support a variety of technological options?

1. Many industries exhibit **increasing returns to adoption**, meaning that the more a technology is adopted, the more valuable it becomes.
2. As the technology is used, greater knowledge and understanding of the technology accrue, which may then enable improvements both in the technology itself and in its applications.
3. As a technology becomes more widely adopted, complementary assets are often developed that are specialized to operate with the technology.
   - Two of the primary sources of increasing returns are (1) learning effects and (2) network externalities.

STANDARDS AND DOMINANT DESIGNS

The literature on standards tends to distinguish four different types or functions of standards. Any one standard may combine more than one of these functions, but it is useful to make a distinction between them because their economic effects are subtly different. -->

Functions of standards

The first is the compatibility standard or inter-connection standard.

The role of the compatibility standard is to ensure that we can connect items A and B, and that they work with each other, or that a piece of software will run on a particular piece of hardware.

Compatibility standards exist to ensure that the user of a particular product who values network effects can indeed enjoy those network effects.

These compatibility standards can be formal or informal.

Functions of standards

The second is the safety standard or minimum quality standard.

It is concerned with addressing questions such as the following. Is the product safe?

Does it reach a minimum quality threshold?

One object of this standard is simply to protect the consumer. More generally, the object of this type of standard is to overcome certain sorts of market failure that arise if the consumer cannot asses the quality of what he is buying.

These standards tend to be most effective if they are formal rather than informal.

Functions of standards

The third is the standard to reduce variety.

A familiar example of this is the clothing size. The objective of producing clothes in a limited number of standard sizes is to achieve economies of scale and economies of stockholding.

- Of course, there is also an element of compatibility standard here: the size 12 foot cannot fit into a size 8 shoe.

These standard sizes can be formal or informal.

Functions of standards

The fourth is the standard for measurement and description.

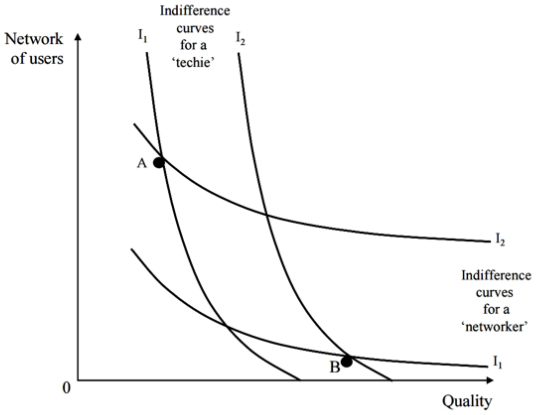
These are, in a sense, a higher level of standard, because they don't so much refer to a standard for a particular product but rather a standard for the units we use to measure and describe the products we buy and sell.

Obvious examples include standards of length, volume and weight.

These standards tend to work best if they are formal, though some informal measurement standards also exist.

An Analysis of the Standards Race

- We can imagine a race in which there are two products – both sold at the same price.
- One product we shall call the ‘established standard’ and the other we shall call the ‘better replacement’.
- The first is of inferior quality, but it is an established product with a large existing network of users.
- The second is of superior quality, but it is a new product and has no network of users at the start of the race.
- As illustrated in the graph, consumer choice between these two products will depend on the shape of consumer indifference curves between quality and network effects.
- In the graph we drew two polar types of consumer indifference curve.
- In this illustration of the standards race, we assume that there is a continuum of customer types, ranging from the ‘techie’ to the ‘networker’.



Consumer choice with network effects

An Analysis of the Standards Race

- Let us imagine that we rank these customer types in order, according to the slope of their indifference curves, from ‘techie’ to ‘networker’, and let us identify the median customer.
- It turns out in races of this sort that the median customer is decisive to the outcome. If the median customer in a particular period prefers the established standard to the better replacement, then more than 50 per cent of customers in that period will choose the established standard.
- This means that the network of customers using the established standard will grow by more than the network of customers using the better replacement, and as a result the competitive position of the established standard will strengthen.
- Conversely, if the median customer in a particular period prefers the better replacement to the established standard, then more than 50 per cent of customers in that period will choose the better replacement.
- This means that the network of customers using the better replacement will grow by more than the network of customers using the established standard, and as a result the competitive position of the better replacement will strengthen.
- Finally, if the median customer is indifferent between the two products, then they each share 50 per cent of sales in that period, and the competitive balance between them is unchanged.

