Theorie (Nationaler und) Regionaler Innovationssysteme

The Genesis of Knowledge and Institutions in Regional Innovation Systems

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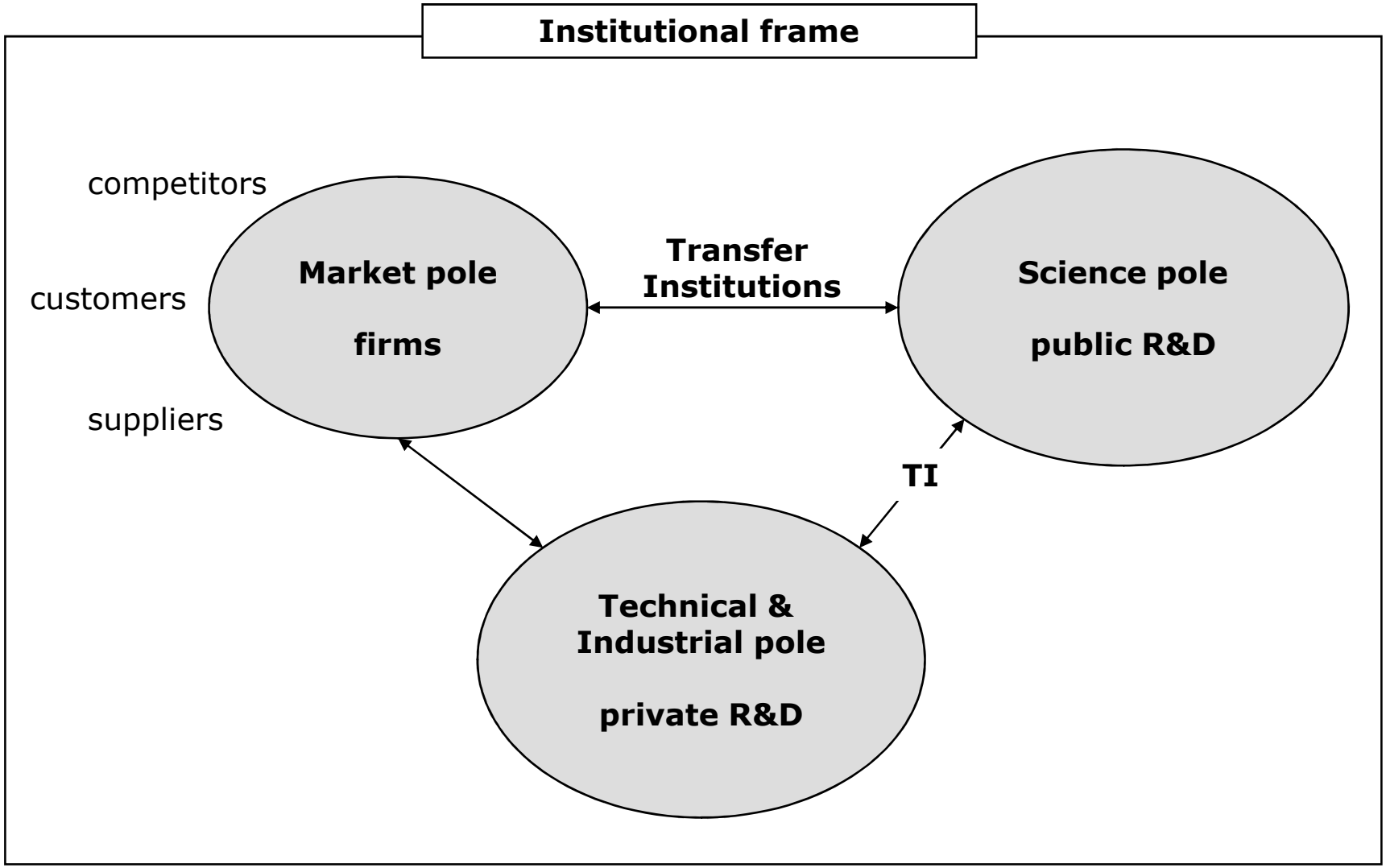
- Schumpeter and systemic innovation
  - Schumpeter I&II
  - Schumpeter J (Imai/Yamazaki 1994)

- Collective invention (Allen 1983, von Hippel 1987)

- Systemic Innovation Approach
  - national innovation systems (Freeman et al. 1988, Lundvall 1992, Nelson 1992)
  - technological systems (Carlsson & Stankiewicz 1991)
  - sectoral innovation systems (Malerba & Orsenigo 1997)
  - regional innovation systems (Cooke 1992)
  - local innovation systems (Breschi & Lissoni 2001)
  - urban innovation systems (Fischer et al. 2001)

- Analytic frames
  - Innovative Milieus
  - Marshallian Industrial Districts
  - Jacobian Systems

- Examples
  - Silicon Valley, Japan, Wissenschaftsstadt Ulm, Sophia Antipolis, Science City Jena


Institutional frame
competitors
customers
suppliers
Market pole
firms
Transfer
Institutions
Science pole
public R&D
TI
Technical &
Industrial pole
private R&D

- Incentives to generate new knowledge
  - economic chances
  - technological opportunities
  - abilities and competences

- Character as an economic good
  - public (Arrow 1962)
  - latent public (Nelson 1990)
  - private / tacit knowledge (Polany 1967)

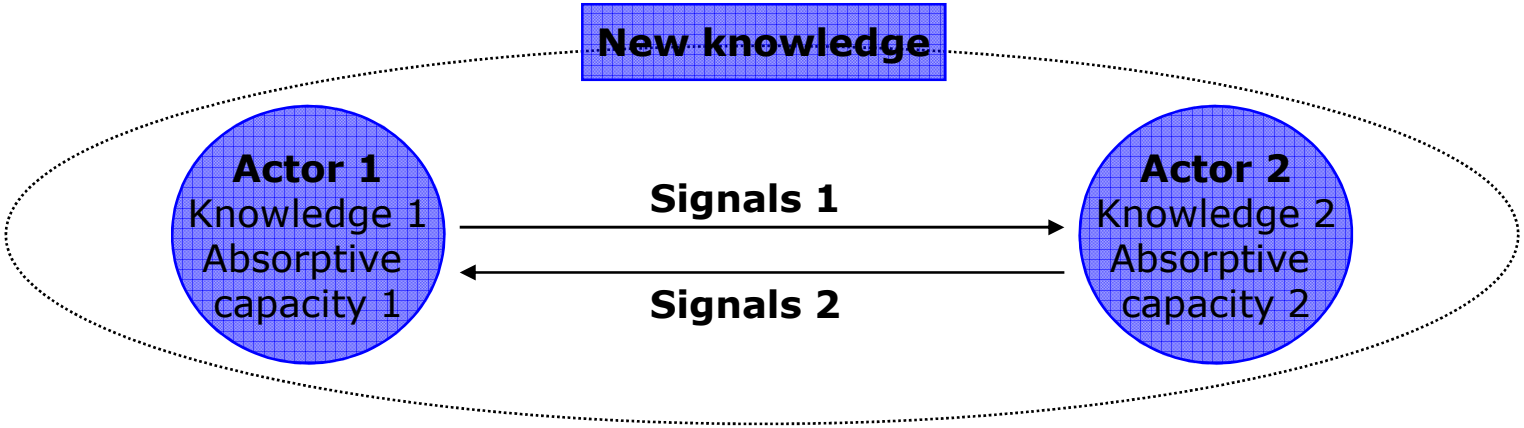
- Knowledge dissemination and transfer
  - Mode of transmission
    - market
    - hierarchy
    - network
  - "Quantity" of transmission
    - sender (outgoing spillovers): willingness and abilities to communicate/codify
    - recipient (incoming spillovers): absorptive capacities (Cohen/Levinthal 1989)
  - Proximity concepts (Boschma 2005)
    - cognitive, social, geographical, institutional, organizational

