A preliminary study of knowledge dynamics: The case of composite materials in aeronautics.

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Aim

- Understand the evolution of an R&D network
- How does it evolve and why?
- What kind of structure does it have ?
- How did the major aircraft manufacturers incorporate the technology?



Data

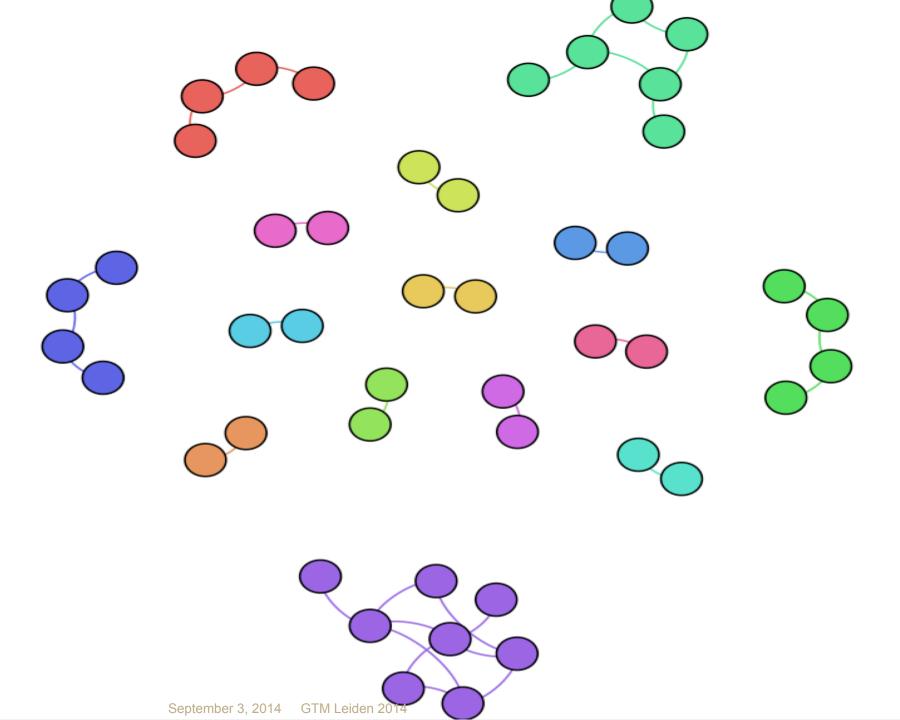
- In order to generate an R&D network we used patent and publication data
- We used Orbit for patent data and Scopus for publication data
- We used Scopus rather than WOS because Scopus has a larger search base. Especially when it comes to conference papers.
- Our query focused specifically on SCM using IPC codes, concepts and keywords
- We started our analysis in 1980 because that's the point where we observe significant patent deposits
- We end up with 9.000 patents and 12.000 publications over the 35 year period



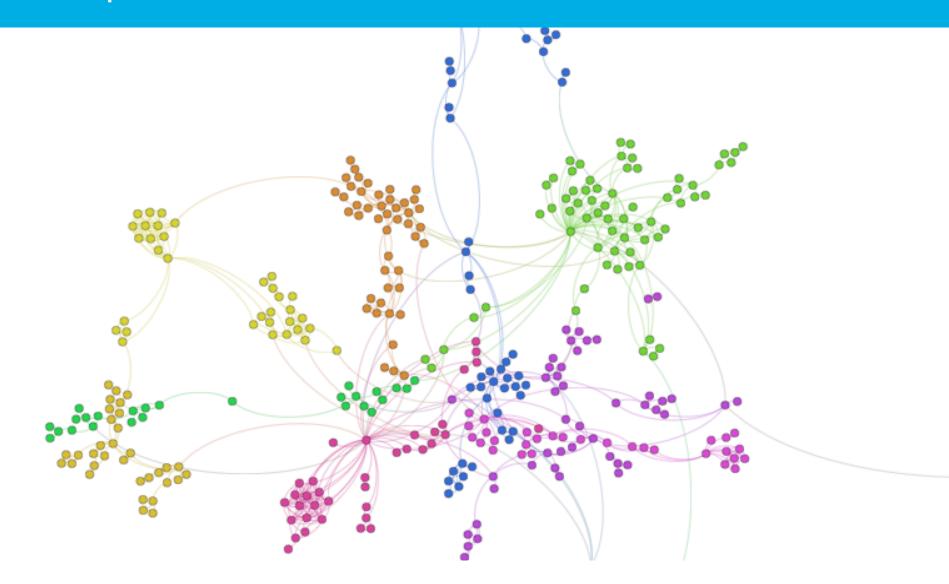
Do firms cooperate for knowledge?

