How do Clusters/Pipelines and Core/Periphery Structures Work Together in Knowledge Processes?

Evidences from The European GNSS Technological Field

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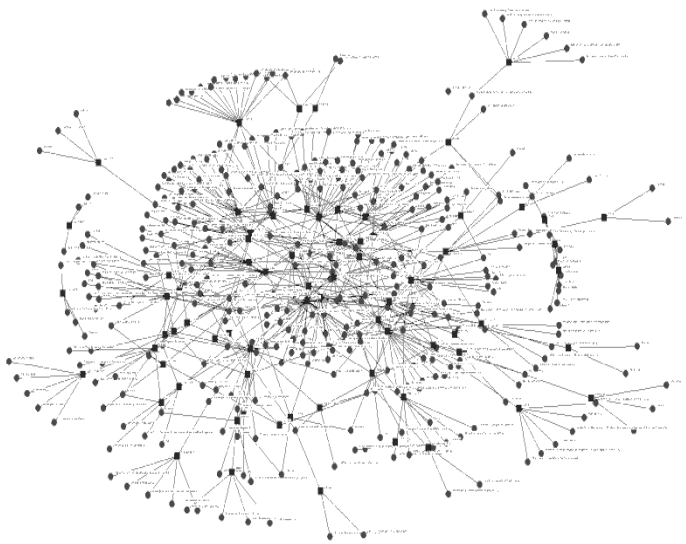
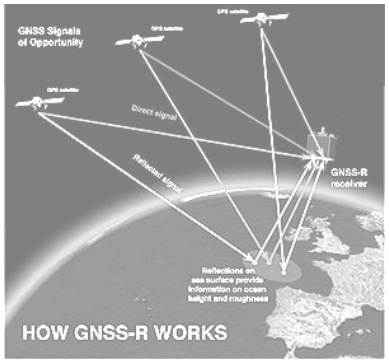
General Outline





- Starting idea: Identify the **geographical**, **structural** and **cognitive** features of a particular technological field (GNSS in Europe)
- Central question: How these characteristics are **articulated** according to the phase of the knowledge value chain (**KVC**): exploration, integration, exploitation ?
- Methods: Consider the two **affiliations networks**: the network of organizations and the network of projects **+** cognitive & geographical **attributes**
- Main finding: a **reverse relation** between geographical concentration (clusters/pipelines) and relational concentration (core/periphery) according to the phases of the KVC

DATA

- The GNSS technological field
  - GNSS are nowadays considered as public utilities that cross and stimulate many innovations in different sectors (transports, telecommunication, tourism, security, environment, …) and different applications (navigation, observation, positioning, communication, …)
  - The Egnos and Galileo programs are political key issues for the European independence on navigation satellite systems, especially considering the American GPS
- Data
  - FP5&6 R&D collaborative projects dedicated to GNSS from 2002 to 2007
  - From the bi-modal network to the network of projects and network of organizations