	Market	Hierarchy	Network
Normative basis	contract and property rights	contractual rela-tions	complementary strengths
Type of communication	prices	routines	relationships
Conflict management	legal system	controlling	reciprocity, reputation
Flexibility	high	low	medium to high
Relationship between actors	independent	hierarchical	mutually dependent

(source: TEP 1992, 78)

- Feedback driven innovation process (Kline & Rosenberg 1986) characterized by (Dosi 1988)
  - Endogenous sources (mainly firms)
  - uncertainty
  - science push
  - learning effects
  - cumulativeness

- Innovative actors and collective invention – cooperative innovation
  - bounded rational (Simon 1957) ⇾ trial-and-error
  - resource based view of the firm (Penrose 1959, Wernerfeld 1984, Barney 1991) and extensions (Teece et al. 1992)
  - get access to external knowledge
    - external R&D
    - integration of innovative activities by M&A
    - collective invention/ cooperative innovation
      - reducing risk and sharing R&D costs (Deeds & Hill 1996, Baum et al. 2000)
      - combining complementary assets (Teece 1986, Nooteboom 1999)
      - internalizing spillovers (Griliches 1992), knowledge exchange, interactive learning



- Conditions for interactive learning and collective invention/innovation
  - Getting into contact
    - Who?
  - Generic potential
    - How endowed?
    - Understanding?
  - Control of the relationship
    - Control and / or trust
    - Tacit knowledge components and face-to-face

Proximity concepts

Boschma (2005)

- Cognitive or technological proximity
  - Common understanding
    - Technological overlap and absorptive capacities
    - Generic potential
  - Horizontal structures, vertical structures, Jacobs structures

- Organizational proximity
  - Mode of know-how transfer
    - Market
    - Network
    - Hierarchy

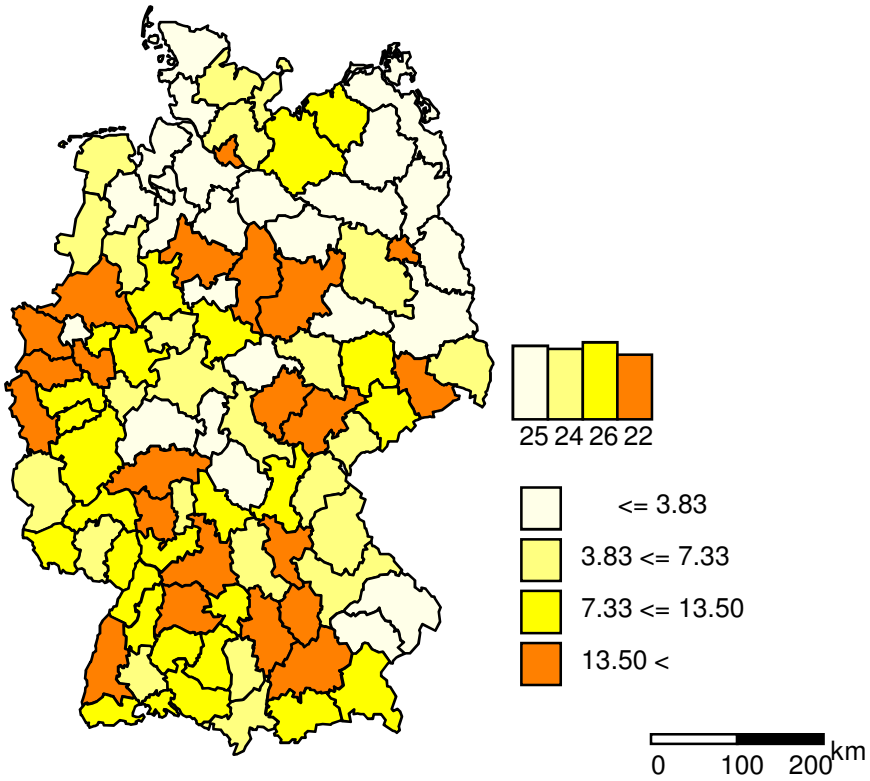
- Institutional proximity
  - Trust based on general habits and attitudes (macro)

- Social proximity
  - Trust based on social relationships (micro)

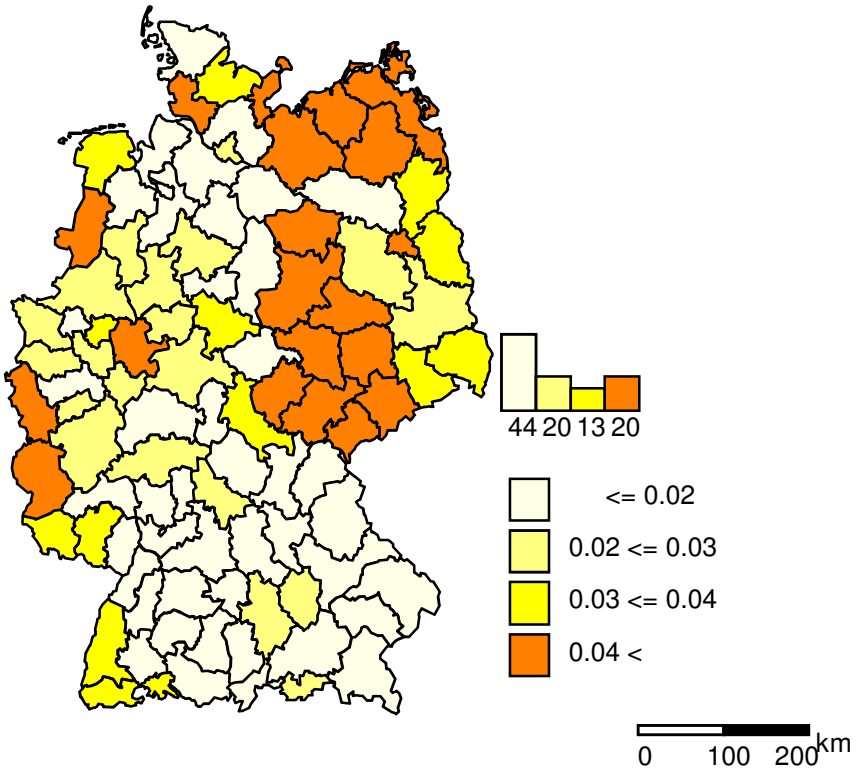
- Geographical or spatial proximity
  - Location in space

- Source of ideas and innovation
- Control of cooperative ventures
- Facilitating function

