

*Social Networks Methodology*  
*to address*  
*European RTD Evaluation Challenges*

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Evaluating R&D Collaboration Networks in Europe

ZiF - Universität Bielefeld

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# PRIOR RESULTS ON IST-RTD NETWORKS



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# Prior Results

## European IST RTD Networks

The network of research collaborations has:

- A self-organizing structure, dominated by “hubs”, which are also key nodes in National research networks
- A scale-free architecture at the thematic levels



# Prior Results

## European IST RTD Networks

European research is characterized by “small world” connectivity

Strong tendency of scientists to cluster around national communities

Strong tendency to cluster with research disciplines and within industrial sectors

The funding structure has a strong influence on research co-operations



# Prior Results

## European IST RTD Networks

As a result of the new *Integrated Projects and Networks of Excellence*:

- The density of links is higher
- The share of participants in the principal component is higher
- The average path length is lower
- Large firms and research institutes are more dominant as gate-keepers of collaboration
- Small companies are “crowded out” relative to FP5



# Prior Results

## European IST RTD Networks

The IST RTD network as a whole has “small world” characteristics - but this is not true for each and every one of its programmes

FP6 is more likely than other research collaboration frameworks to:

- Connect universities and industry
- Connect different research themes
- Include new Member States
- Include key patent-holders
- Include SMEs



# THIS STUDY ON IST-RTD NETWORKS



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# Towards an ERA for IST: Overall Objectives

Develop and apply a quantitative analytical framework for the assessment of the characteristics and performance of networks supported by IST RTD in FP5 and FP6.

Analyze knowledge and partnership networks in selected IST RTD domains, concentrating on network nature, topology, time evolution and effectiveness.

Supplement quantitative information with some qualitative information, and inter-organizational networks with inter-personal networks



# Towards an ERA for IST: Evaluation Questions

- How do the characteristics of the *IST-RTD partnership and knowledge networks* compare with the characteristics of the *global partnership and knowledge networks* of IST-RTD companies and with the characteristics of the related global networks?
- How well are the companies participating in IST RTD programs positioned in the global partnership and knowledge networks?



# Towards an ERA for IST: Evaluation Questions

- How effective are IST-RTD networks as mechanisms for transmitting knowledge?
- Are the Integrated Projects (IPs) and the Networks of Excellence (NoEs) creating leading “knowledge hubs”?
- What makes these “knowledge hubs” effective?



# Towards an ERA for IST: Evaluation Questions

- To what extent does the prominent network status of certain IST RTD companies or clusters match the EU technological leadership in certain areas?
- Are the global networks of selected “hub” companies with extensive ICT supply chains represented in the FP6 IST RTD?
- Are the perceived national IST “knowledge hubs” well integrated into the FP6 network?



**IST-RTD  
Framework Programme 6**

**Selection of  
IST  
technology  
domains**

*Patent  
examiners*

*Field  
experts*

*Matching of IPC  
codes with  
technological  
domains*

***PARTNERSHIP  
NETWORK Ia***

*Matching of SIC  
codes with  
technological  
domains*

**EP-CESPRI  
patents/citations**

**INET  
alliances**

***KNOWLEDGE  
NETWORKS  
(Ib, IIb, IIIb)***

***PARTNERSHIP  
NETWORKS  
(IIa, IIIa)***

# Towards an ERA for IST: Network Types

- IST-RTD partnership network
- IST-RTD knowledge network
- Global partnership network of IST-RTD project participants
- Global knowledge network of IST-RTD project participants
- Global partnership network akin to the E technology areas
- Global knowledge network akin to the E technology areas



# Towards an ERA for IST: Examined Programs

FP6	
Thematic Areas	Strategic objectives
1. Applied IST research addressing major societal and economic challenges	• eSafety of road and air transports
	• eHealth
	• Technology-enhanced learning and access to cultural heritage
	• Towards a global dependability and security framework
	• Networked business and governments
	• eInclusion
	• Applications and Services for the Mobile User and worker
	• Cross-media content for leisure and entertainment
	• GRID-based Systems and solving complex problems
	• Improving Risk management
2. Communication, computing and software technologies	• Broadband for all
	• Mobile and wireless systems beyond 3G
	• Networked audiovisual systems and home platforms
	• Open development platforms for software and services
	• Embedded systems
3. Components and micro-systems	• Pushing the limits of CMOS and preparing for post-CMOS
	• Micro and nano-systems
	• Advanced displays
	• Optical, opto-electronic, photonic functional components

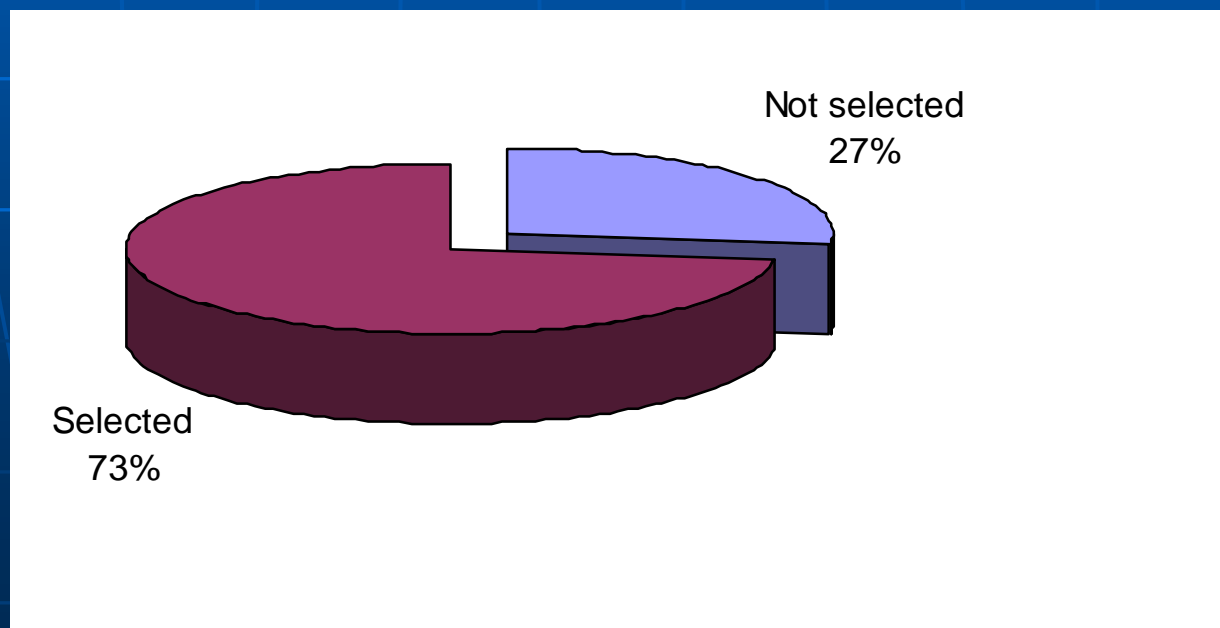
# Towards an ERA for IST: Examined Programs

