

Clusters and networks

Clusters and networks

1. Clustering is a pervasive characteristic of innovative industries.
2. The cluster offers a powerful way to bring together many ideas.

SILICON VALLEY

- The leading example of a successful cluster is the 'Silicon Valley'.
- Silicon Valley became the centre of world computer industry in the 1950s, building on electronics expertise.
- It is home to many major companies in the computer industry, including Apple, Hewlett-Packard, and Intel. One distinguishing characteristic of Silicon Valley is the large number of startup companies that became major players in the industry (e.g. Intel and Apple).
- Many companies there are described as 'network firms', specialising in one part of the vertical chain and outsourcing the rest.
- It is generally reckoned to have the best risk and venture capital resources anywhere in the world. Some essential features of economic life in Silicon Valley are informal networking, job mobility, network firms, startups, specialisation and the division of labour.
- Most other clusters do not enjoy all the beneficial effects observed in Silicon Valley. Nonetheless, clustering is an essential feature of life in many industries – especially high - technology industries.

THEORETICAL DEFINITION OF A CLUSTER

Use of the term cluster is not standardised, and different authors mean different things. The table tries to summarise in a very simple way some of the different interpretations of the cluster concept. It is a simple one-dimensional spectrum of interpretations, from rich to shallow.

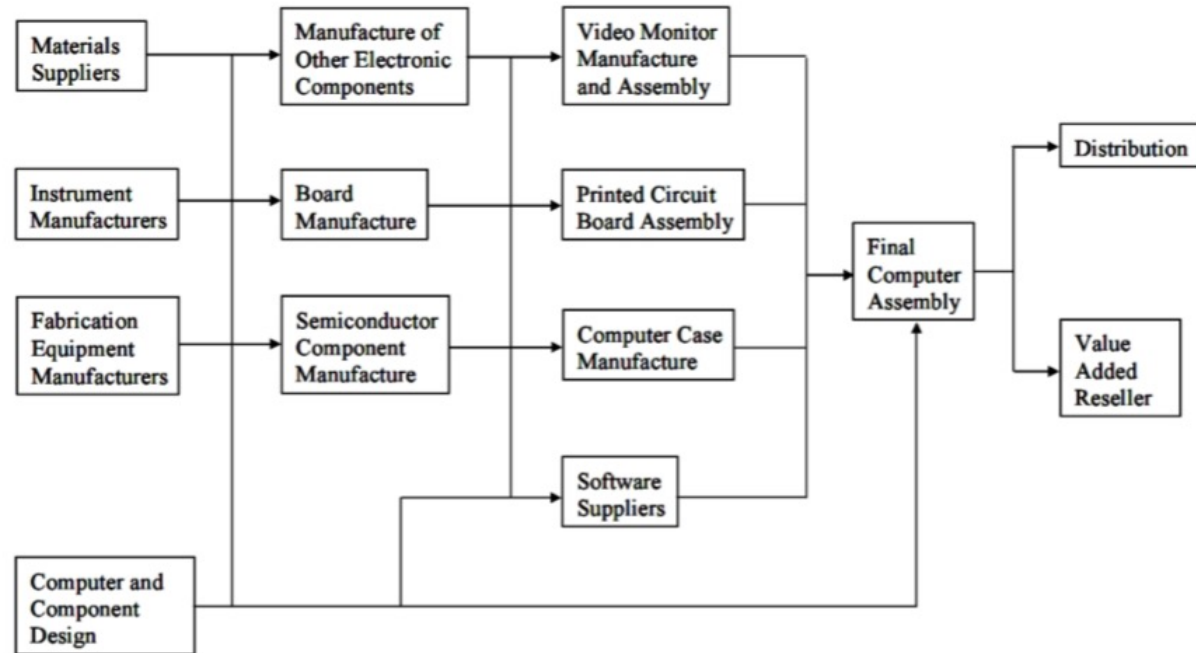
The cluster 'ladder': variations on the cluster concept

Phenomenon	Richness of Cluster	Difficulty of Measurement
Informal knowledge exchange	Rich	Difficult
Explicit collaboration		
Labour mobility		
Marshallian externalities		
Network firms		
Companies interdependent in a value chain		
Co-location and superior performance		
Co-location and technological proximity		
Co-location	Shallow	Easy

1. The most 'shallow' definition of clustering simply says that a group of firms are **co-located**.
2. A slightly more demanding definition is that this **co-located group should also be technologically related** (e.g. they are in the same industrial sector – as in Silicon Valley).
3. The next step upwards would require that these **co-located firms should show superior performance** and that this is attributable to their location in a cluster.