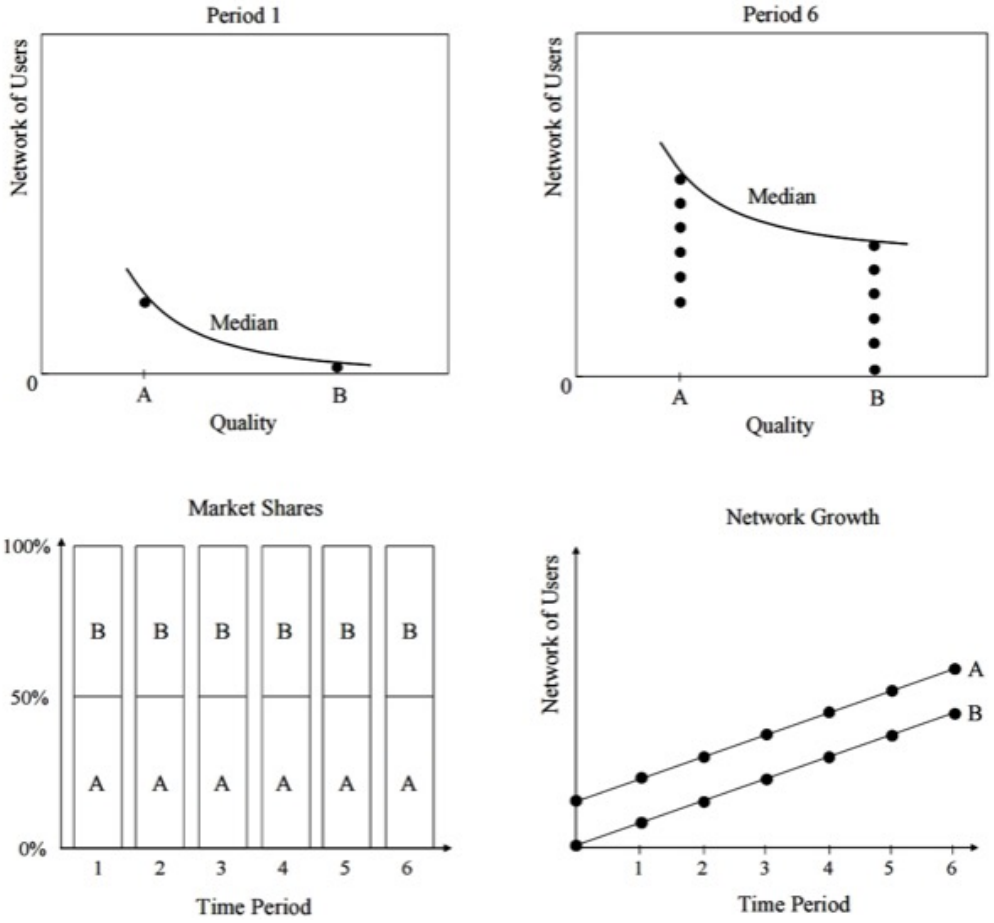
A ‘neck and neck’ standards race

This is the ‘neck and neck’ race where the established standard (A) and the better replacement (B) continue to split the market equally between them, and neither wins the race. This outcome is theoretically possible but pretty unlikely.

In the upper half graphs, we illustrate the choice facing the customer in period 1 (left) and period 6 (right), and we show the indifference curve of the median customer.