FP 5	FP6
Key Actions	Thematic Areas
1. System and services for the citizen	1. Applied IST research addressing major societal and economic challenges
2. New method of work and electronic commerce	
4. Essential technologies and infrastructures	2. Communication, computing and software technologies
	3. Components and micro-systems

# TA 1-2-3 FP6

## Projects

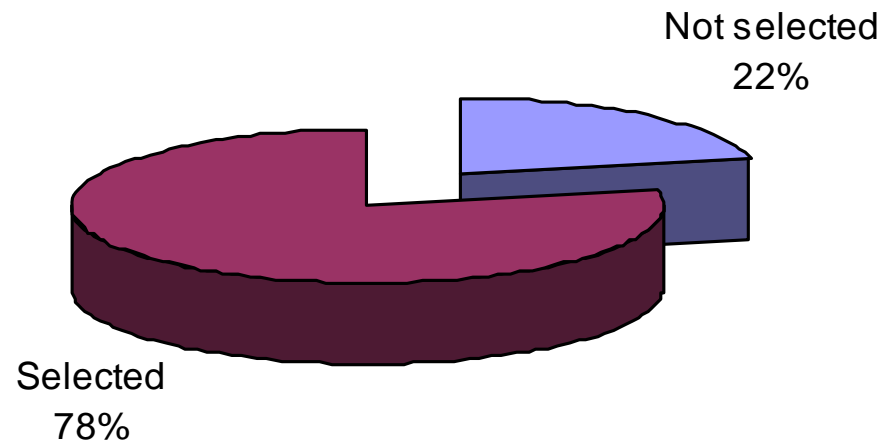
Not Selected	115	27,3
Selected	307	72,7



# TA 1-2-3 FP6

## Participants

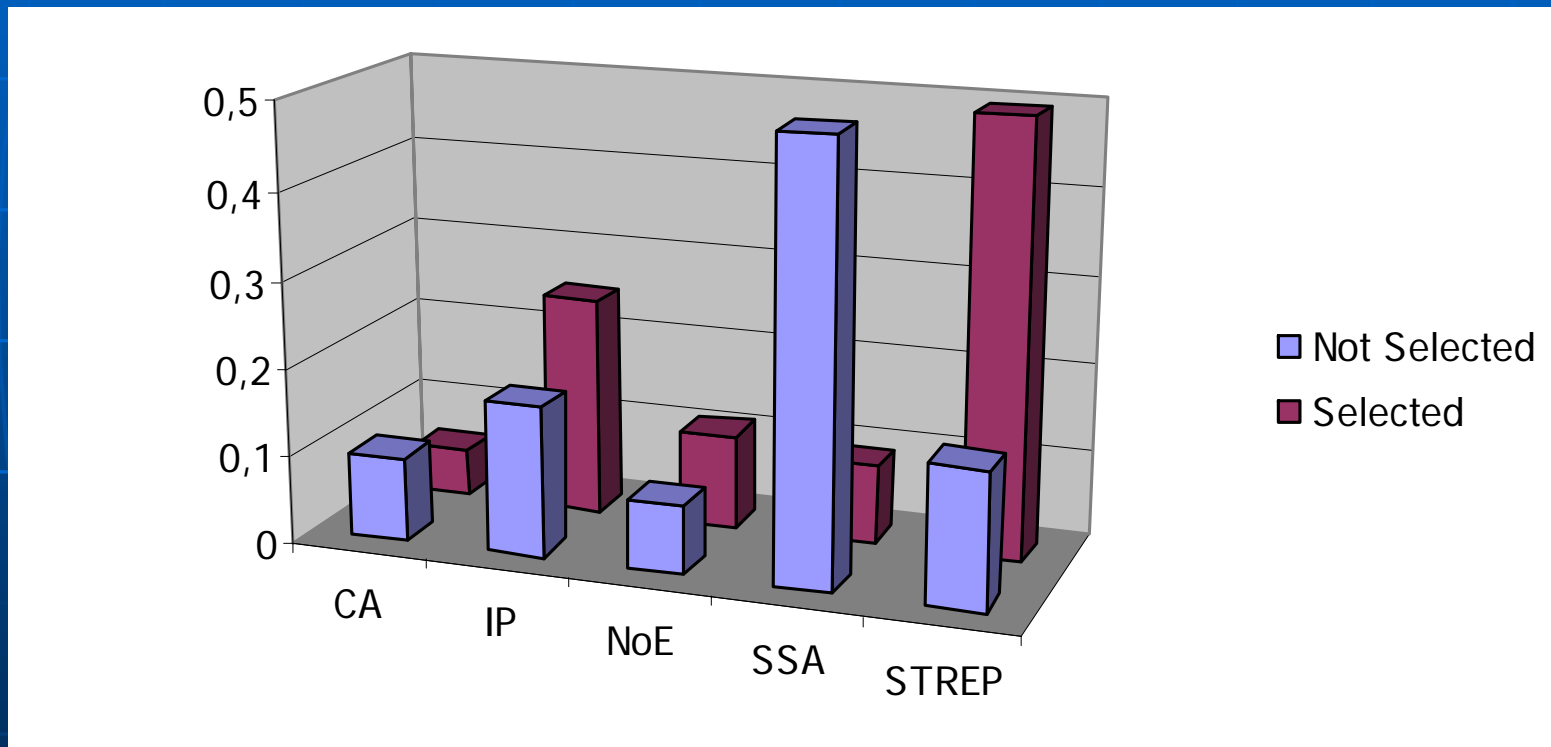
Not selected	1340	21,8
Selected	4814	78,2



Participants

# TA 1-2-3 FP6

By instrument  
(projects)