THEORETICAL DEFINITION OF A CLUSTER

4. A further step would be that these firms in the cluster are **explicitly inter-related in a value chain**. So for example, if the cluster contains all the firms illustrated in figure, and they trade directly with each other as illustrated, then that would be a further step up the ladder of Table.



Simplified value chain for personal computer manufacture

THEORETICAL DEFINITION OF A CLUSTER

5. The next step up the ladder is that firms in the **clusters have an explicit strategy as 'network firms'** and exploit the existence of all the other network firms in the cluster. **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 and benefit from location in strong clusters (networks) when:

- (a) the required competencies are uncommon and no one team member has them all;
- (b) the ability of team members to work with each other cannot be taken for granted, so it helps to have a large pool to draw on.

6. The next step up is that firms in the cluster enjoy the sorts of mutual benefits from each other's company that are usually called '**Marshallian externalities**' (e.g. sharing a common infrastructure, access to a pool of skilled labour, and so on).
7. A further step up would be that there is **labour mobility** around this network, and this is important because mobile labour is one of the most effective ways of transferring technology around all the firms in a cluster.
8. A further step up would be that companies in the cluster have **explicit collaboration** in R&D – not, we should stress, in anything that might get them into trouble with anti-trust authorities.
9. the final step is the sort of **informal knowledge exchange** between technologists of different, even rival companies in the bar after work.

WHY DO COMPANIES CLUSTER?

The company's location decision is, like many other economic decisions, one where there is some element of choice at an initial stage, but by the time the company is firmly established in a particular location it is much less likely to move – even if there would be some benefits in doing so.

WHY DO COMPANIES CLUSTER?

Companies making location decisions cluster for a variety of reasons. We can group the benefits from clustering into two types: demand side and supply side.

Advantages and disadvantages of clustering

	Demand Side	Supply Side
Advantages	<ul style="list-style-type: none">• Strong local customers• Reduced customer search costs• Market share gains from clustering (Hotelling)• Reduced transaction costs• Information externalities	<ul style="list-style-type: none">• Strong local suppliers• Pool of specialised labour and other specialised inputs• Shared infrastructure• Reduced transaction costs• Information externalities and knowledge spillovers• Facilitates innovation
Disadvantages	<ul style="list-style-type: none">• Competition in output markets	<ul style="list-style-type: none">• Competition in input markets (real estate, labour) – ‘overheating’• Local infrastructure overstretched• Congestion (e.g. in transportation)• Cartels• ‘New ideas need new space’

Source: Adapted from Swann et al. (1998, p. 57), Taylor et al. (2003).

Advantages on the Demand Side - **strong local customers**

Some companies benefit from having **strong local customers** for their products and services.

At first, this may seem surprising. In an age of low transport costs and online services, many companies supply global markets and their customers are spread all over the world. The existence and strength of local customers might not appear to matter very much. However, this takes too simplistic a view of the relationship between an innovative company and its customers.

We can make a distinction between passive consumers and active consumers:

- Companies do not need close geographical proximity with their passive consumers. They can ship their products round the world to these consumers and provide online after-sales support.
- But companies can benefit enormously from close contact with their active consumers, because active consumers are often an important source of ideas for the next generation of innovative products. Some companies find considerable competitive advantage in co-locating with some of their key customers – or at least having an office near key customers – even if other parts of the operation are located elsewhere.

Advantages on the Demand Side- **reduced customers search costs**

Companies may benefit from location in a cluster because that **reduces the search costs of potential customers.**

Again, in the age of the Internet, that might seem irrelevant.

If all suppliers list their entire catalogue online then the customer can search and find what he is looking for regardless of the location of the supplier.

Location in a cluster means that the discerning consumer will be more likely to search my store to see if he can find what he wants. Location outside the cluster means that the customer is much less likely to come across my store accidentally, and as a result is much less likely to find what I have in store.