Accounting for collective invention and cooperative innovation



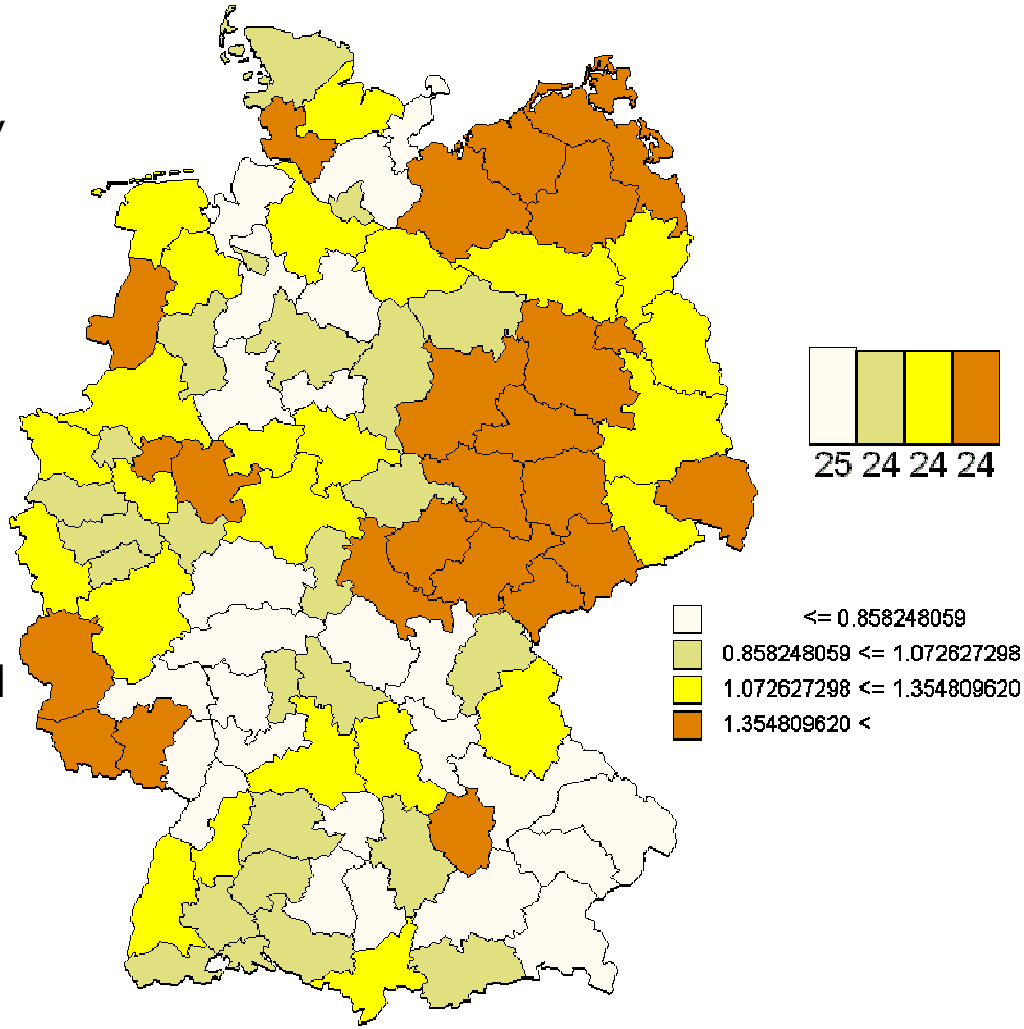
Observed Co-applications
2002 - 2003



Co-application propensity
2002 - 2003

Source: Cantner/Meder 2008

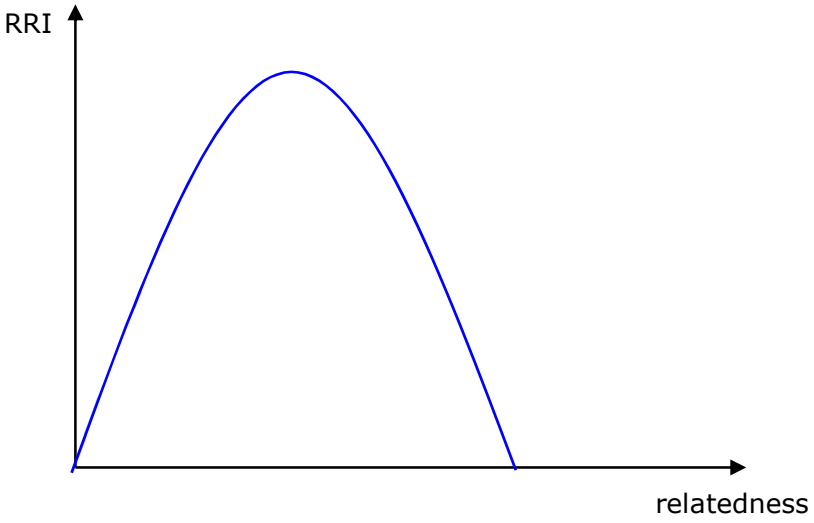
- Are these differences the effect of a specific constellation of industries (which show a relatively high degree of cooperative patents)?
  - index measuring the relative regional effect on cooperative patenting (Cantner/Meder 2008)
  - some regions show a rather high relative regional effect
  - the relative regional impact
    - is persistent over time and
    - depends on the coherence of the underlying knowledgebase of the actors involved (inverted-**u** relationship)



Source: Cantner/Meder 2008

- What determines the relative regional effect on cooperative patenting?

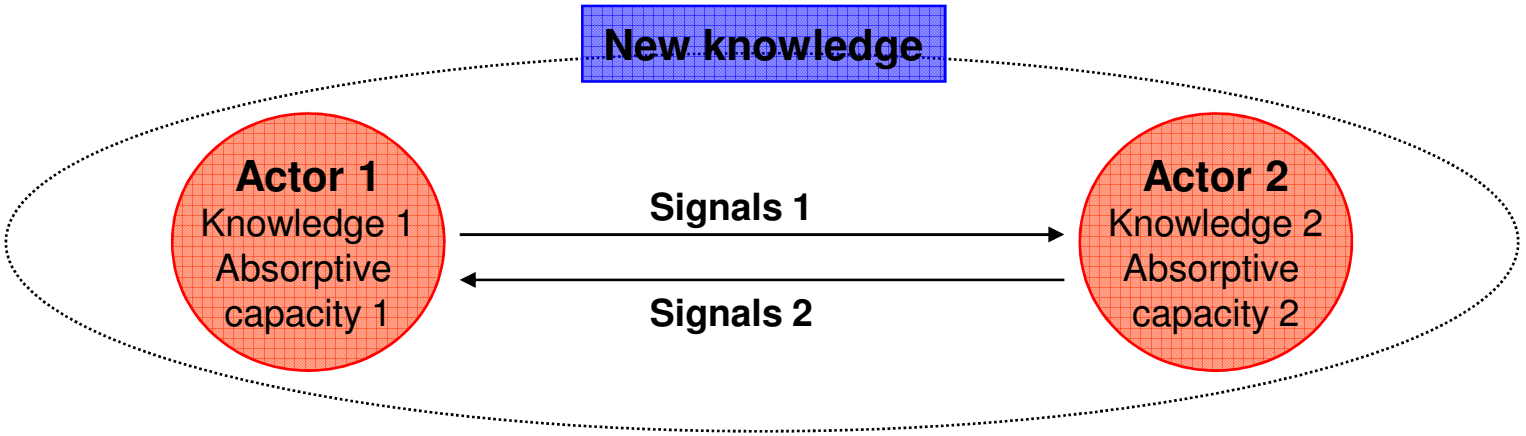
- Results
  - **R1**: persistency
  - **R2**: dependence on knowledge
    - qualitatively
    - quantitatively
    - inverted-**u** relationship