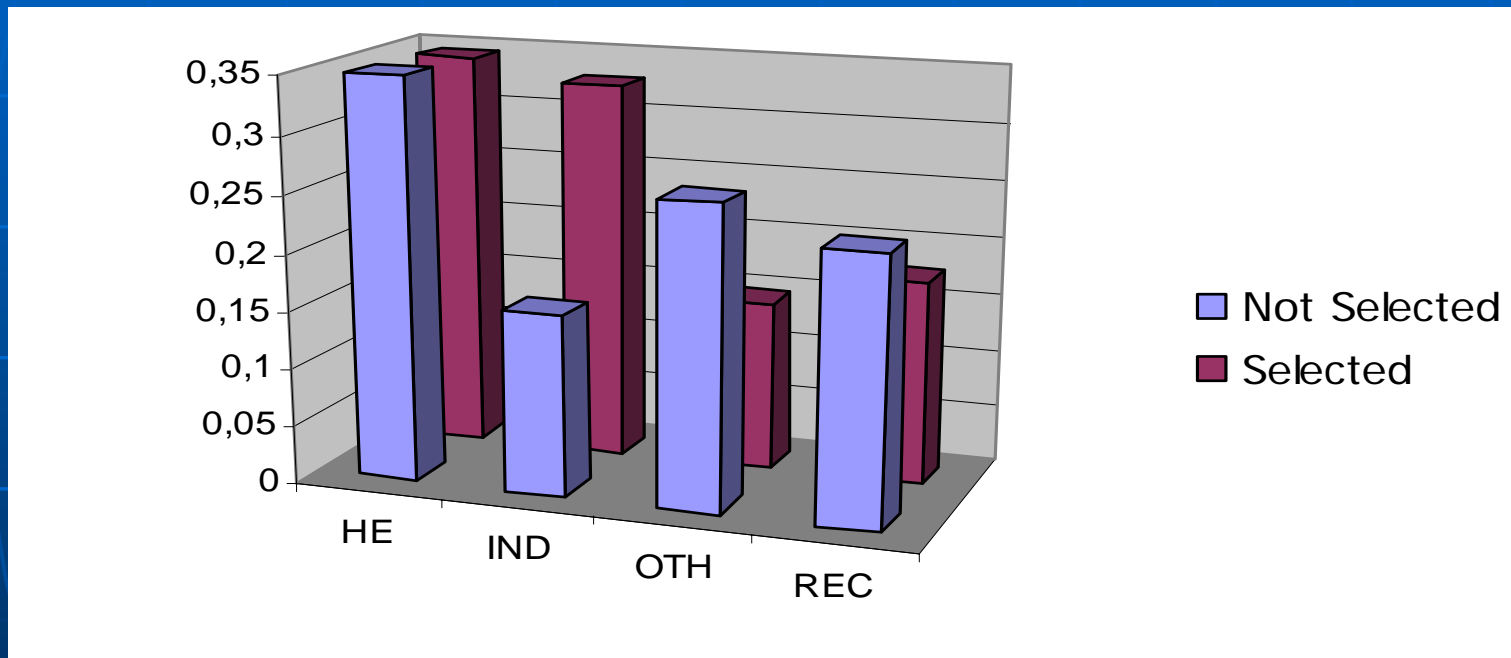


**CA:** Coordination Action  
**IP:** Integrated Project  
**NoE:** Network of Excellence

**SSA:** Specific Support Project  
**STREP:** Specific Targeted Research Project

# TA 1-2-3 FP6

## Organization Type



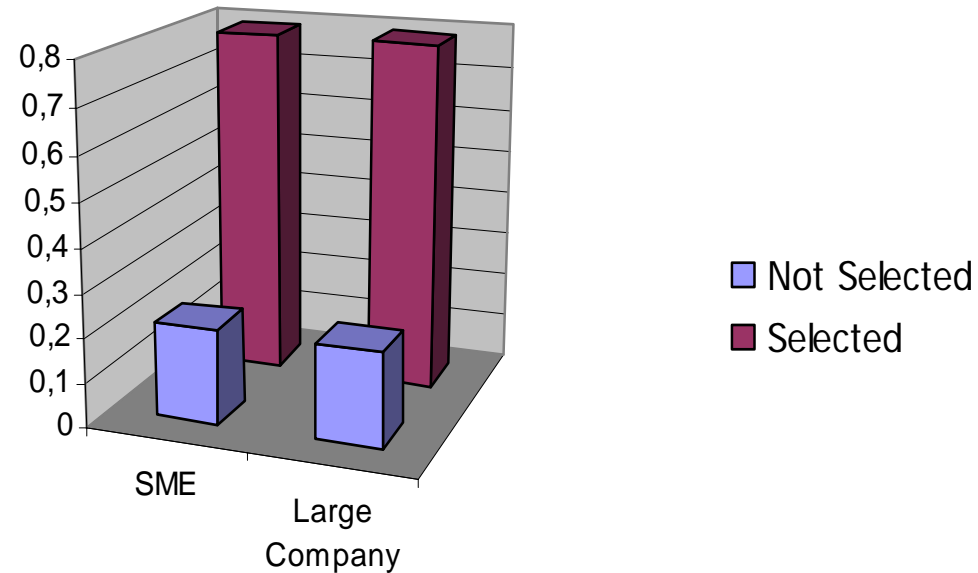
**HE:** Higher Education  
**IND:** industry

**REC:** Research  
**OTH:** Other

# TA 1-2-3 FP6

## SMEs and Large Enterprises

<b>Not Selected</b>	Large Company	1032	21.15
	SME	260	21.17
<b>Selected</b>	Large Company	3846	78.85
	SME	968	78.83



# **Indicative Analysis: 3 subjects**



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# Subject 1: Identifying HUBs and their relative roles



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# Hub definition

- An organization is a hub in a specific network if it has many links and/or if it connects the otherwise unconnected parts of the network

The above translates into high degree centrality and/or high betweenness centrality