- Yes, by analyzing firms that deposit alone we are able to identify which technology a firm masters.
- > 28% of all patent used IPC codes that are not used during alone deposits.
- In the remaining 72%, 45% of IPCs are exclusively used during collaborations, never when they deposit alone.
- Observed collaboration hence imply that they were initiated for the purpose of knowledge.





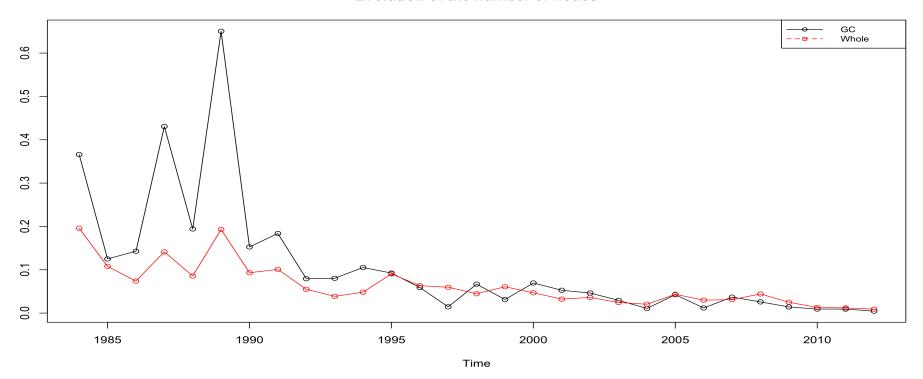
Complete network





Network evolution

Evolution of the number of nodes

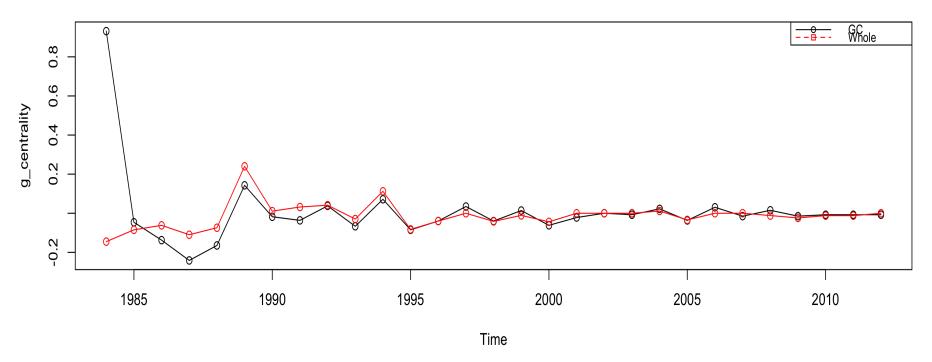


- Stabilization of the network begins in 1995
- Date at which aircraft manufacturers start integrating the technology into their aircrafts



Centrality

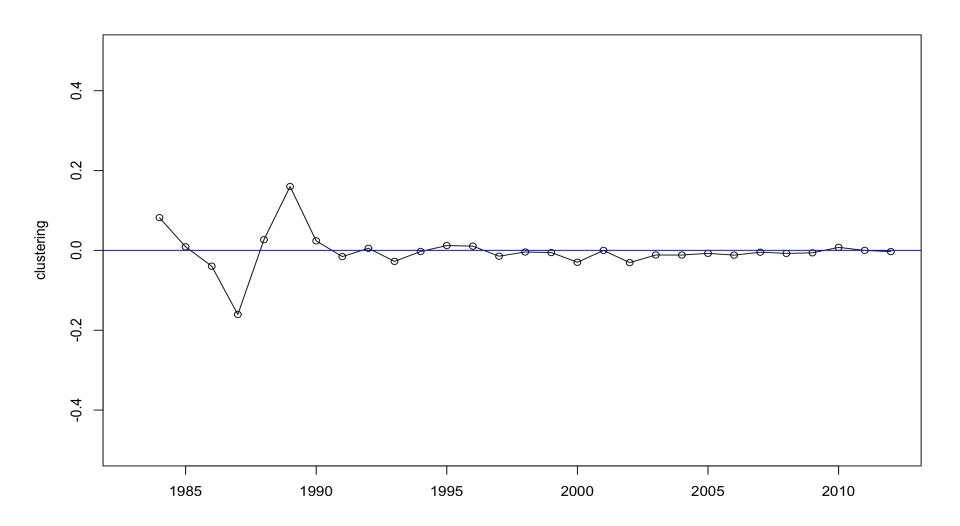
Evolution of the centrality coefficient



Convergence towards a low centrality which is typical of the sector.