Advantages on the Demand Side – market share gains from clustering

A third demand-side benefit from clustering is the idea captured in Harald Hotelling's (1929) famous old model of the two ice-cream sellers located on a beach. This model examines the location decisions of two ice-cream sellers on a beach of 1 km in length where holiday-makers are distributed uniformly along the length of the beach. The model assumes that there is no price competition or product differentiation: both sellers have the same product range and set the same prices for their ice creams. The model also assumes that demand is inelastic: each customer will, if necessary, walk the full length of the beach to reach the nearest ice-cream seller to buy what he wants. The model assumes that customers will for convenience always choose the nearest seller.

Finally, the model assumes that relocation is costless: either seller can wheel his barrow to a new position on the beach if he thinks there is competitive advantage in doing so. Under these conditions, the model shows that the equilibrium outcome is for the two sellers to cluster together side by side at the mid-point of the beach.

If they were located apart, then that would not be an equilibrium, because either producer would stand to gain market share by bringing his barrow closer to his rival, and thereby gaining some more custom from holiday-makers located in between his barrow and his rivals.

If they are located together, but not at the mid-point of the beach, then one seller will have less custom because he only supplies less than half the beach. In that case, the seller would have an incentive to move his barrow to the other side of his rival, so that he is now the preferred seller for more than half the beach. But any such advantage is at most transitory, because the rival will repeat the same move. This progressive leap-frogging will go on until they are clustered together at the centre. That is the only point at which each seller is in an equilibrium position

Advantages on the Demand Side – information externalities

A fourth demand side benefit is the existence of information externalities.

This is the idea that if I see another trader selling successfully at a particular location then that tells me something about the strength of local demand. The other trader's visible success creates an information externality.

This seems to be a strategy employed by some café proprietors. They see that a particular café in a particular location is performing well and reckon that if an adjacent property becomes available, this would be a good location in which to open a rival café. In this example, there is an element of location to reduce consumer search costs. If the new café is located next to a well-known and popular established café, then the newcomer will be easier for customers to find, and may benefit if the established café is very busy.

Advantages on the Demand Side - reduced transaction costs

Clustering can reduce transaction costs more generally.

The literature on the economics of organisation argues that transaction costs may be important when:

- (a) it is a difficult task to ensure that components from an external supplier will exactly meet the customer's requirements;
- b) it is costly to communicate with outside companies;
- c) the customer is concerned about the risk of opportunistic behaviour by sub-contractors.

Advantages on the Supply Side- strong local suppliers

The first benefit is the existence of strong local suppliers.

Again, we might wonder if this really matters all that much. In an age of low transport costs and online services, many companies buy their inputs from global markets and their suppliers are spread all over the world.

The existence and strength of local suppliers might not appear to matter very much.

But this is too simplistic. In those cases where the company is a passive customer of standardised components, then it can obtain these components from anywhere.

But when the company is an active customer for non-standardised components, then it may require regular face-to-face contact with its suppliers and that is easier if they are co-located in a cluster.

Advantages on the Supply Side- pool of specialised labour and other specialised inputs

The second supply side advantage to location in a cluster is that it means the company has access to a large common pool of specialised labour and other specialised inputs.

If the company has a very specialised requirement, then it will be more likely to find this in a large cluster than in an outpost of the industry.

The reason is simply that a specialised worker, for whose services demand is limited, will generally find it most efficient to locate in a cluster because that is where the jobs will be.

We can say, indeed, that this is both a demand-side and a supply-side advantage to clustering.

Advantages on the Supply Side – shared infrastructure

The third benefit is similar, and relates to the fact that clustered companies can share a common infrastructure which is not available to companies outside the cluster.

This shared infrastructure could be very wide in scope, including transport infrastructure (road, rail, and air), public assets (the science base and other publicly provided business services) and real estate (suitable office buildings).

In surveys, quite a lot of companies say that this logistic argument is an important reason for location in a cluster, even if they do not enjoy any of the other benefits from clustering.

Advantages on the Supply Side - reduced transaction costs

The fourth benefit is reduced transaction costs.

- Transactions with a neighbouring supplier may be easier than transactions with a distant supplier.

Advantages on the Supply Side- information externalities and knowledge spillovers

The fifth benefit is information externalities and knowledge spillovers.