# STYLIZED 3A PARTNERSHIP NETWORK

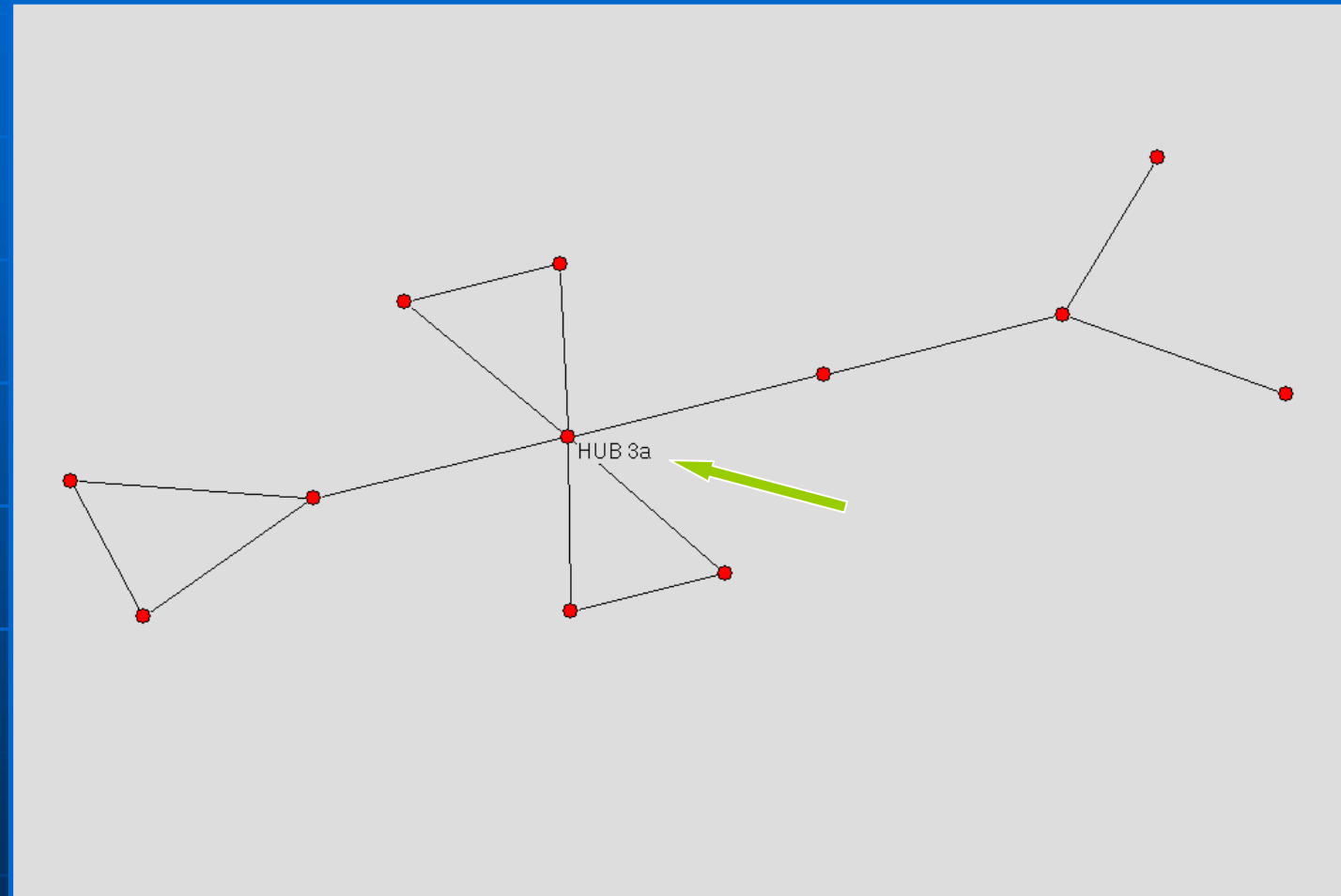
This is a stylized model of Network 3a (Alliances)



Give intuition behind the concept of a Partnership Hub



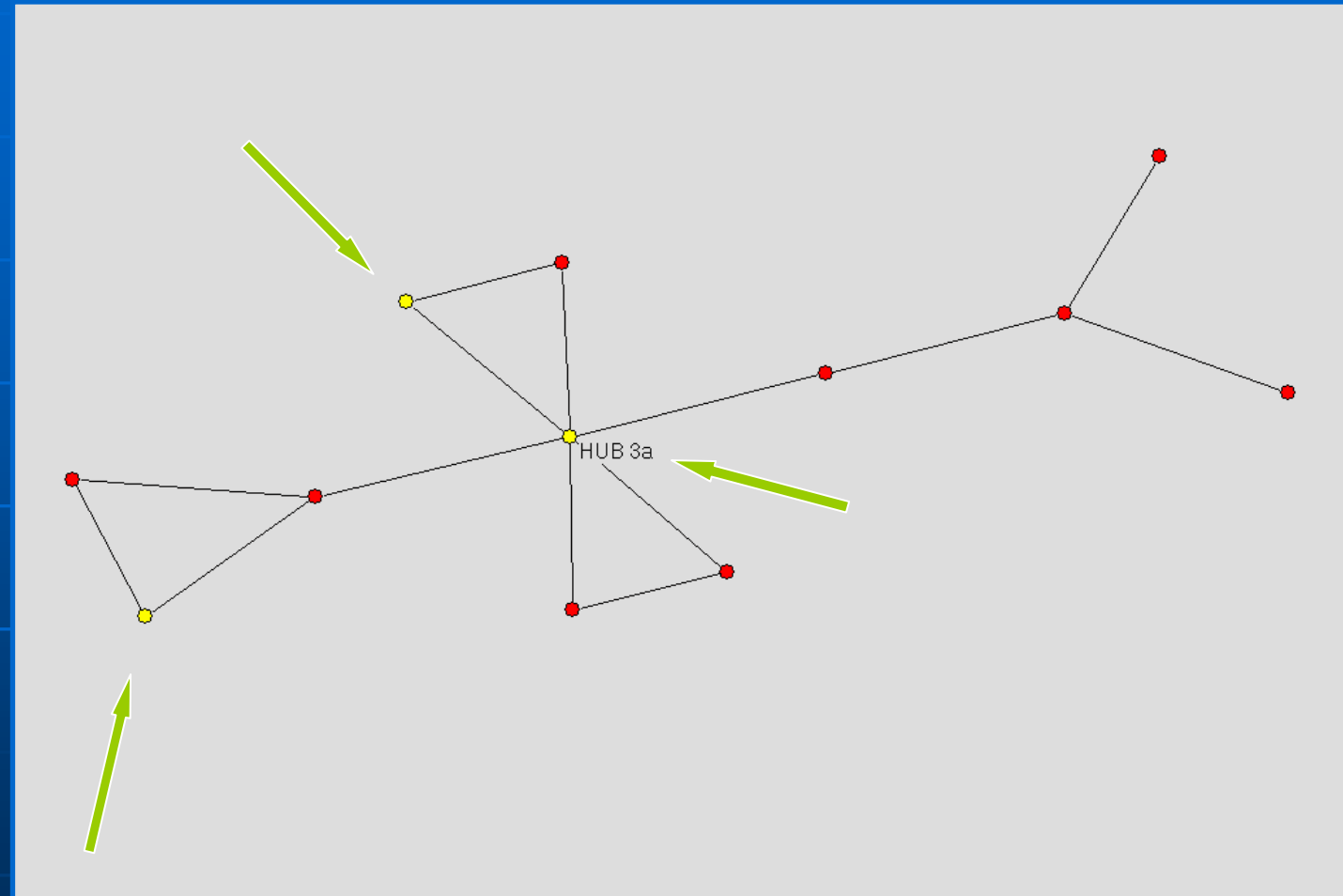
A Hub is defined as a node exhibiting high value of betweenness and degree



The node labelled "HUB 3a" is the designated Hub for this network.