Model Method dep. Variable	M1 System GMM **regional effect$_t$**	M2 System GMM **regional effect$_t$**
regional effect$_{t-1}$	**0.155**** (0.029)	**0.155**** (0.033)
relatedness$_{t-1}$	**9.012**** (0.029)	
(relatedness$_{t-1}$)^2	**-24.85*** (0.067)	
knowledgebase$_{t-1}$		**1.319*** (0.053)
(knowledgebase$_{t-1}$)^2		**-0.521**** (0.037)
Pop. density$_t$	-0.001* (0.057)	-0.001** (0.025)
GDP$_t$	-0.007 (0.65)	0.001 (0.97)
D$_{2002}$	0.063 (0.25)	0.062 (0.25)
Sargan test serial auto-correlation AR(1) AR(2)	0.504 0.000 0.881	0.442 0.000 0.810
# of observations	383	383
# of ror regions	97	97
p values in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%		

Source: Cantner/Meder 2008

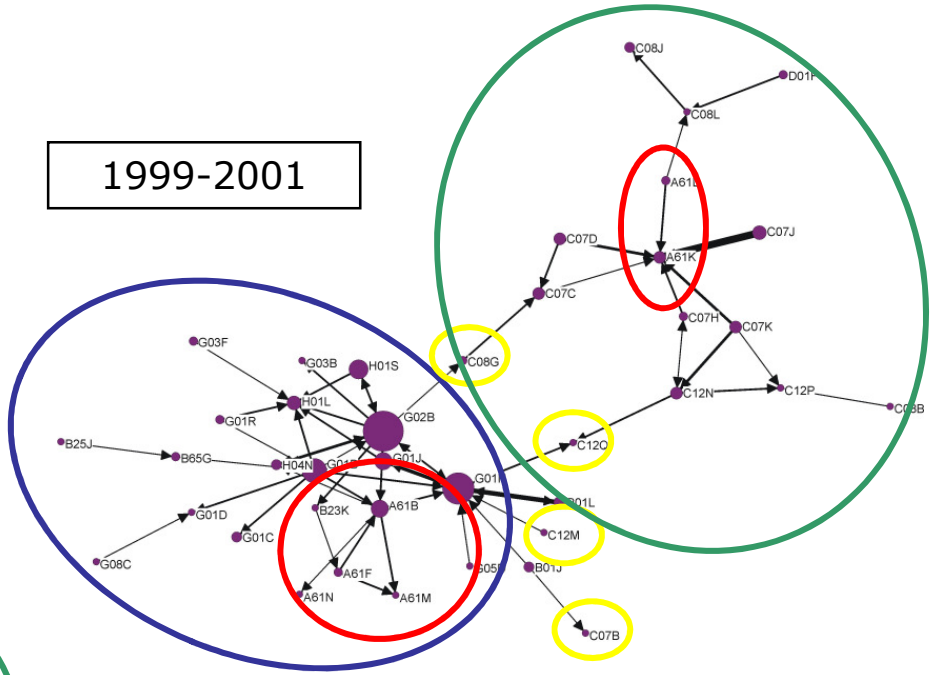
Availability/Awareness and Compatibility

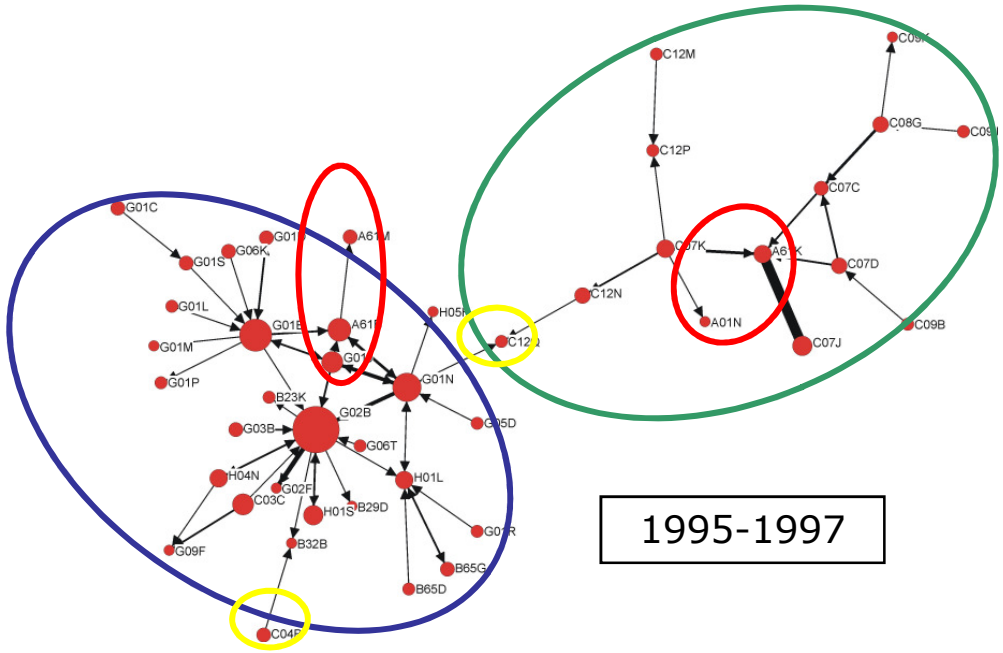


- Issue 1:
  Finding cooperation partner(s) and compatibility of actors / knowledge
  - Costs of search and transfer institutions
  - Technological relatedness, absorptive capacity and cross-fertilization

- Empirical results (Cantner/Meder/Wolf 2009; Cantner/Conti/Meder 2009)
  - For Jena, Northern Hesse and Sophia Antipolis (Nice) the involvement of transfer institutions has
    - no significant effect on finding a cooperation partner
    - but a significantly positive effect on the success of research cooperations

Technological basis and relatedness

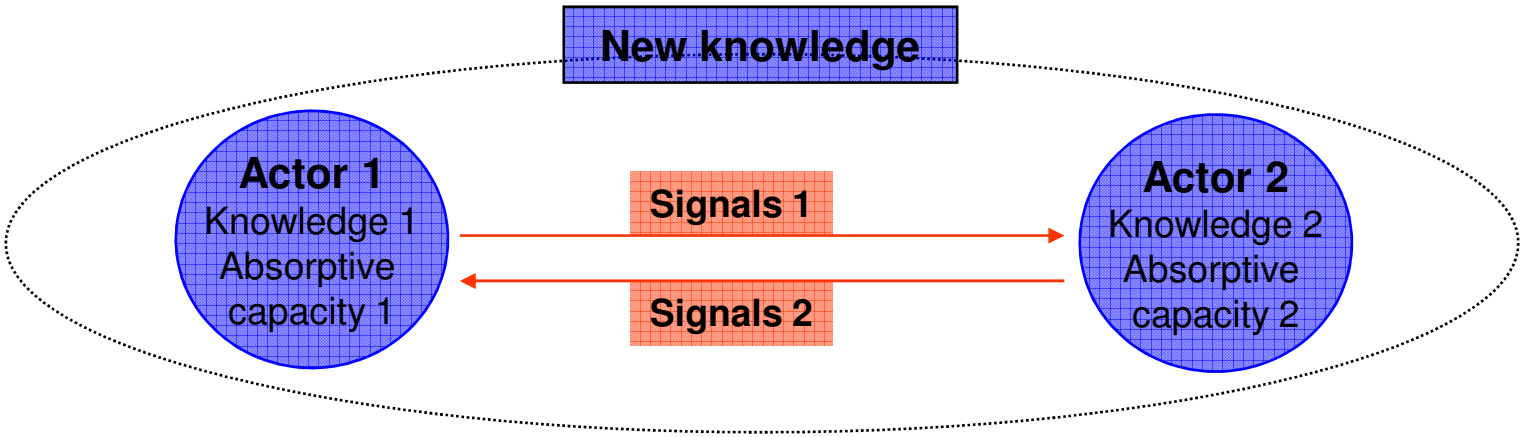




rank	field
1	Optics
2	Biotechnology
3	Medical instruments
4	Measuring instruments
5	Pharmaceuticals