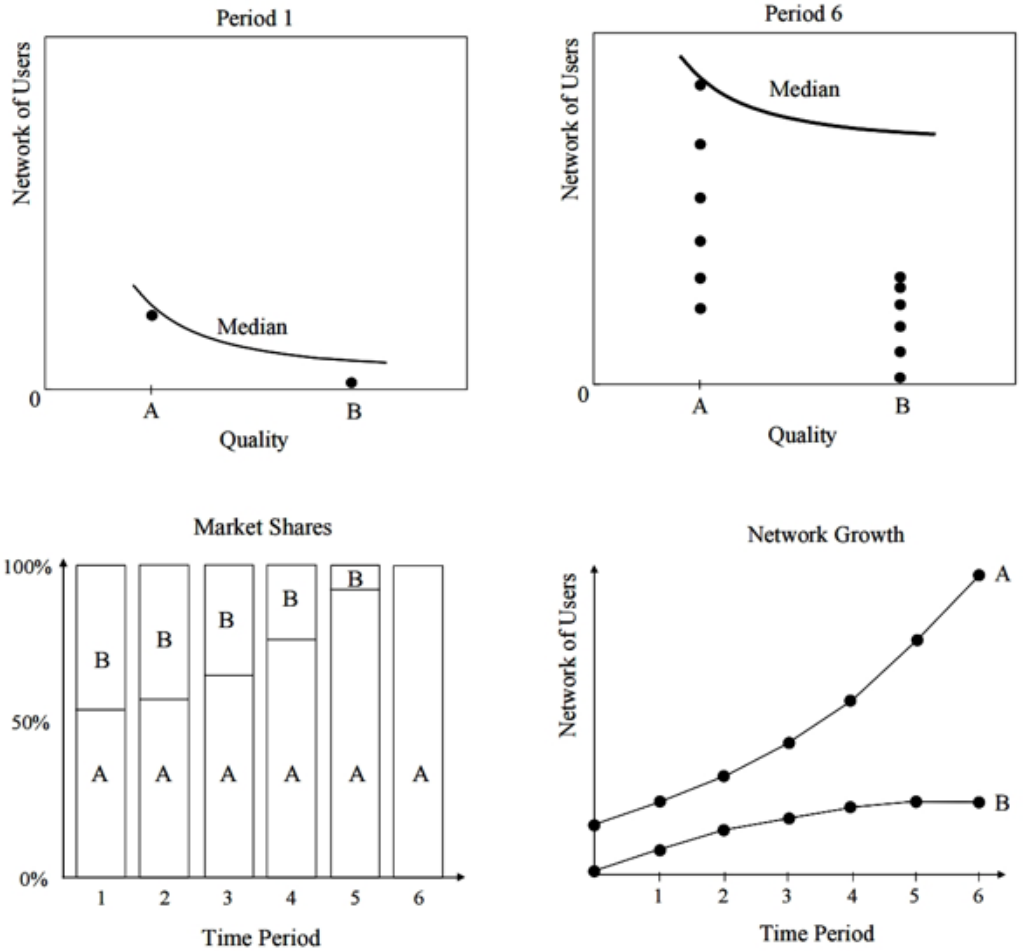
In the lower half graphs, we show the market share split in each period and the trend in the total network of users for products A and B.

We see in the graphs that the market share split is always 50:50 and hence the total network sizes grow in parallel.