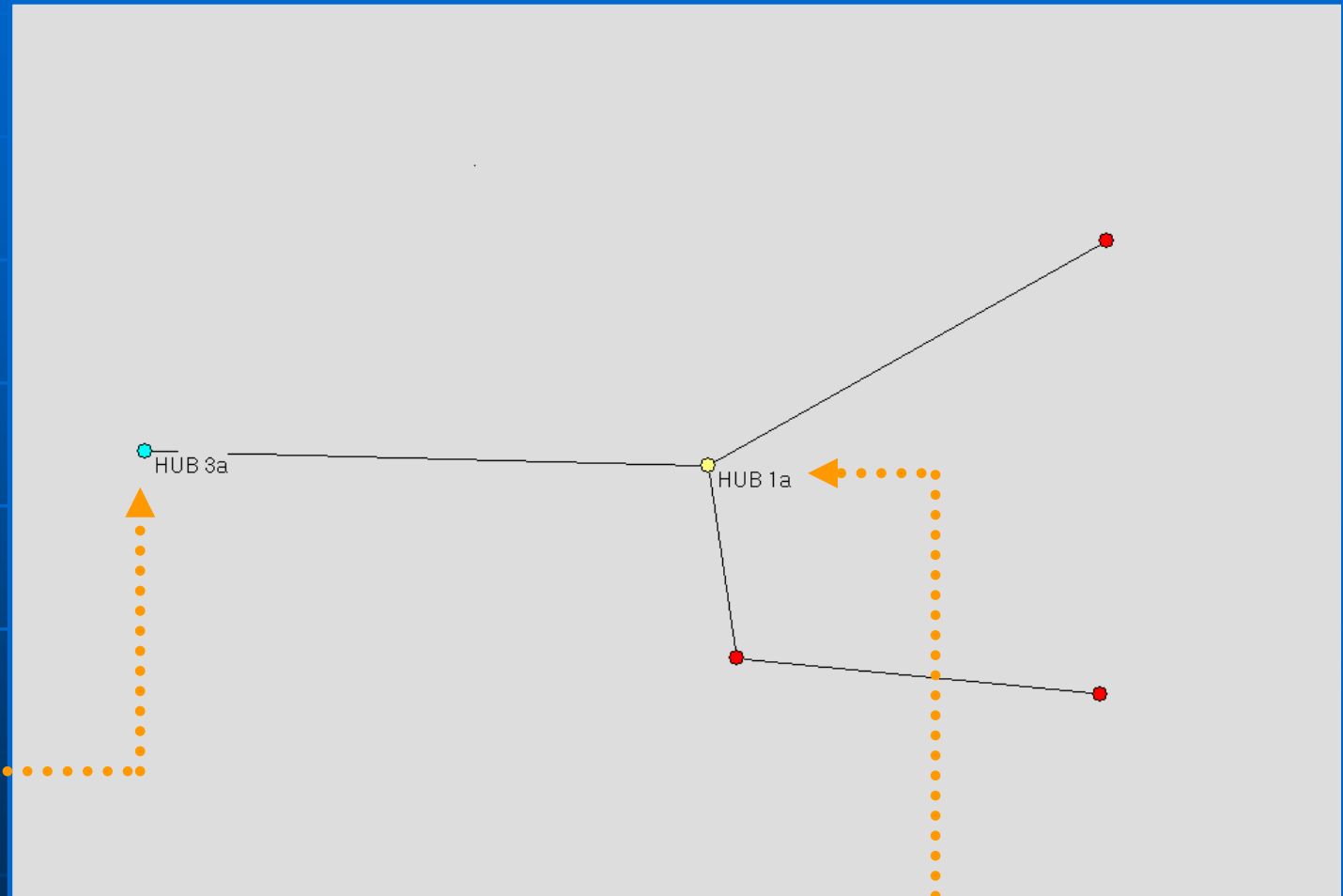
# STYLIZED 3A PARTNERSHIP NETWORK

Yellow nodes indicate organizations participating in Framework Programme.



# STYLIZED 1A PARTNERSHIP NETWORK

This is a stylized model of Network 1a (FP Participants)



The blue node is the 3a network relevant Hub

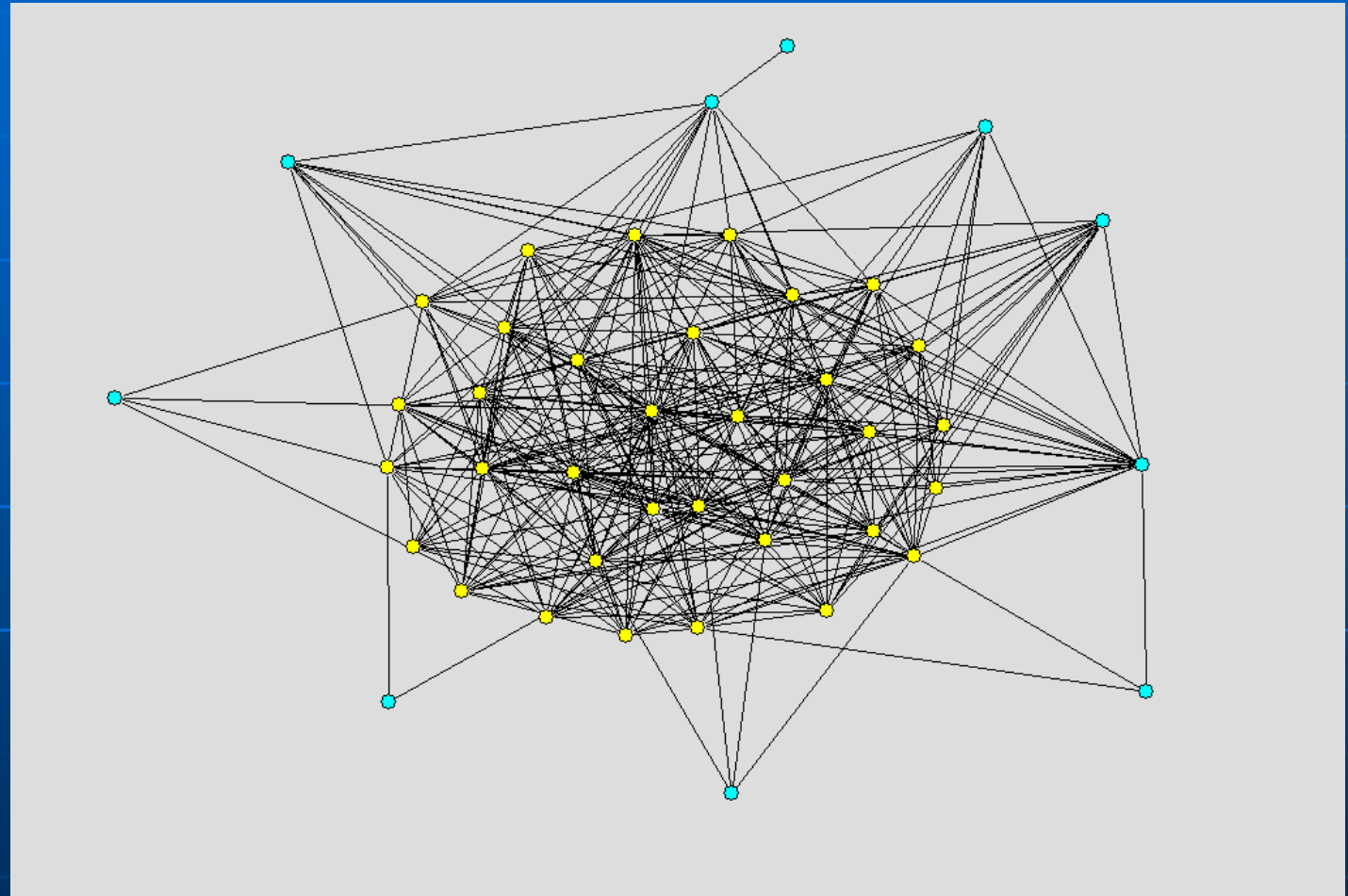
The yellow node represents the relevant Hub in the stylized 1a partnership network

