Co-evolution of networks and spatial clustering

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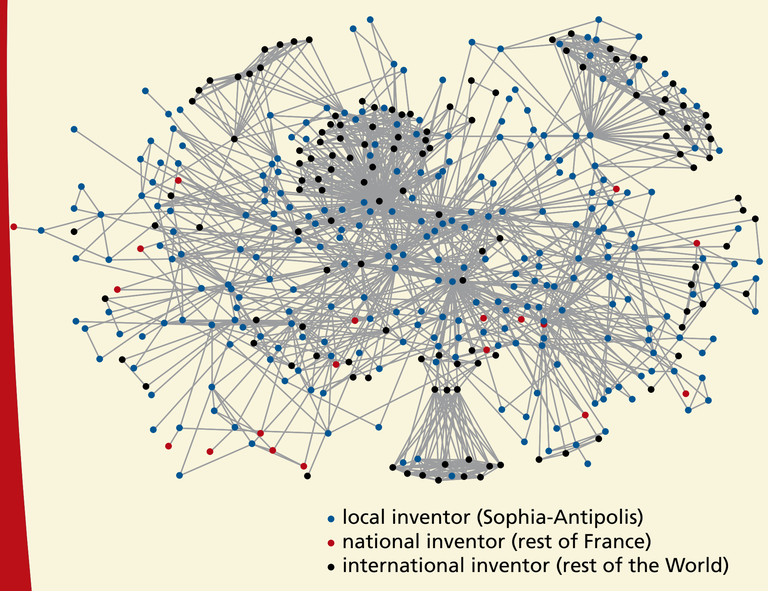
Cluster emergence and network evolution:
a longitudinal analysis of the inventor network in Sophia-Antipolis

Introduction

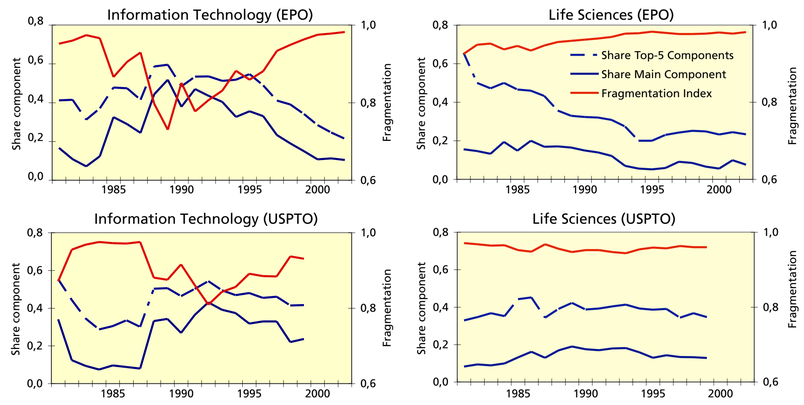
By looking at the successful business park of Sophia-Antipolis this study investigates whether and how networks of collective learning among inventors emerged throughout the emergence of a cluster.

We expect local collective learning has only emerged in IT, where growth has been more extensive and more locally-based, and not in Life Sciences.

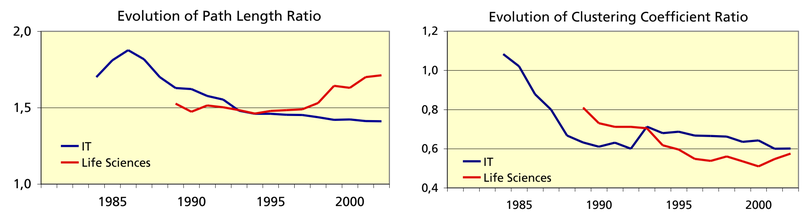


Main Component of the Inventor Network in IT, 1977-2002

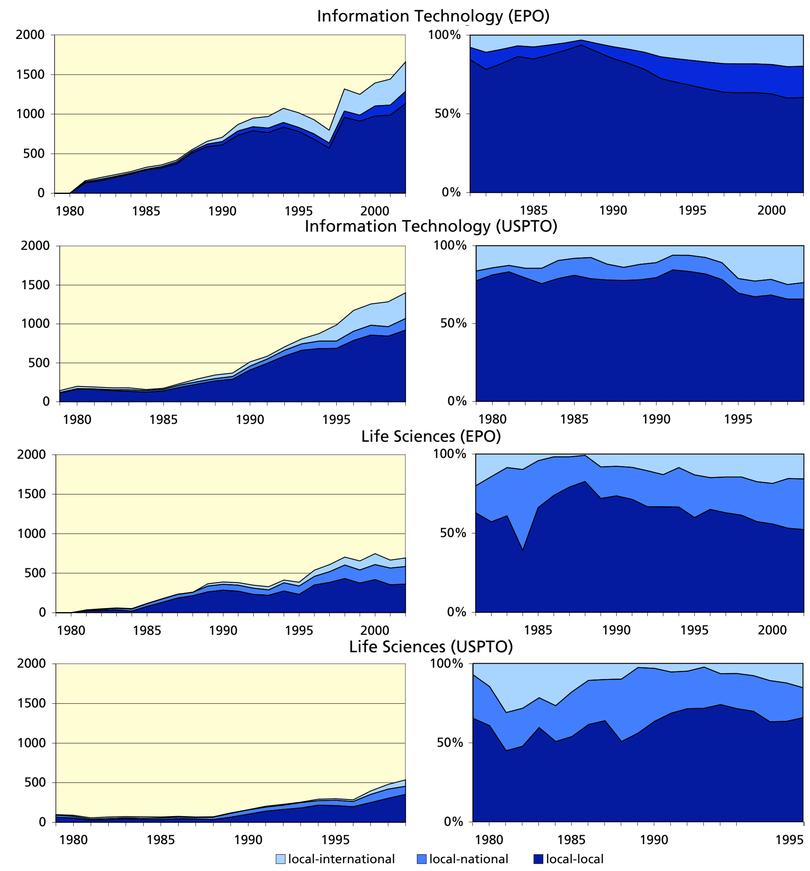
Results: emergence of collective learning