Source: Cantner/Graf 2003
Cantner/Meder/ter Wal 2008

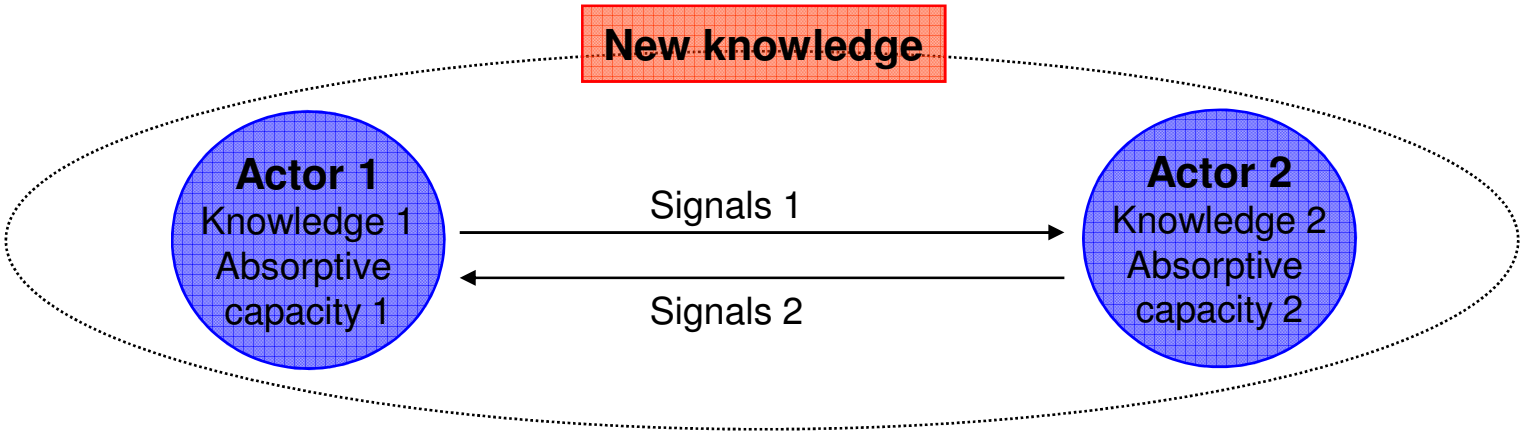
Reciprocity and Trust



- Issue 2:
  Flexibility for exchanging knowledge ↳ Controlling these processes
  - Knowledge exchange and networking
  - Direct versus indirect reciprocity

- Empirical results (Cantner & Meder & Wolf 2008)
  - no indication of an ex-ante reciprocity problem (in the sense that lacking trust causes actors not to cooperate)
  - ex-post trust has a significantly positive influence on cooperation success

Generic Potential and Lock-in



- Issue 3:
  Sustaining the generic potential
  - Technological lock-in
    - Internal density of a local network increases specific knowledge-stock
      - BUT: risk of lock-in
    - Local 'buzz' and global 'pipelines' (Storper/Venables 2004; Bathelt et al. 2004)
  - Gate-keepers (Giuliani 2005) serve two functions:
    - external knowledge sourcing and
    - diffusion within the local system
- Empirical results (Cantner/Graf 2008)
  - internal orientation of incumbents
  - orientation of innovators entering the system towards the system's core

Thank you for your attention!

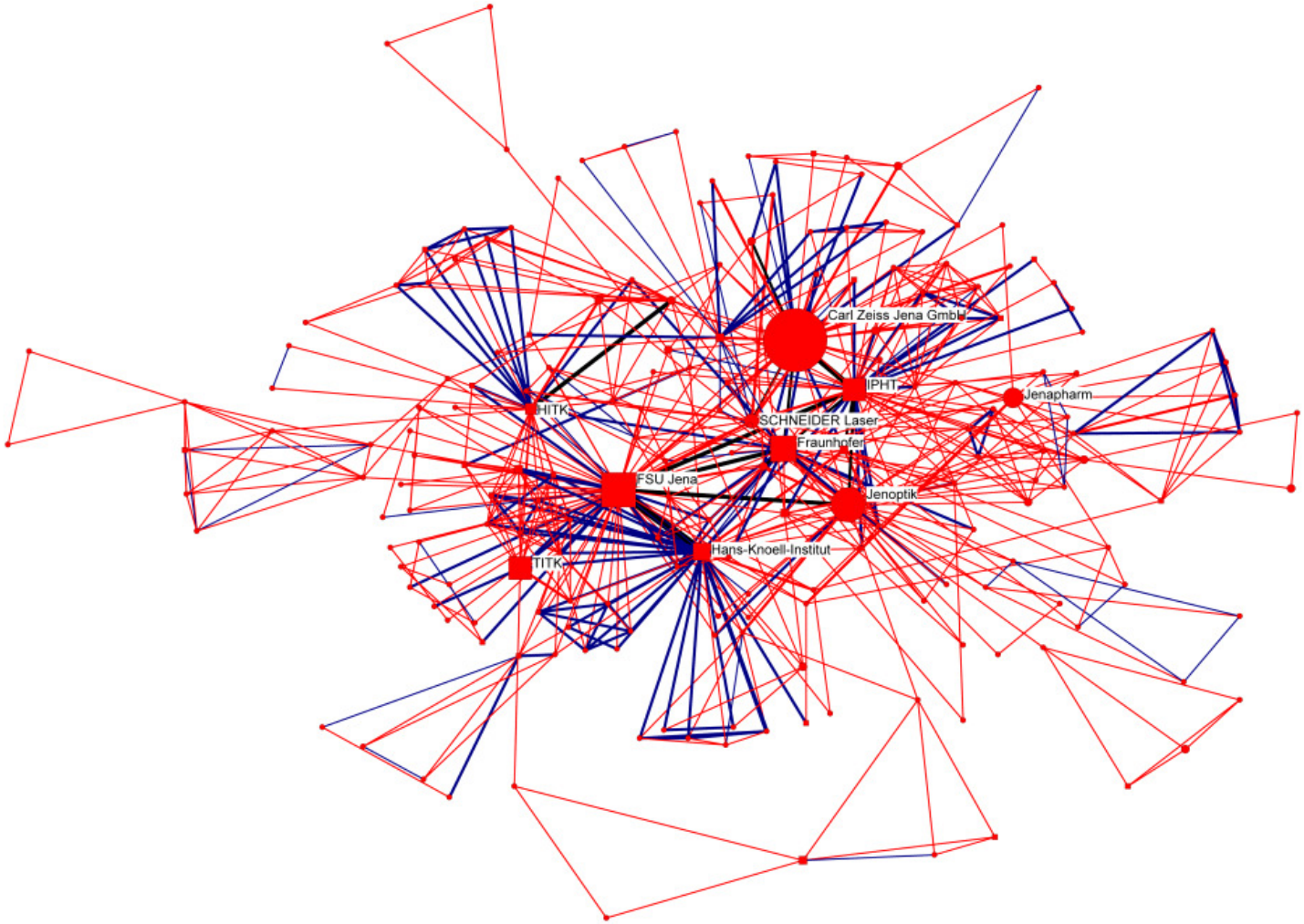
Epistemological Reservation

„Almost by definition, it is hopeless to develop a model which will genuinely predict innovations: an innovation is something new, and if you know what will be in the future, you know it now. [...]