# Links Between 1a Hubs and 3a Hubs

Blue nodes are the  
3a network Hubs

Yellow nodes  
represent the  
1a network Hubs

1a Hubs are strongly  
inter-connected and  
they are also connected  
with 3a Hubs



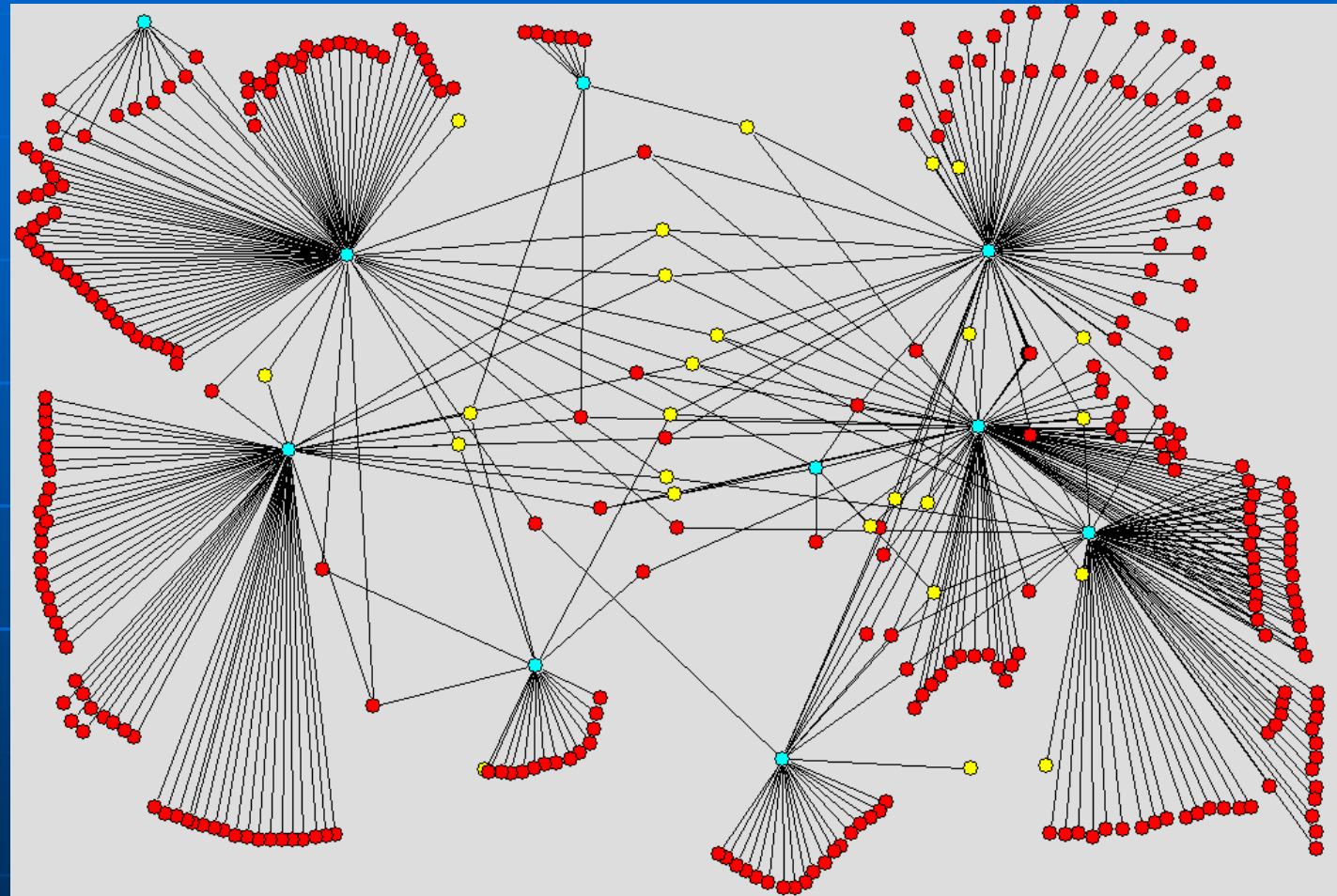
3a Hubs are NOT hubs in network 1a, BUT are gateways that  
connect FP organizations to the global network

# 1A FP6 (TA1) PARTNERSHIP NETWORK

Blue nodes are the  
3a network Hubs

Red nodes are other  
3a network  
participants within  
distance 1 from 3a  
Hubs