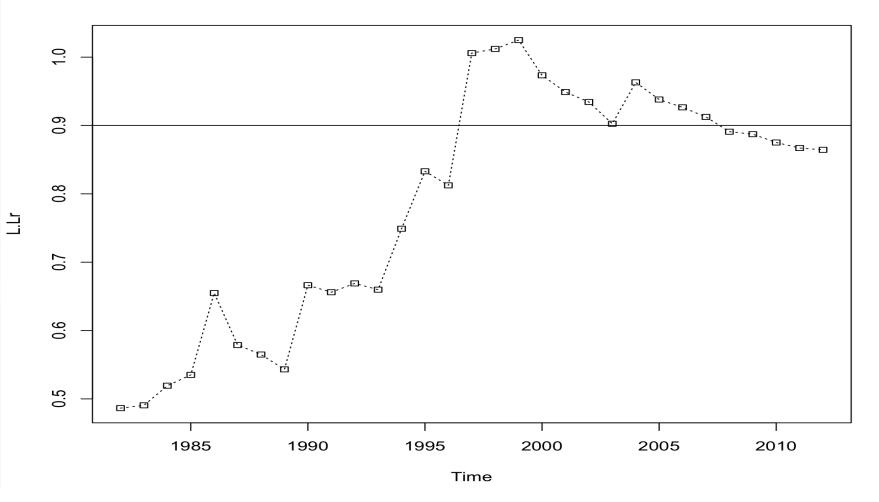
Clustering





But is it a small world?

Evolution of L/Lr





Conclusions of the Macro analysis

- The network evolves to a small world by the interconnection of clusters.
- We observe two major phases in the evolution of the network.
- After the high variation of the network indicators firms start to patent on their own rather than by cooperation.
- Explaining why the network is no longer a small world after that period.
- Shows that the knowledge has transferred.



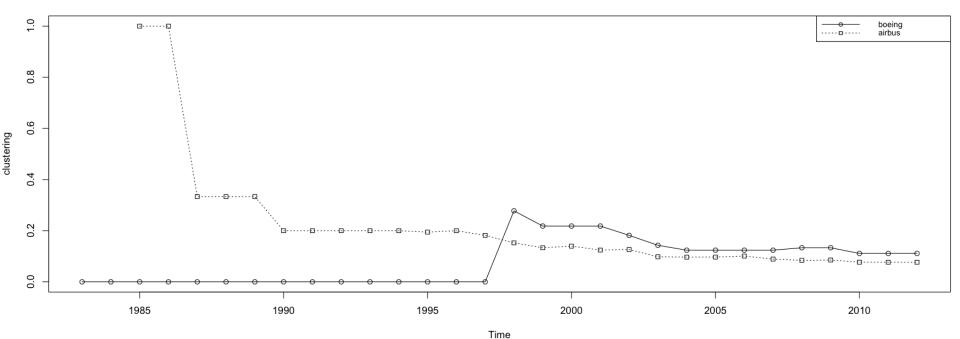
Meso analysis

- An airplane is a multi-technology product, the aircraft manufacturers hence have to incorporate many different technologies in order to assemble their airplanes.
- They can only absorb knowledge once it is operational.
- Let's have a look at their evolution in the network, which should reflect the technology lifecycle.



How did they incorporate the technology?

Evolution of the clustering coefficient

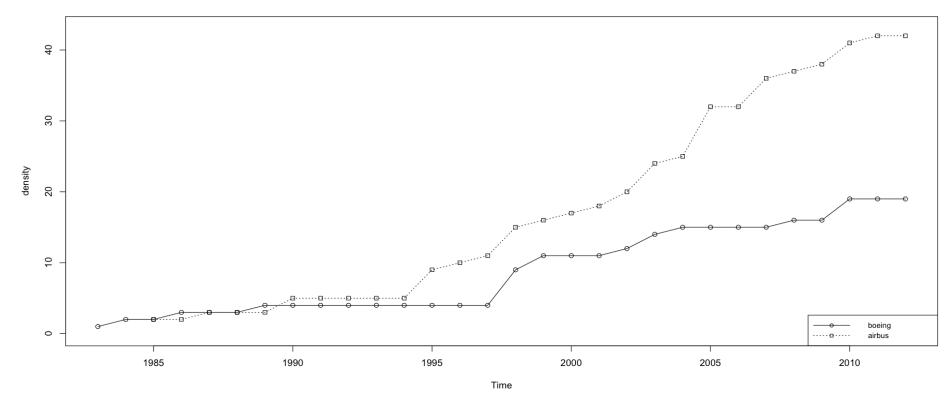


> From 1998 onwards, Boeing drastically increased its number of cooperations to absorb the developed knowledge. Resulting in an increase of clustering



Collaboration behavior

Evolution of the density





Strategies

- Airbus has a preference for working with firms it has worked with in the past (preference for strong links, social lock-in).
- > Boeing has preferred looking for new partners
- Let's see how these different strategies worked out for both firms:



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Conclusions of Meso analysis

- The dynamic network of IPC codes shows that Airbus is becoming a follower behind Boeing
- Different strategies can amount to similar positions inside a network
- The benefits in terms of knowledge absorption are however defined by the choice of partner



Thank you for your attention