However, I do not conclude from this that dynamic models which incorporate technical change are useless. What they give you is not any predictions of specific innovations, but an idea of the statistical properties of technological progress.

We may have some useful idea of the average rate of technological change, of the degree of fluctuations and the kinds of surprise that we may find in the future. We cannot, of course, predict a surprise; that is a contradiction in terms. But we can predict the kind of surprises that might occur."

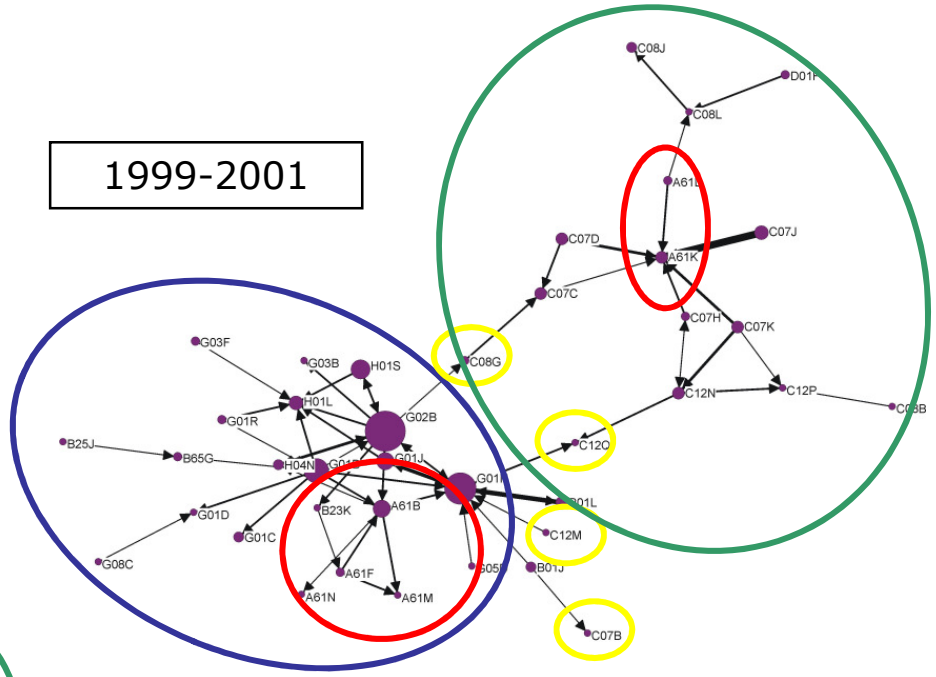
Kenneth Arrow (1991, 473)