- These spillovers can operate on the supply side in the same way as they operate on the demand side.
- Companies may learn from informal knowledge exchange with their neighbouring suppliers just as they learn from informal knowledge exchange with their neighbouring customers.

Advantages on the Supply Side- facilitates the innovation

Proximity with suppliers can facilitate the innovation process.

- It is well known from surveys and case studies of innovation that customer- supplier interaction plays an important role in the innovation process.
- Moreover, in the combinatorial theory of creativity, creativity requires the inventor to bring together habitually distinct insights. While this need not involve social networking between distinct people, it often does. To the extent that such creativity involves bringing together exactly the right mix of people with distinct but complementary expertise, then such creative work is easier to achieve in a cluster and network with a wide diversity of participants. To facilitate such common understanding is generally reckoned to be very difficult online but may be easier when the two groups meet face to face on a regular basis. This is easier to achieve in a cluster than at a distance.

Disadvantages on the Demand Side - competition in the output market

Clustering can bring some disadvantages to the clustered firm as well as advantages.

The clustered firm may encounter greater competition in the local markets it supplies than it would if it were located outside a cluster.

- Obviously this argument is most relevant when the customers that matter are mainly local.
- If a clustered company supplies a global market, then greater competition in supplying local customers is probably not of great concern to it.

Disadvantages on the Supply Side - competition in the input marketing overheating

Most of the disadvantages of clustering apply to the supply side, however.

The first is that firms located in a cluster may face more competition in their input markets.

The most obvious examples of this are the greater competition for real estate and for skilled labour in a cluster. This may sometimes lead to what is informally called 'overheating'. Thus for example, in the context of Silicon Valley, was the rapid growth in the salaries that skilled semiconductor engineers could command. This is again a disadvantage to locating in that cluster.

Disadvantages on the Supply Side- local infrastructure over-stretched

A second, and related point, is that in a strong cluster the local infrastructure shows signs of being over-stretched.

- The City of London again provides a striking example of this. Parts of the London Underground date to the nineteenth century and were not built to deal with the volume of passengers that now use that system.

Disadvantages on the Supply Side- congestion

A third aspect of this is that clusters become uncomfortably congested.

- This is a problem that many living in London, Tokyo and other major world cities complain about.
- Moreover, the road infrastructure around major clusters tends to become seriously congested as the cluster grows – the South East of England and Los Angeles are two examples.

Disadvantages on the Supply Side - cartels

A fourth disadvantage of location in a cluster is that the clustered firm may suffer from the existence of supply-side cartels.

- Just as geographical proximity makes it easier for companies to collaborate in research and innovation, so it makes it easier for companies or other agencies to collude in their supply of a critical input.
- Collaboration of the first sort is usually legal, and indeed encouraged by government.
- Collusion of the second sort is often illegal, but such collusion still goes on, and the severity of anti-trust legislation varies from country to country.

Disadvantages on the Supply Side - 'new ideas need new space'

A fifth disadvantage of location in a cluster is captured by the maxim: 'new ideas need new space'.

- This idea has its roots in the autonomous theory of creativity.
- To some degree at least, creativity means breaking the rules and those who do that will usually encounter resistance from their peers. As peer-group contact is much more vigorous in a cluster than outside a cluster it may be easier to break the rules in isolation.
- Indeed, the autonomous theory of creativity says that deep creativity requires that inventors either have a degree of social and/or emotional autonomy which means that either they are isolated from such peer group pressure or they just ignore it.