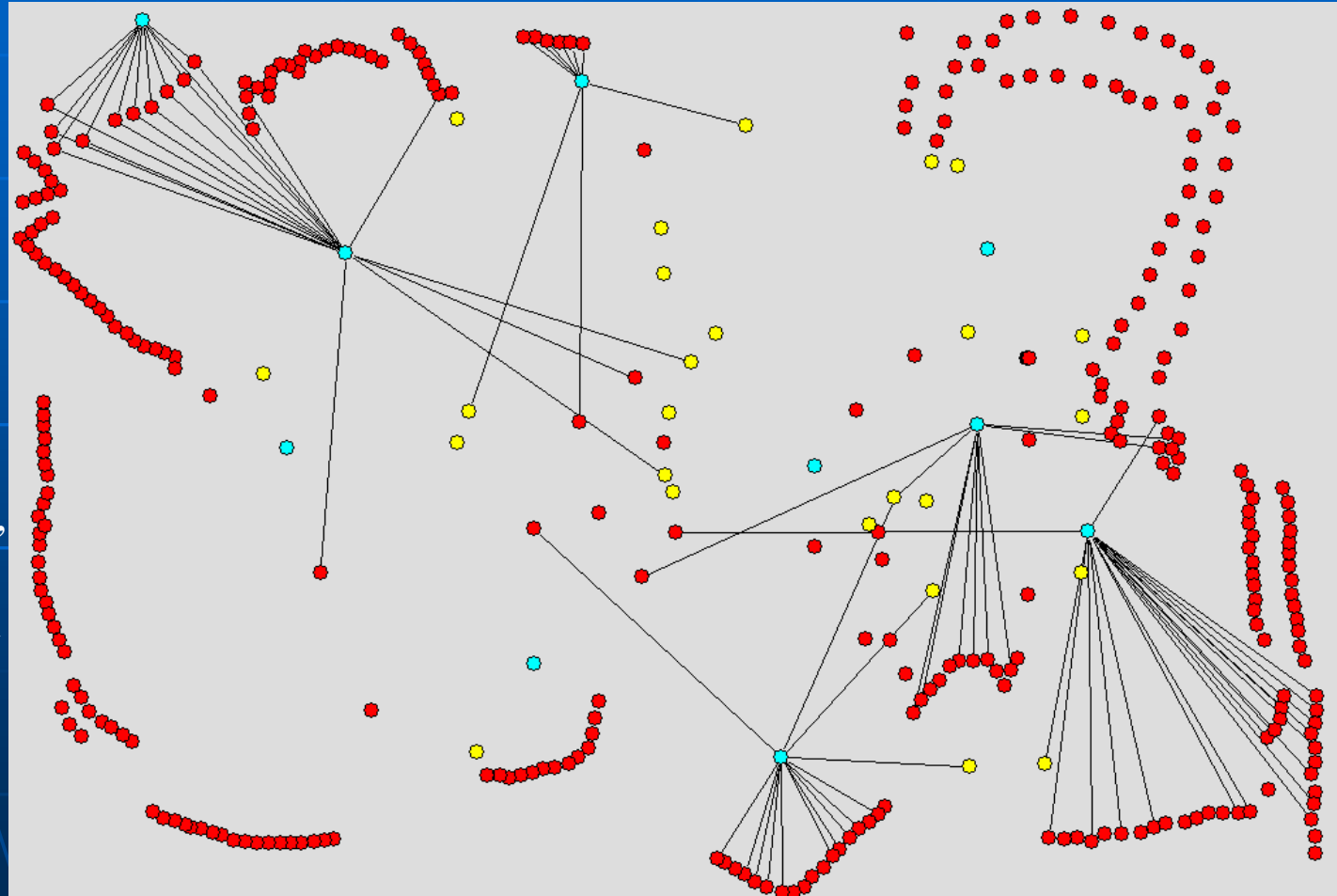
Yellow nodes  
represent 1a  
network Hubs



# 1A FP6 (TA1) PARTNERSHIP NETWORK (no IP)

This is the TA1  
Network without the  
links related to IP

The network is  
substantially different,  
with many isolated  
nodes and diminished  
complexity



# Subject 2: Effectiveness of KNOWLEDGE HUBS



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# Effectiveness of Knowledge Hubs

## Hubs as *knowledge depositories*

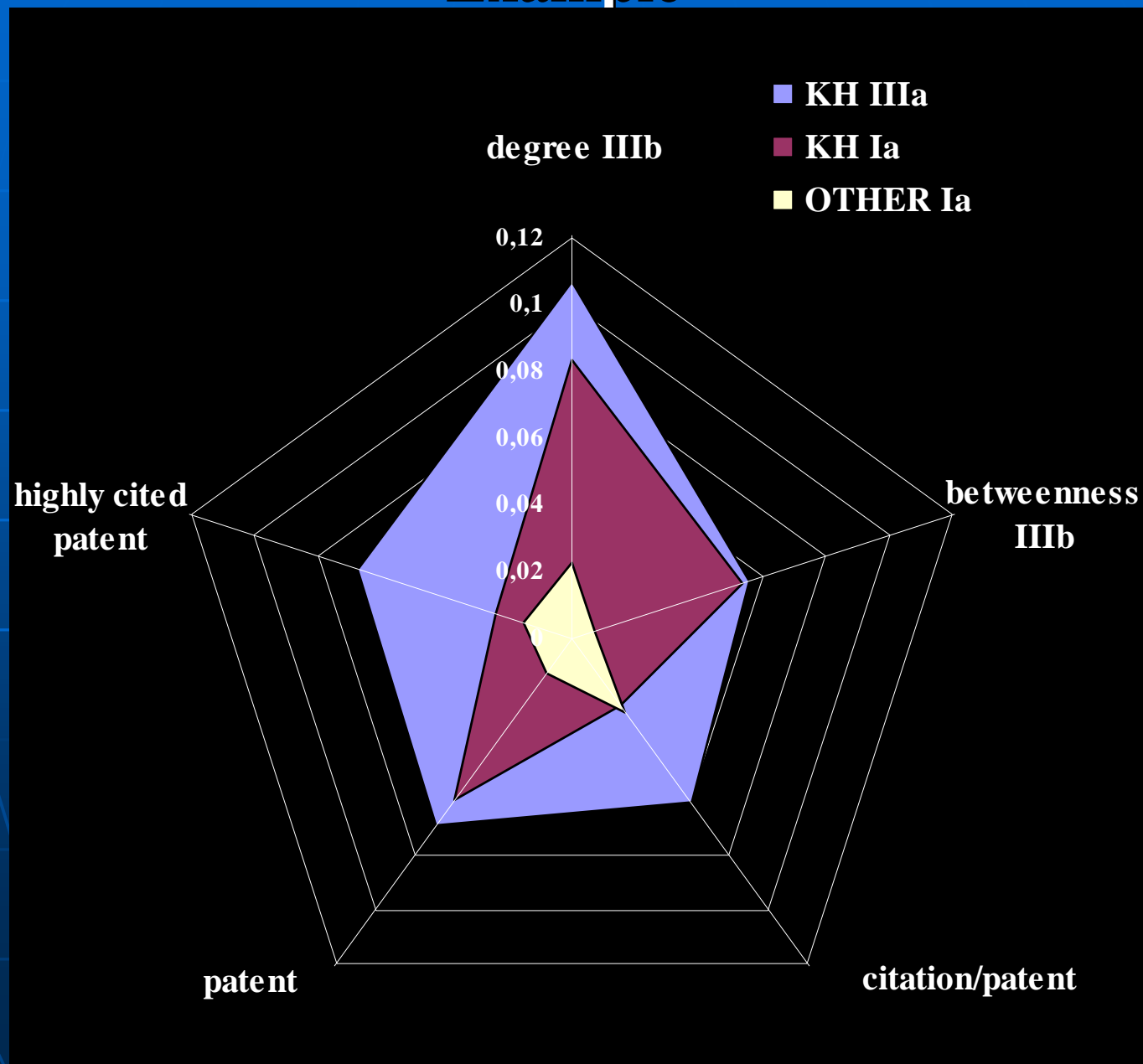
- Number of Patents
- Number of Citations Received
- Number of Highly Cited Patents