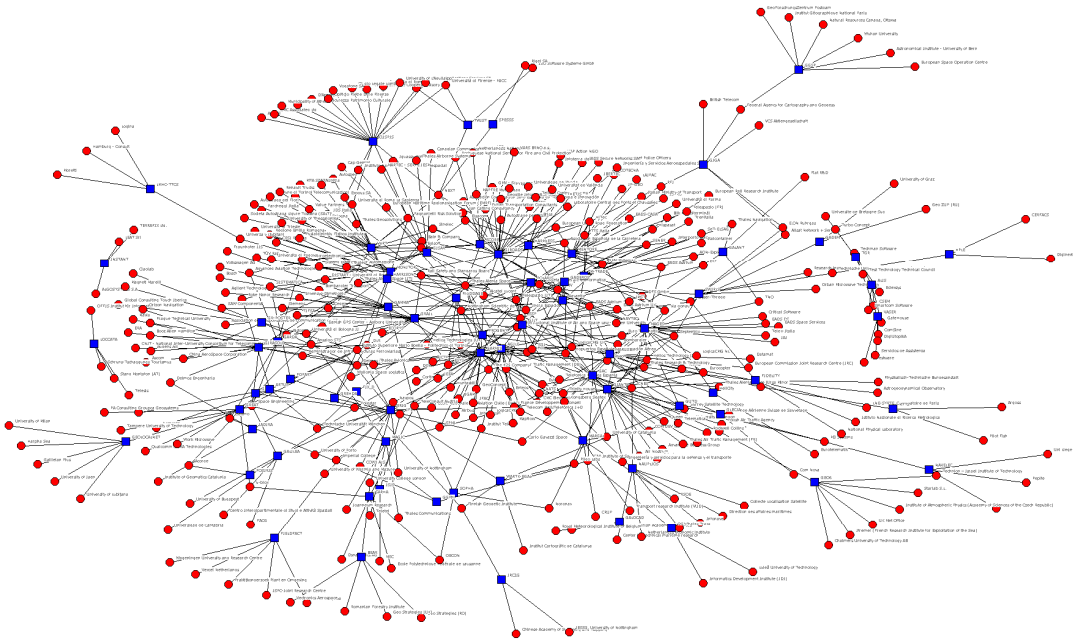


Figure 1. The GNSS bimodal network

Projects		Organizations	
Number of projects	72	Number of organizations	360
Average of organizations by project	8,2	Average of projects by organization	1,7
Standard error	6,6	Standard error	1,7
Minimum	2	Minimum	1
Maximum	32	Maximum	17

Table 1. Descriptive statistics of the bimodal network

THE ATTRIBUTES

- The **nature** of knowledge involved in relationships
  - Based on the phases of the knowledge value chain
- The **knowledge bases** of the organizations
  - The SAS model (Synthetic, Analytic, Symbolic)
- The **location** of organizations: how to identify clusters?
  - The NUTS2 level of European regions

	Exploration	**Integration**	**Exploitation**
Main goal	New knowledge for future technologies	Combine pre-existing technologies	Develop GNSS-based applications and services
Distance to the market	***	**	*
Key words	Concepts/theory Research Investigation Simulations Mathematical model	Technological standard Interoperability Combination Satellite + ICT	Market Use Applications Design Development

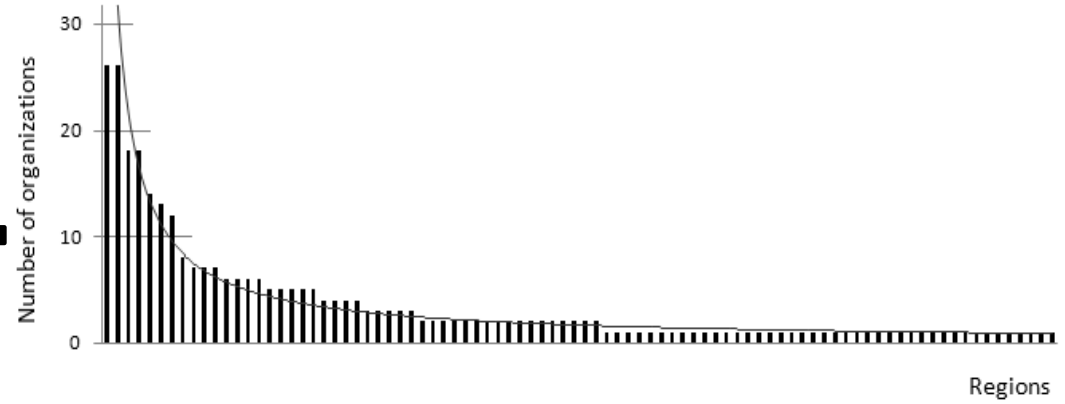


Figure 2. Distribution of organizations among 88 NUTS II European regions

Structural properties

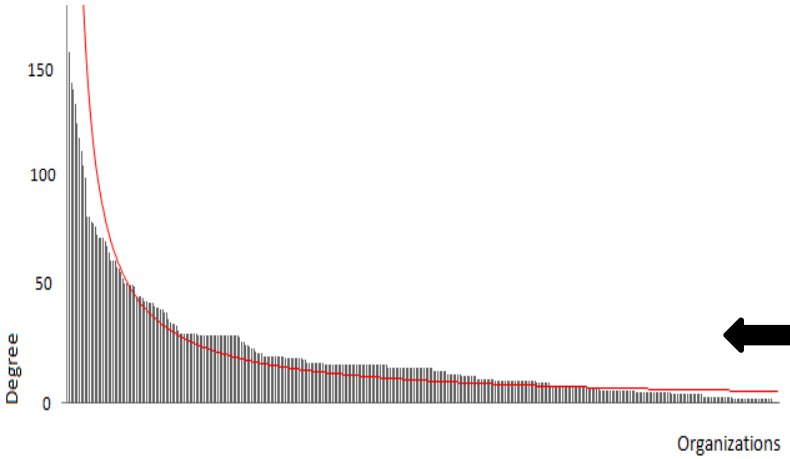


Figure 3. Degree centrality distribution among the 360 organizations

- High level of connectivity in the network of organizations as well as in the network of projects
- A core of projects (highly connected) and a periphery of projects (poorly connected)
- A power law distribution of organizations' degree centralities
- A salient observation: public research organizations have a higher ranking of betweenness centrality than degree centrality

Cognitive properties (1)