Discussion question

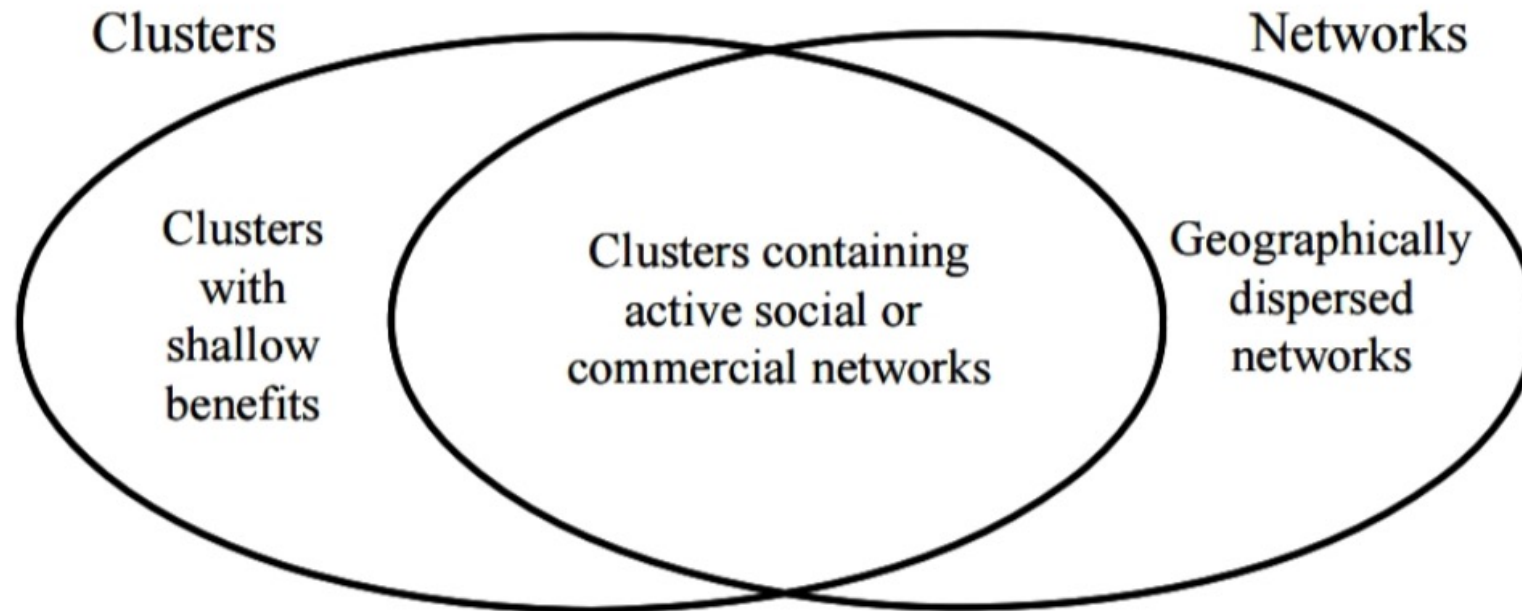
Which is the difference between a cluster and a network?

NETWORK FIRMS

There is high incidence of 'network firms' in clusters.

These are firms that take advantage of the efficiency gains available through the division of labour to specialise in a very narrow part of the vertical chain, and outsource most other activities.

Such network firms are common in strong industrial clusters, as they benefit especially from location in strong clusters.



Clusters and networks are not necessarily the same

NETWORK FIRMS

The literature on economics of organisation uses the term 'network' in two senses:

- network structure within a firm --> is one in which relationships among work groups are governed more by the often-changing implicit and explicit requirements of common tasks than by formal lines of authority. Indeed, workers or work groups can be reconfigured and recombined as the tasks of the organisation change.
- network firm --> is one which specialises in a small part of the vertical chain, and trades with a network of other firms to complete the vertical chain.

NETWORK FIRMS

The network structure into which network firms locate themselves will change as the activities of firms alter.

- A classic example of the network firm was Apple in the early days of the PC market (late 1970s onwards). Apple was a highly specialised design company, which outsourced most component supply and indeed much of the assembly process to other network firms in the Silicon Valley. The structure of the network which Apple used changed as their competencies and strategy changed.

NETWORK FIRMS

Network firms thrive in clusters because:

- there they can find a wide variety of **possible partner firms and sub-contractors** from which to form the network required to complete the vertical chain of production.
- there is the prevalence of **face-to-face contact in clusters**, coupled with the prospects of repeat business for honest traders, may mean that firms in a cluster enjoy relatively **low transaction costs**.
- network firms are well placed to exploit **efficiency gains from the division of labour**, concentrate on core competencies in house, and outsource the rest. So the network firm is well suited to markets with rapid innovation.

NETWORK FIRMS

- This organisational form also has some shortcomings.
- Hybrid forms such as network firms, strategic alliances, and joint ventures, require careful coordination. But the loose evolving structure of these hybrid forms may compromise coordination.
- There may not be clear formal management structures, nor mechanisms to make decisions and resolve disputes.
- These forms depend on a high degree of trust and reciprocity, and can suffer from agency costs (e.g. risks of free riding) and influence costs.