Evolution of connectivity



Evolution of small world properties of the main component



Evolution of geographical orientation (number of links per geographical scale)

Methodology

On the basis of EPO and USPTO patent data we reconstructed co-inventorship networks for the two main industries of Sophia-Antipolis from 1978 till 2002. The emergence of a local collective learning is indicated by:

- increasing local orientation
- increasing connectivity
- decreasing average path length
- increasing clustering coefficient

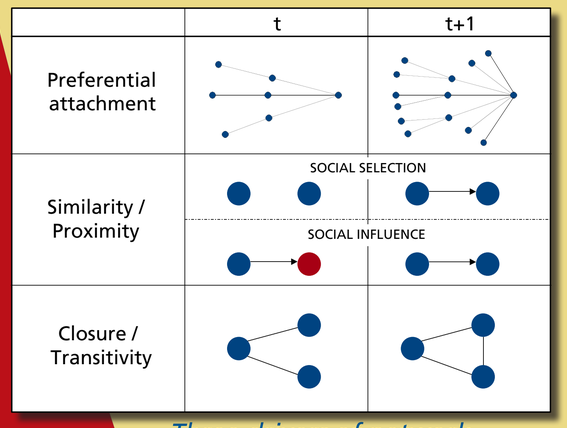
Conclusion

- The growth process of firms in a cluster strongly affects the evolution of local knowledge networks.
- The emergence of a local collective learning milieu is a very incremental and long-lasting process, for which geographical proximity per se is not a sufficient condition.

Longitudinal network analysis: using SIENA

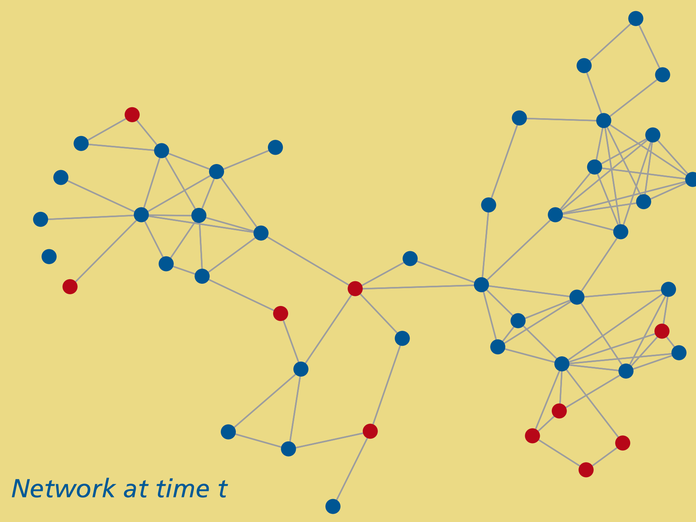
What is SIENA?

- A software program that analyses the dynamics of networks over time;
- Detecting the forces that have driven the evolution of a network from one state into another;
- Estimating parameters for selected drivers of network evolution;
- By simulating repetitively with which micro-steps the network evolution might have taken place.

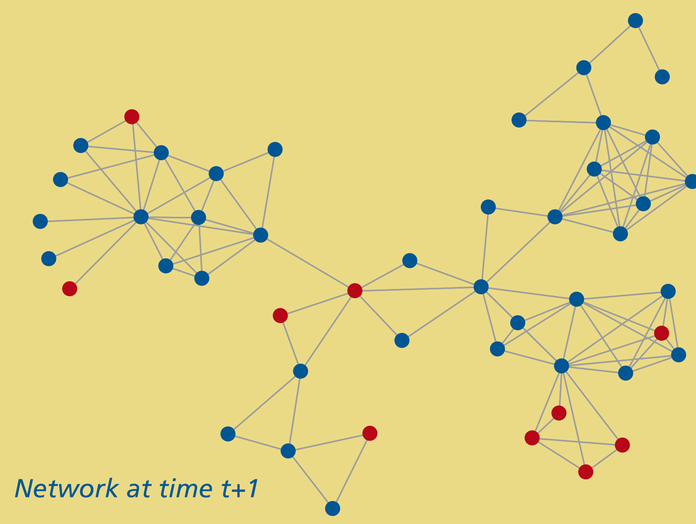


Three drivers of network evolution

A hypothetical example



Network at time t



Network at time t+1

	NETWORK STRUCTURE	
	t	t+1
Number of nodes	50	50
Number of links	88	107
Density	0.0072	0.0087
Average degree	3.592	4.367
	NETWORK CHANGE	
Number of links created	25	
Number of links dissolved	6	
Number of links retained	82	
Distance (total change)	31	

Descriptive statistics of network at two observation moments

	Model 1	Model 2
Rate parameter *(rate of network change)*	0.664 *** (0.120)	0.664 *** (0.123)
Density *(baseline parameter)*	-4.226 *** (1.153)	-5.150 *** (1.226)
Preferential attachment *(degree of alters)*	14.753 *** (4.020)	
Preferential attachment *(sqrt degree of alters)*		1.169 *** (0.588)
Geographical proximity *(country similarity)*	2.709 *** (1.012)	2.620 ** (1.383)

** significant at 0.10→ ** significant at 0.05→ *** significant at 0.01*

Estimating a social selection model with constant node attribute

Geosciences

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