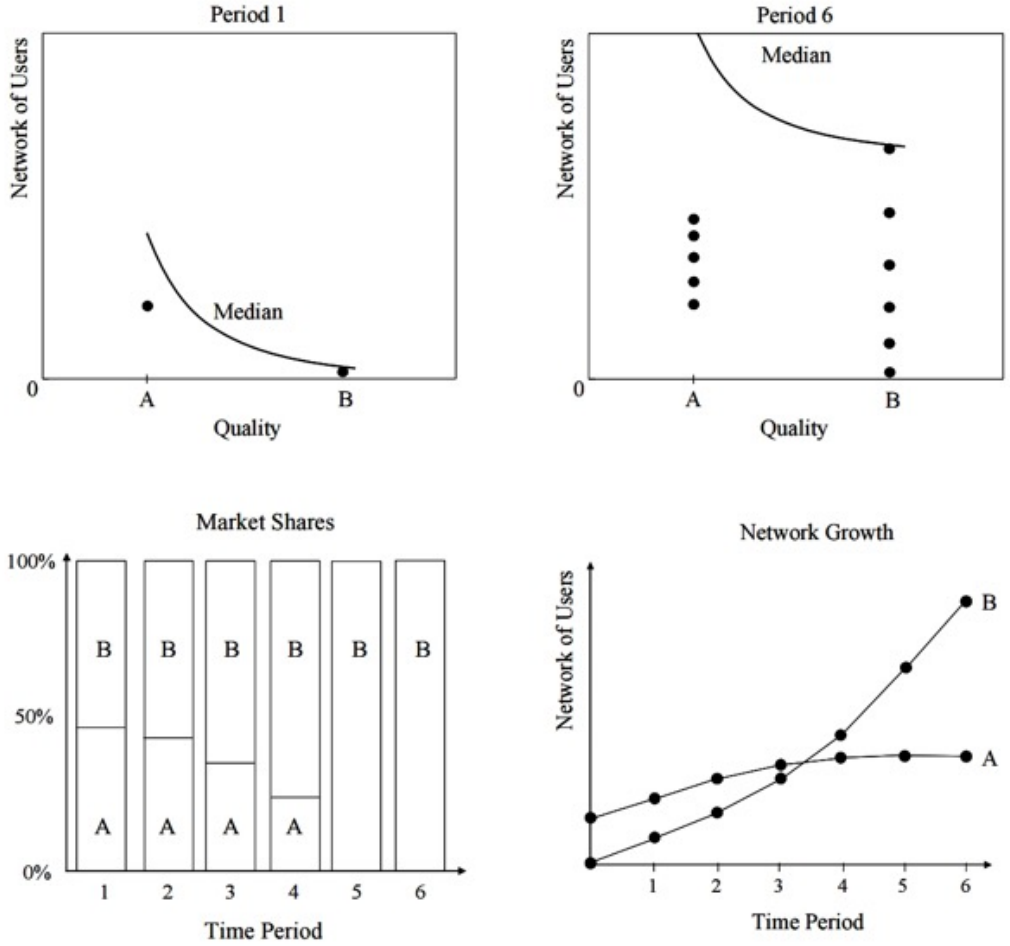
The established standard forges ahead

This is the case where the established standard (A) forges ahead because the replacement (B), better though it may be, is not good enough to make up for its smaller network of users.
In the upper half graphs, we illustrate the choice facing the customer in period 1 (left) and period 6 (right), and we show the indifference curve of the median customer.
In the lower half graphs, we show the market share split in each period and the trend in the total network of users for products A and B.
In the graphs, the market share for the established standard starts off above 50 per cent, and grows, and as a result the total network using the established standard forges ahead.



The better replacement catches up

This is the case where the better replacement (B) is good enough to make up for its smaller network of users, and it catches up and eventually overtakes the established standard (A).
In the upper half graphs, we illustrate the choice facing the customer in period 1 (left) and period 6 (right), and we show the indifference curve of the median customer.
In the lower half graphs, we show the market share split in each period and the trend in the total network of users for products A and B.
In the graphs, the market share for the better replacement is always above 50 per cent, and grows, so that the total network using the better replacement catches up and eventually overtakes the network for the established standard.



Strategies for Winning Standards Races

- Many companies have used the **product preannouncement** as part of their strategy for winning standards races.
- Product preannouncement is often used by the producer of a system that is relatively late to market. Before the product is ready to be launched on the market, the company makes a preannouncement (often to the trade press, or perhaps at an industry conference or exhibition): this states that their system will be launched in a few months' time.
- In the present context, the company's object is usually an attempt to persuade customers to wait for their forthcoming system rather than buy from the existing range of available systems.
- If successful, the preannouncement will delay the growth of the network of users of rival systems, so that when the company is ready to bring its product to market, the established products in the market do not enjoy such a large head start.

Strategies for Winning Standards Races

The preannouncement has been open to abuse.

1. First, some companies gained a reputation for preannouncing products that did not appear until much later, or perhaps never appeared at all.
2. The latter was quite common in the software market, where it became known as ‘vapour-ware’. In the light of this, preannouncements from some companies could lack credibility. Moreover, it was alleged (as part of an anti-trust case against IBM) that the preannouncement could be used in an anti-competitive fashion.

Strategies for Winning Standards Races

- A second strategy for winning standards races has been to recognise that '**the best is the enemy of the good**'.
- To stand a chance of winning a standards race, the company cannot risk being too late to market.
- This may mean that it is better to bring the product to market as soon as it is 'good' rather than to wait until it is at its 'best'.
- Indeed, some have suggested that so intense is the pressure to bring software products to market promptly that companies may decide to market their products even if these software products may still contain 'bugs'.

Strategies for Winning Standards Races

A third, and related strategy, again common in the software market, is to sign up **beta testers** for a new software package.

This is a way of releasing an early version of the software to selected high-value customers, of encouraging them to invest some time in learning to use the software.

Such beta testers may help the software producer to identify faults or areas for improvement and that is of course very important. But in the context of a standards race, the use of beta testers may help to build up a network of users in advance of general release.

Strategies for Winning Standards Races

Several other strategies can be important in this context.

- One is the **explicit sponsorship of some 'blue chip' customers**, to ensure that these important companies become part of the network using a new product.
- Another is the strategy of **building up indirect network effects by licensing third party producers** to make a variety of add-on products that can be used in conjunction with your product.
- A further related strategy is to **develop gateways from other products to your own**, so that you reduce the user's costs of switching from a rival system to your own system.