NETWORK FIRMS

These hybrid forms are used when:

- Technological change is very rapid
- Market opportunities are transitory or of uncertain longevity, so long-term contracts or merger are unattractive
- No one party has expertise to do everything in house, or it would be excessively costly to organise this internally
- All parties have to make relationship-specific investments, so there can be potential hold-up problems
- Transactions are hard to pin down with comprehensive contracts
- Transactions are complex, not routine. Traders cannot count on contract law to 'fill the gaps'.

NETWORK FIRMS

The network firm has a particular advantage when it is part of a large clustered network from which a wide variety of specialised teams can be assembled.

The network firm in a large clustered network can bring together a wide range of competencies to fill a short-lived market opportunity.

This is especially relevant where:

- the required competencies are uncommon and no one team member has them all;
- the ability of team members to work with each other cannot be taken for granted, so it helps to have a large pool to draw on.

THE CLUSTER LIFE CYCLE

The advantages and disadvantages from clustering, tend to occur at different stages of the history of the cluster.

- Many of the advantages tend to occur during the early history of the cluster and
- many of the disadvantages tend to occur during the later history of the cluster.

Clusters exhibit something like the life cycle observed with products.

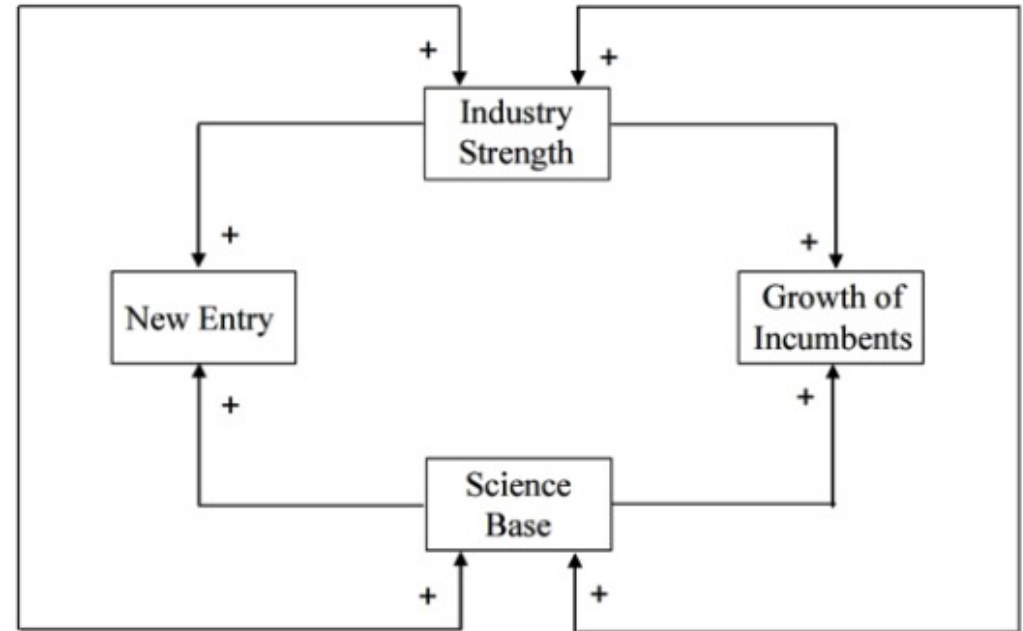


- Clustering seems more important for those activities that are important in the introductory and growth stages of the product life cycle (such as entry, growth, invention, innovation)
- while clustering seems less important for those activities that are important in the maturity and decline stages of the product life cycle (such as productivity and cost-cutting).

Positive feedback in the growth of clusters

This evidence suggests a pattern of positive feedback.

- Clusters with a strong industrial base and a strong science base attract entry and promote growth.
- That entry and growth in turn strengthen the industrial base and science base in the cluster.
- That in turn gives a further boost to entry and growth. And so on.



Positive and negative effects of clustering

Positive effects

There are some important sources of positive feedback during the early history of a cluster:

- Companies located in strong clusters often grow faster than average;
- Strong clusters attract disproportionate amounts of new firm entry (startups)
- In high-tech industries (e.g. biotechnology), proximity of the science base (e.g. a major university) attracts entry
- Strong clusters generate high levels of innovation and patenting.