Knowledge bases and cognitive nature of collaborations				
SAS & KVC	**Exploration**	**Integration**	**Exploitation**	**Total**
Analytic				
(Nb of organizations)	**62**	37	25	124
(%)	**52,5 %**	15,9 %	9,2 %	20 %
Synthetic				
(Nb of organizations)	46	**163**	169	378
(%)	39 %	**70,3 %**	62,4 %	60,8 %
Symbolic				
(Nb of organizations)	10	32	**77**	119
(%)	8,5 %	13,8 %	**28,4 %**	19,2 %
Total				
(Nb of organizations)	118	232	271	621
(%)	100 %	100 %	100 %	100 %

Cognitive properties (2)

E-I index	Internal	External	Total	E-I
Analytic	24 %	76 %	100 %	0,521
Synthetic	65 %	35 %	100 %	-0,291
Symbolic	26 %	74 %	100 %	0,476

Table 6. E-I index

- Homophile (within group) vs. heterophile (between group) knowledge interactions.

Cognitive properties (3)

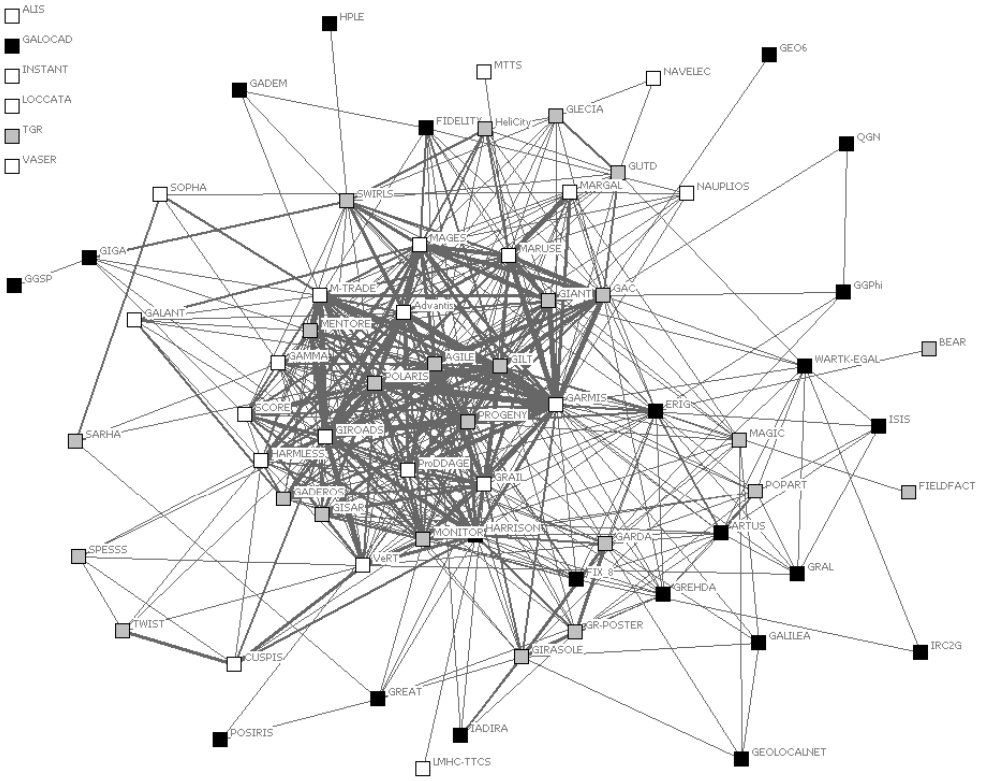


Figure 4. Core & Periphery structure and knowledge phases[1]

Core & Periphery	Core	Periphery	Total
Exploration			
Nb of projects	1	22	23
%	4,4%	95,6%	100%
Integration			
Nb of projects	8	17	25
%	32%	68%	100%
Exploitation			
Nb of projects	10	14	24
%	41,7%	58,3%	100%
Total			
Nb of projects	19	53	72
%	26,4%	74,6%	100%

Table 7. Core & Periphery

The more the projects move closer to the market, the more projects are connected between themselves, while the very upstream phase of knowledge value chain remains “located” at the periphery of the network