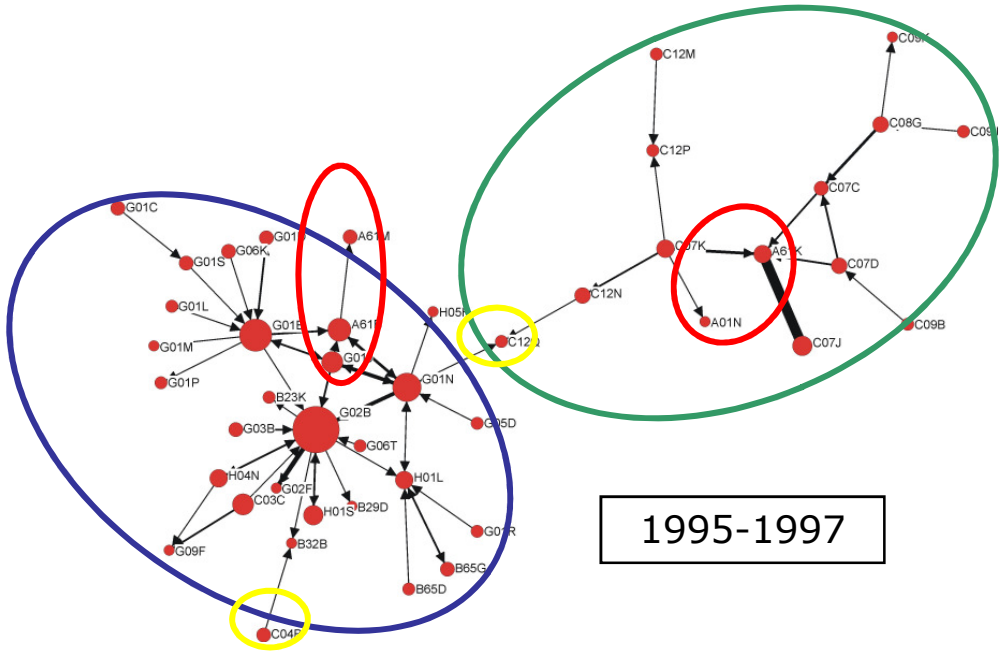


Jena network of innovators 1995-2001

Technological basis and relatedness

1999-2001



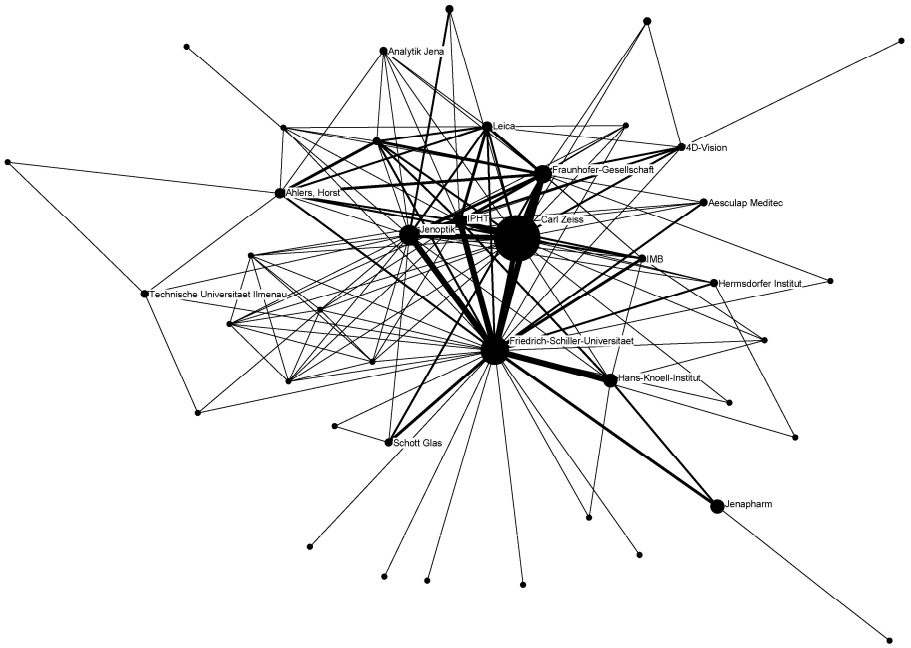


1995-1997

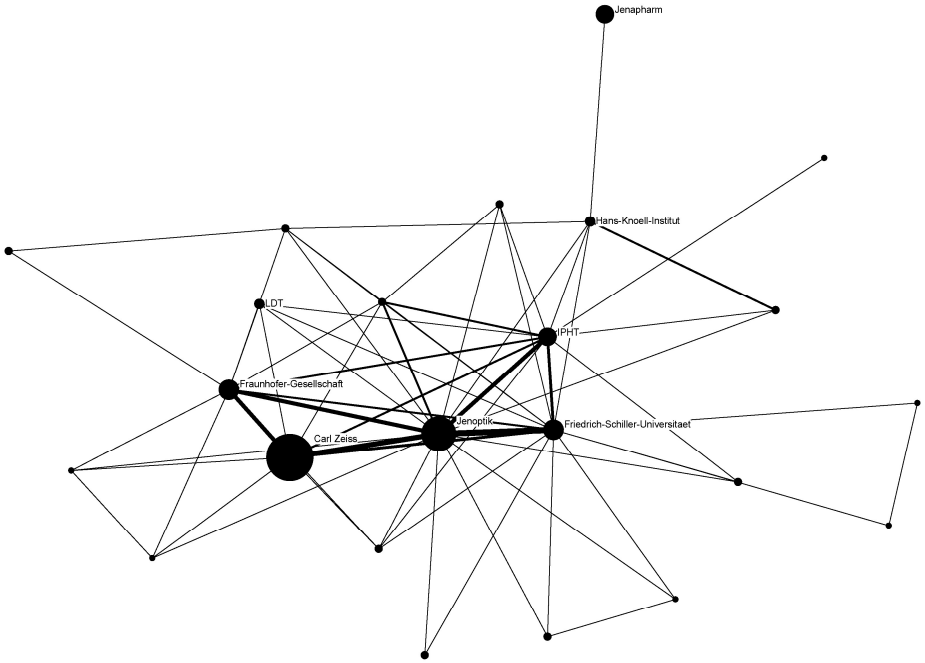
rank	field
1	Optics
2	Biotechnology
3	Medical instruments
4	Measuring instruments
5	Pharmaceuticals

Source: Cantner/Graf 2003
Cantner/Meder/ter Wal 2008

Potentials for cooperation



1999-2001

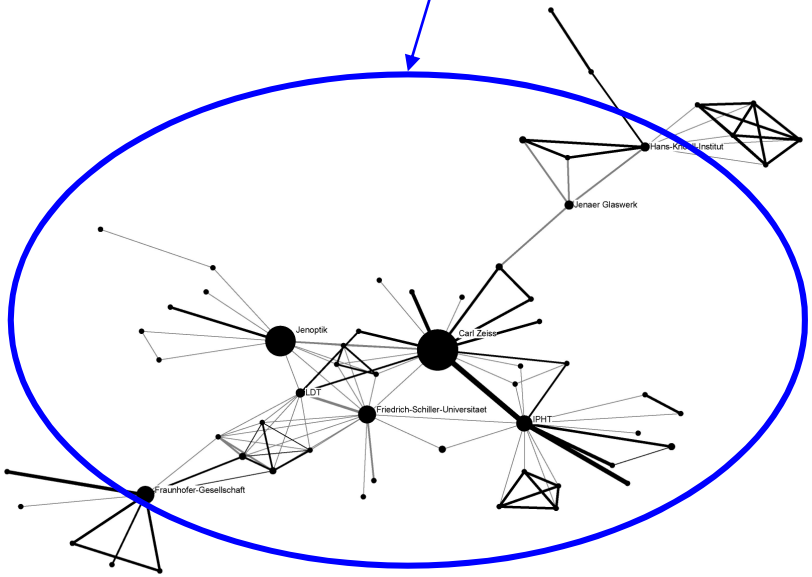


1995-1997

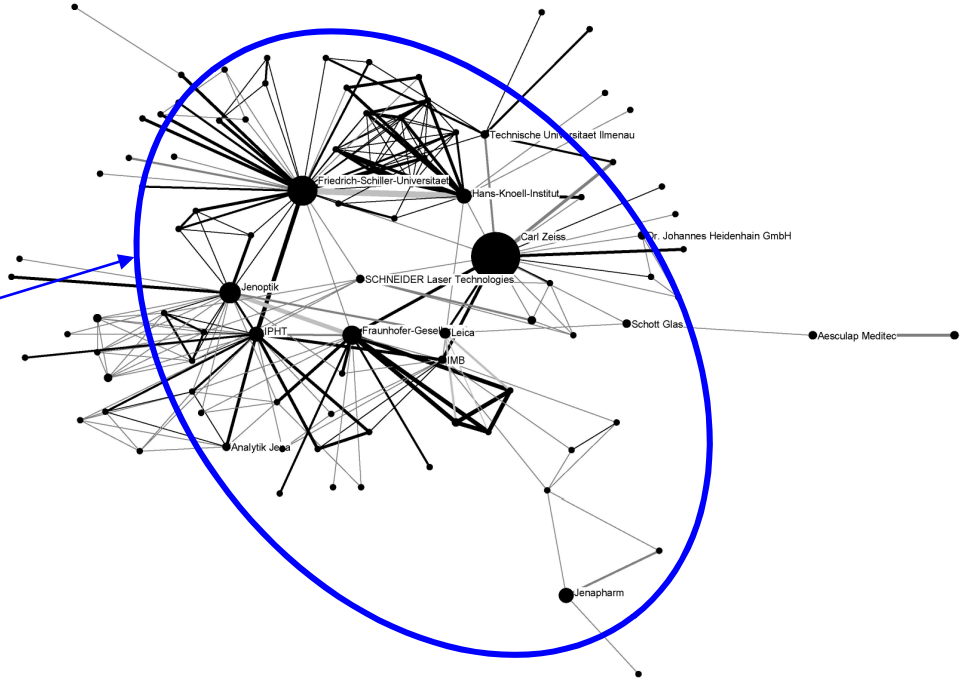
Source: Cantner/Graf 2006

Realized cooperation

32 persistent innovators



1995-1997



1999-2001

cooperation, scientist mobility

Source: Cantner/Graf 2006
equiv. on a local basis: Joel 2008

- What is the influence of the perceived importance of **intermediation actors** on cooperation success?

- Results
  - **R1**: intermediation actors are considered important by actors running a successful cooperation project
  - **R2**: For Jena this relationship does not hold, contrary to Northern Hesse and Sophia Antipolis

- Interpretation
  - the Jena spin-off agglomeration does not require intermediation as the actors know each other already

Model Method dep. Variable	M1 Logit **coop-success**	M2 Logit **coop-success**
int-imp	**0,732***** (3,09)	
int-imp * jena		**0,461** (1,41)
int-imp * northern hesse		**0,926***** (3,01)
int-imp * sophia antipolis		**1,670**** (2,36)
firm size	0,352*** (4,40)	0,34*** (4,15)
firm age	-0,005 (-1,39)	-0,007* (-1,79)
group member	0,495** (2,04)	0,52** (2,17)
higly educated researchers	1,529*** (4,17)	1,413*** (4,07)
Constant	-2,903*** (-8,54)	-2,768*** (-8,50)
Observations	659	659
Robust z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%		

Source: Cantner/Meder/Wolf 2009

- How are **political actors, research institutes and network partners** related to a firm's innovative capacity?