Negative effects

These effects tend to get weaker as the cluster gets older.

The effects of cluster strength on productivity and financial performance are weaker.

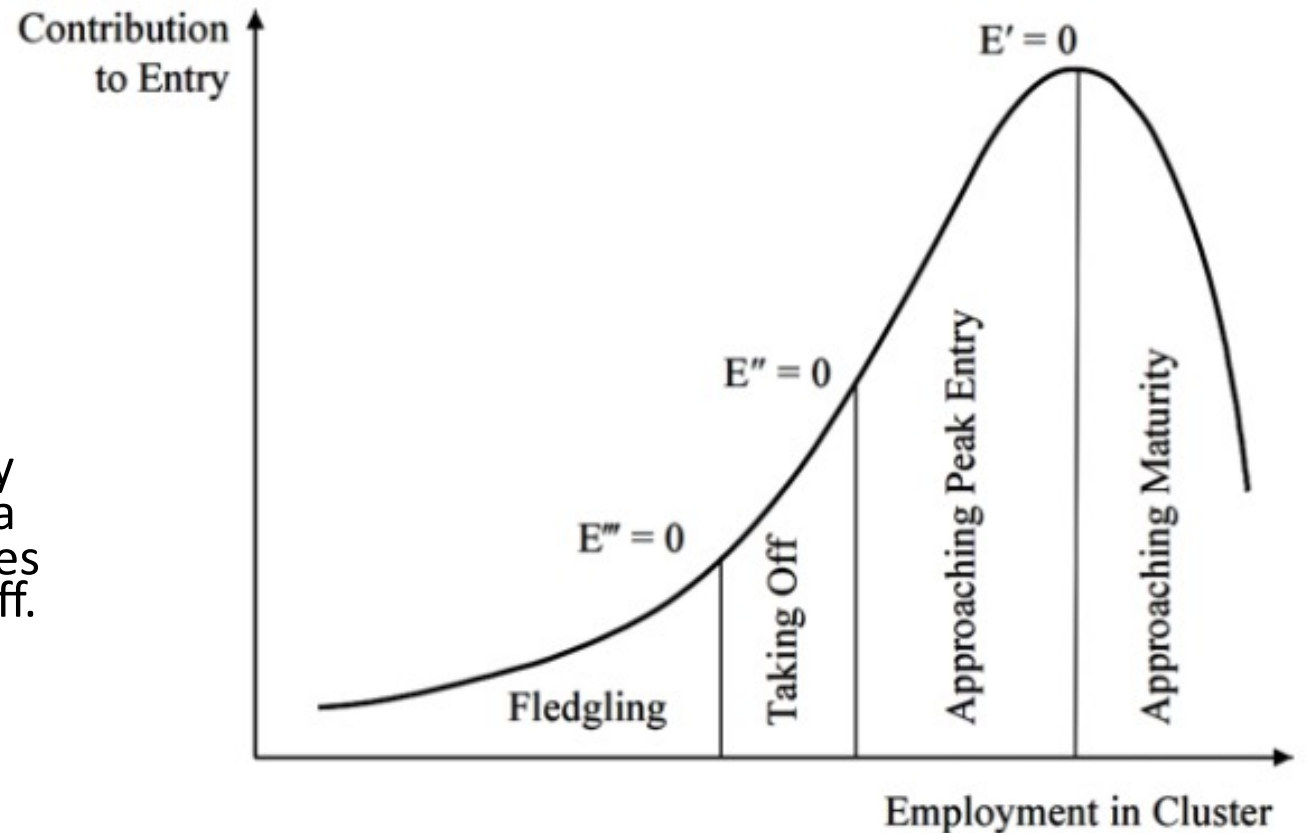
Critical mass in clustering

How big does a cluster have to be to enjoy benefits?

Some writers have used the concept of 'critical mass'.

One way to get a handle on critical mass is by looking at rates of new firm entry in different cluster sizes.