## Hubs at the *cross-road of information and ideas*

- Degree Centrality
- Betweenness Centrality



# Effectiveness of Knowledge Hubs: Example



# Effectiveness of Knowledge Hubs: Example

- closely matches that of global KHs in terms of three variables (number of patents, network centralities);
- lags seriously behind in terms of the remaining two variables that approximate the quality and the importance of their patent portfolios;



the FP KHs seem to perform better in diffusing knowledge through their centrality roles in the networks than in creating powerful and influential portfolios of new ideas.



# Subject 3: Leadership



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# Leadership

Two different definitions of Leadership:

- **Technology Leadership:** the role played by each organisation in the innovative process
- **Market leadership:** the share of revenues in ICT among EU25



# Technology Leadership

Technology leadership is defined in terms of two concepts:

- *Niche overlap* concerns the crowdedness of the technological area explored by organisations. Its measure is based on similarity of technological antecedents (i.e. co-citation).
- *Prestige* deriving from the direct technological ties between actors (i.e. direct patent citations)



# Technology Leadership

Four different kinds of actors:

- **Technology Leaders:** a key source of knowledge spillovers for many other organizations in the industry. Their research activity is focused on the exploitation of opportunities in relatively mature and therefore highly crowded fields
- **Technology Brokers:** sources of knowledge in relatively new and *unexplored* fields

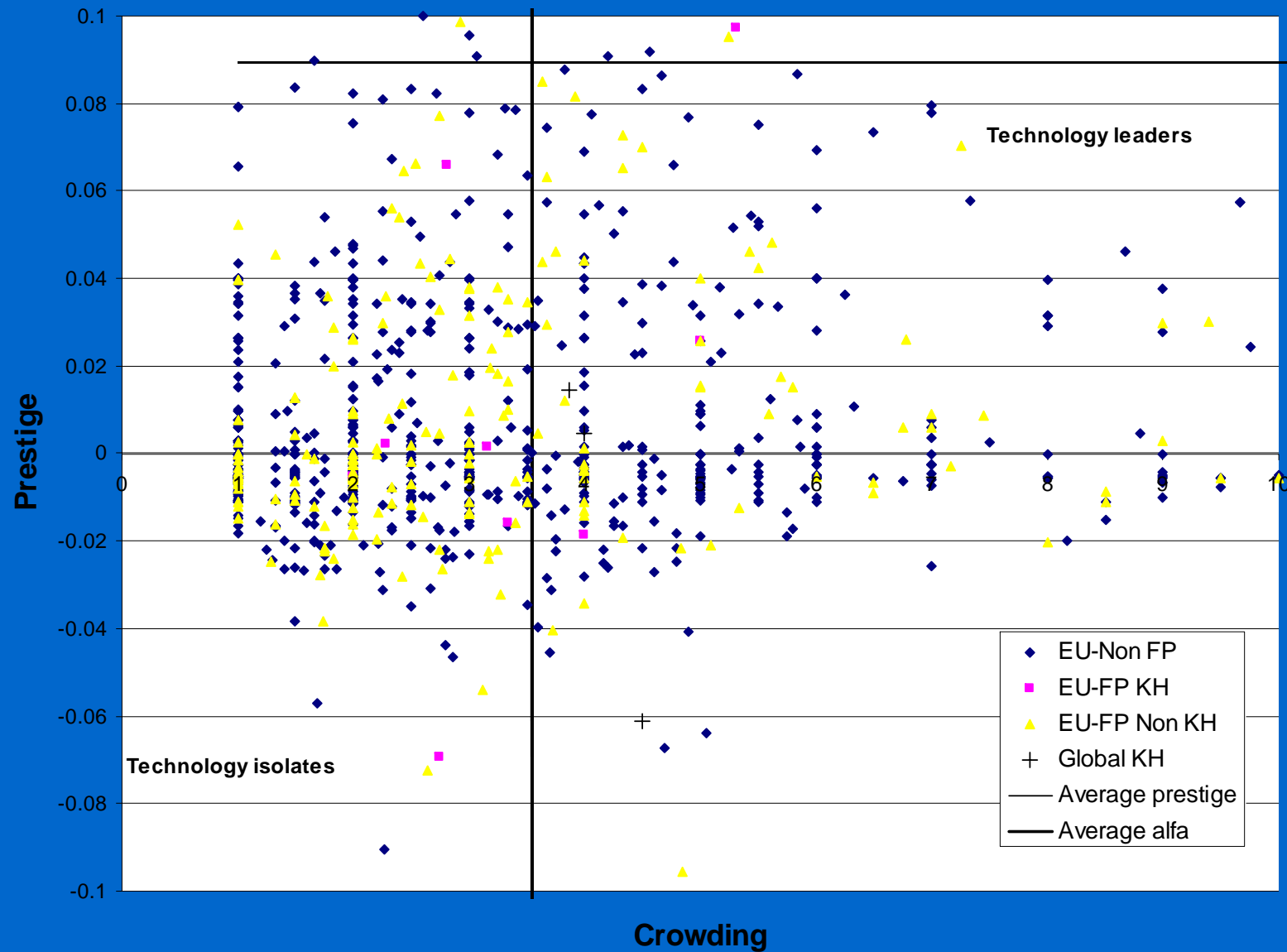


# Technology Leadership

- **Technology Followers:** they do not contribute significant spillovers to other organizations and engage into relatively mature and crowded technological subfields
- **Isolate Organisations:** they do not receive direct citations from many other organizations and are exploring relatively untapped technological subfields.



# Technology Leadership: Example



# Technology Leadership: Example

This analysis might suggest:

- The number of identified leaders and brokers that participate in the Framework Programme
- The number (and identity) of those who not only participate but they can also be characterized as Partnership HUBs in the Framework Programme.