Geographical properties

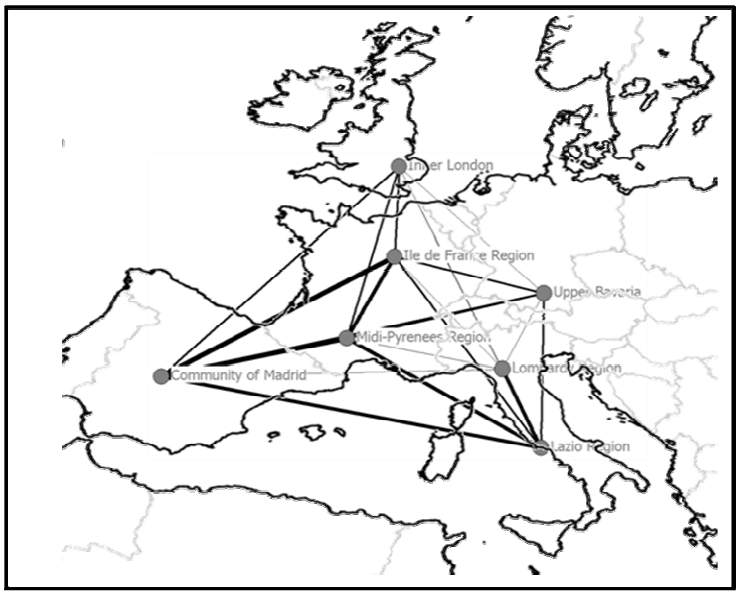


Figure 5. GNSS clusters and pipelines in Europe[1]

- 7 main clusters are identified with the pipelines between them
- Clusters differ according to their inside density and outside openness (see district/satellite platform of Markusen)

Cognitive structure of clusters and pipelines				
	Exploration	**Integration**	**Exploitation**	**Total**
Within the clusters				
Nb of links	178	116	84	378
%	47 %	31 %	22 %	100 %
Within the pipelines				
Nb of links	462	588	274	1324
%	35 %	44,5 %	20,5 %	100 %
Clusters/others				
Nb of links	1482	1610	890	3982
%	37 %	40,5 %	22,5 %	100 %
Others/others				
Nb of links	662	734	762	2158
%	31 %	34 %	35 %	100 %
All				
Nb of links	2784	3048	2010	7842
%	35,6 %	38,8 %	25,6 %	100 %

Table 9. Cognitive structure

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	Knowledge exploration	**Knowledge integration**	**Knowledge exploitation**
Cognitive properties	*Analytic and fundamental knowledge*	*Synthetic and engineering knowledge*	*Symbolic, price and marketing knowledge*
Geographical properties	*Highly clustered in a couple of places*	*Pipelines, cluster relatedness*	*Dispersed and covering the European area*
Structural properties	*Periphery*	*Core and periphery*	*Core*

Table 10: cognitive/geographical/structural properties and the phases of the knowledge value chain

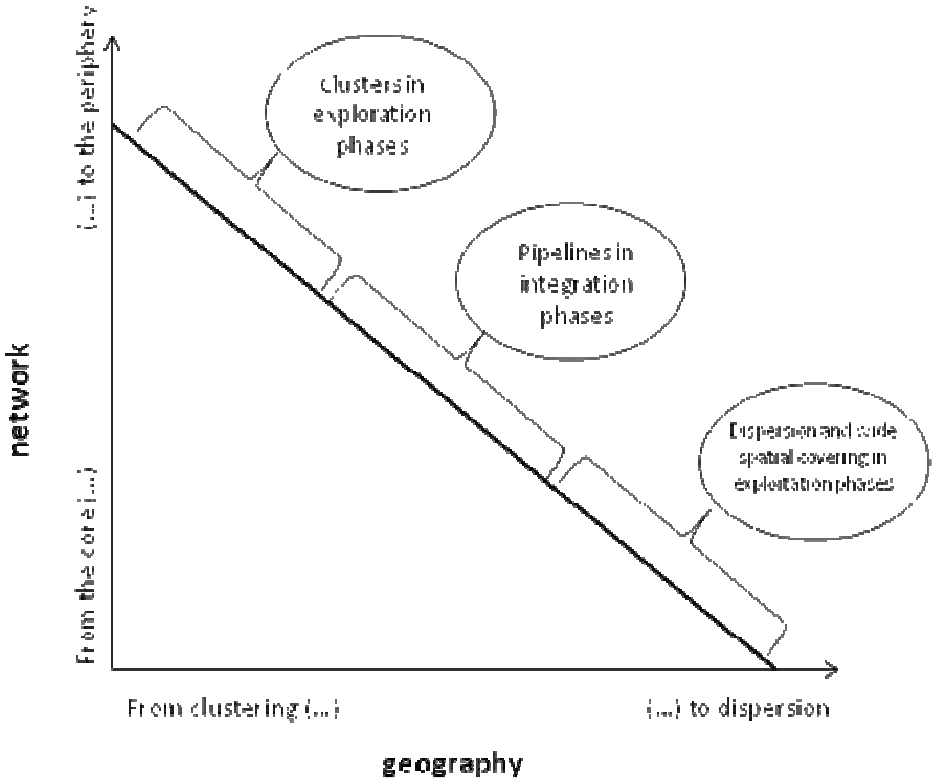

Figure 6: geographical cluster/pipeline and network core/periphery structure

Thank you for attention!