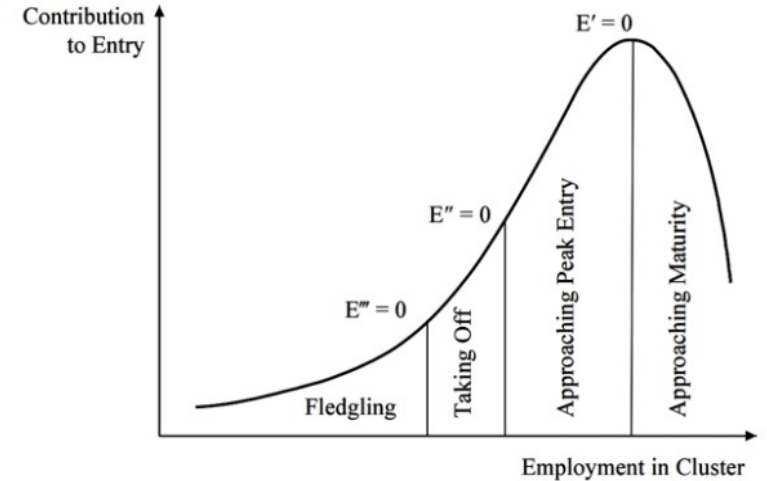
- In small clusters, entry is modest.
- As the cluster grows, however, the rate of entry increases, and at an accelerating rate. Beyond a certain point ($E'' = 0$), the rate of entry continues to grow, but the rate of acceleration is tailing off.
- And eventually, we reach a point of maximum entry ($E' = 0$).
- Beyond that point, there is still entry into the cluster, but at a declining rate.



Critical mass in clustering

This life cycle curve marks three points on the curve:

- The maximum rate of acceleration in entry ($E''' = 0$)
- Zero acceleration in entry ($E'' = 0$)
- The maximum rate of entry ($E' = 0$).



This curve suggests that there is a concept of critical mass in cluster size, and that the benefits of clustering do not accrue until the cluster reaches a certain size. It also suggests that these benefits tail off as the cluster gets large. This means that there is a limit to the positive feedback

To the right of the peak of the curve the cluster is approaching maturity. This means that the disadvantages of clustering are starting to catch up with the advantages of clustering and will eventually overtake the advantages.

DOES THE 'DEATH OF DISTANCE' MEAN THE END OF THE CLUSTER?

- The last topic concerns a question about clusters that is the source of much confusion.
- Does the advent of the Internet, low-cost global communications and low transport costs mean that the concept of cluster is becoming irrelevant?
- Much journalism and other contributions to popular debate would suggest that it is. But such arguments are too simplistic.
- Cairncross (1997) coined the memorable term '**the death of distance**' to describe how the advent of the Internet and the falling cost of global communications and transport means that companies find it possible to do business at ever greater distances. At one level, this 'death of distance' is undeniable. But, surprising as it may seem, that does not necessarily mean that location becomes less important for economic activity. Nor does it imply the end of clustering.

DOES THE 'DEATH OF DISTANCE' MEAN THE END OF THE CLUSTER?

The resolution is a paradox: falling transport costs makes location less important from one perspective, but more important from another. This sort of paradox can be found in many analyses of how falling costs of transport and communication influence the geographical location of activity.

The same sort of result occurs whenever:

1. Location as such of the producer is unimportant to the customer.
2. Falling costs of transport and communication increase the extent of the market and hence increase (in the short-term, at least) the number of competitors in the market.
3. In an increasingly competitive global market, the survival of a specific company depends ever more on that company exploiting every possible source of competitive distinction.
4. If there is any source of competitive advantage in location then the company should exploit it.
5. Companies in clusters can often find sources of competitive advantage that are denied to companies located outside clusters.

DOES THE 'DEATH OF DISTANCE' MEAN THE END OF THE CLUSTER?

- In these conditions, location is less important from one point of view but more important from another point of view.
- In these conditions, falling costs of transport and communication can make clustering more important. Indeed, production may become even more concentrated into a smaller number of clusters, and companies located in the periphery will decline.
- We do not suggest that falling transport and communications costs will always lead to this paradoxical result.
- Concluding falling costs of transportation and communication with no reduction in economies of agglomeration will lead to greater clustering. The dispersion of economic activity requires decline in agglomeration and scale economies – not just a decline in the costs of transport and communication. But in many cases these agglomeration and scale economies are, if anything, getting stronger!