- Results
  - **R1**: political actors are not significantly related to innovative capacity
  - **R2**: research institutes are positively related to innovative capacity
  - **R3**: size of the own network is significantly related to innovative capacity; inverted-**u**

- Interpretation
  - the Jena spin-off agglomeration does not benefit from policy contact
  - but from public research and own network

MODEL method dep. Variable	M1 OLS **Innovative capacity**	M2 Poisson **Innovative capacity**	M3 Negbin **Innovative capacity**
rel. to pol. actors	**0,022** (0,172)	**0,029** (0,988)	**0,049** (0,795)
rel. to res. institutes	**0,482**** (2,392)	**0,100**** (2,081)	**0,022** (0,226)
coop. netw.	**0,780***** (4,430)	**0,200***** (5,868)	**0,298***** (3,739)
(coop. netw.)^2	**-0,026***** (-3,132)	**-0,007***** (-4,573)	**-0,011***** (-3,130)
coop. netw. X optic	**-0,350*** (-1,884)	**-0,109***** (-3,160)	**-0,190**** (-2,306)
log(employment)	1,108*** (3,195)	0,096 (0,987)	0,088 (0,498)
optic industrie	-0,056 (-0,073)	-0,266 (-1,499)	-0,281 (-0,813)
service sector	-0,27 (-0,613)	-0,023 (-0,197)	-0,073 (-0,344)
R&D staff	3,444*** (4,803)	0,020*** (3,032)	0,044** (2,114)
exp. future dev.	0,426** (2,169)	0,243*** (4,226)	0,272*** (2,773)
Intercept	-1,186 (-1,49)	-0,357 (-1,332)	-0,581 (-1,306)
Adjusted R^2 Pseudo R2 observations	0,49 153	 0,346 153	 -1.79 153
in parentheses t-tests (OLS) or z-test (Poisson, Negbin); * significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level			

Source: Cantner/Conti/Meder 2009
similar Cantner/Joel 2008

- How do network incumbents **interact and build linkages**? Can we identify a time persistent **pattern of linkages**?

- Results
  - **R1**: linkages do not seem to be persistent but rather short term
  - **R2**: linkages in 99-01 are best explained by mobility of researchers in the same period
  - **R3**: technological overlap is a necessary condition for building a linkage

- Interpretation
  - in a spin-off agglomeration, flexibility in linkages may indicate a high degree of trust among the network actors

Model Method dep. Variable	M1 network regression **cooperation$^{99-01}$**		
		Pr(≥|*t*|)	*Pr*(≥*b*)
cooperation$^{95-97}$	**-0,082*****	0,154	1,000
scientist mobility$^{95-97}$	**-0,136****	0,43	0,989
scientist mobility$^{99-01}$	**0,410*****	0	0,004
tech. overlap$^{95-97}$	**0,075***	0,361	0,072
(tech. overlap95-97)^2	**0,038****	0,014	0,014
public linkages	0,277*	0,051	0,077
private linkages	-0,109	0,178	0,842
intercept	0,051	0,431	0,894
mult. R2 (adj.) # of obs. (nodes)	0,153 496		(0,141) (32)
significance-levels according to QAP: ***≤0.01, **≤0.05, *≤0.1; significance is the minimum of Pr(>b) (which is documented) and Pr(<b); # of permutations: 1000			

Source: Cantner/Graf 2006

- What role does **trust** play for the failure / success of cooperation projects?

- Results
  - **R1**: the higher the level of ex-post trust, the less likely a cooperation will fail
  - **R2**: this is more pronounced in Jena compared to Northern Hesse and Sophia Antipolis

- Interpretation
  - the Jena spin-off agglomeration enjoys a trust heritage from the Kombinate and VEB times

Model Method dep. Variable	M1 Logit **coop-failed**	M2 Logit **coop-failed**
ex-post-trust	**-1,130***** (-2,71)	
ex-post-trust*jena		**-1,454***** (-3,54)
ex-post-trust*northern hesse		**-1,114***** (-2,87)
ex-post-trust*sophia-antipolis		**-0,985** (-1,62)
firm size	-0,072 (-0,29)	
firm age	-0,004 (-0,62)	
group member	0,586 (0,89)	
highly educated researchers	-0,784 (-0,69)	
Constant	1,458 (1,01)	
Observations	279	279
Robust z statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%		

Source: Cantner/Meder/Wolf 2009

- How are **innovators, entering the system, connected** compared to those exiting?
  How does the **connectedness of the permanent innovators** develop over time?

- Results
  - **R1**: entering innovators are significantly better connected to permanent innovators than exiters
  - **R2**: exiting innovators are significantly better connected among themselves than entering innovators
  - **R3**: over time permanent innovators become significantly more connected among themselves

- Interpretation
  - Jena network core is attractive for entry
  - network core increases its internal connectedness

method variable	network analysis **mean degree in cooperation**	
	within	to permanent
1995-1997 exit	**3,084** (5,207)	**0,710** (1,873)
1999-2001 entry	**2,242** (4,424)	**1,516** (2,623)
difference p-value	0,066	0,003
1995-1997 permanent	**2,563** (5,346)	
1999-2001 permanent	**3,938** (6,710)	
difference p-value	0,1	
standard deviation in parentheses		

Source: Cantner/Graf 2006

- How do the Jena innovators draw on **Jena external cooperation partners**?

- Results
  - **R1**: concerning all actors (persistent and temporary innovators) we find the share of external linkages to decrease over time
  - **R2**: concerning the persistent actors we find a drastic decrease in the share of external linkages

- Interpretation
  - in the Jena system there is a tendency towards stronger internal orientation
  - esp. public research institutes do not seem to provide an antenna function

variable	**ratio of external to internal linkages**		
all innovators		**1995-1997**	**1999-2001**
private actors	cooperation scientist mobility	**1,65** **2,09**	**1,59** **1,74**
public actors	cooperation scientist mobility	**1,86** **1,77**	**1,52** **1,27**
only persistent innovators			
private actors	cooperation scientist mobility	**0,50** **2,25**	**0,13** **0,69**
public actors	cooperation scientist mobility	**1,25** **1,25**	**0,08** **0,33**

Source: Cantner/Graf 2006

- How does a relationship to the Jena **innovator network** affect the **survival of newly founded firms**?

- Results
  - **R1**: for all new firms, the ATT of those surviving 6 and 7 years is significantly positive
  - **R2**: for all new firms in closer geogr. proximity, the ATT of those surviving 5-8 years is significantly positive and higher than in R1
  - **R3**: for spin-offs, the ATT of those surviving 4-8 years is significantly positive and higher than in R1 / R2

- Interpretation
  - being integrated in the Jena system provides better survival probabilities to new firms that are spin-offs and that are closer to Jena geographically

Matching algorithm	NN radius caliper (0,05)			Bootstrap results (200)	
	ATT	std. err.	T-stat	z	P>|z|
all new start-ups and spin-offs in Thuringia					
survival4	0,0048	0,0365	0,13	0,13	0,90
survival5	0,0688	0,0386	1,78	1,61	0,11
survival6	**0,0727***	0,0388	1,87	1,86	0,06
survival7	**0,0775***	0,0380	2,04	1,90	0,06
survival8	0,0362	0,0352	1,03	0,98	0,33
# of obs.	treated untreated	188 4412			
all start-ups and spin-offs within East Thuringia					
survival4	0,0275	0,0510	0,54	0,54	0,589
survival5	**0,1568*** **	0,0532	2,95	2,84	0,005
survival6	**0,1590*** **	0,0538	2,95	2,87	0,004
survival7	**0,1457*** **	0,0531	2,74	2,62	0,009
survival8	**0,0949***	0,4949	1,92	1,77	0,077
# of obs.	treated untreated	105 980			
only spin-offs in Thuringia					
survival4	**0,2056****	0,0759	2,71	2,28	0,02
survival5	**0,3375*** **	0,0837	4,03	3,51	0,00
survival6	**0,3735*** **	0,0852	4,38	4,23	0,00
survival7	**0,3683*** **	0,0860	4,28	3,95	0,00
survival8	**0,1930****	0,0800	2,40	2,40	0,02
# of obs.	treated untreated	45 198			

Source: Cantner/Wolf 2009