

**ICRIOS**

The Invernizzi Center for Research on Innovation,  
Organization, Strategy and Entrepreneurship



## **Knowledge-intensive entrepreneurship: going beyond the Schumpeterian entrepreneur**

**Franco Malerba**

**Roundtable: System Innovation Axes: University and Entrepreneurship**

**FAPESP, Sao Paulo, July 6, 2016**

I will talk about one of the System Innovation Axes:

## Knowledge-intensive Entrepreneurship

Why knowledge-intensive entrepreneurship  
and not knowledge-based entrepreneurship ?

Because knowledge-intensive entrepreneurship is more focussed.

Knowledge-based entrepreneurship is too broad and includes also knowledge and experience from previous activities, such as **spinoffs** (Klepper, 2001) and the role of the knowledge context such as **user-industry spinouts** (see Adams, Fontana and Malerba, 2016).



Knowledge-intensive entrepreneurship has become of paramount importance in the knowledge economy and can play a major role in innovation and growth of countries.

Existing research on entrepreneurship puts a lot of emphasis on the characteristics of the entrepreneur and the type of activity she/he conducts.

Instead, knowledge-intensive entrepreneurship puts a lot of emphasis on

- a) **knowledge** - related to science, technology and design and creative activities, and to education and advanced skills
- b) **the innovation systems** - that surround, support and interact with the entrepreneur.



More specifically, knowledge-intensive entrepreneurship refers to ***new learning organizations that generate new knowledge or use, transform or recombine existing knowledge and are problem solvers through innovation systems and knowledge networks***

Knowledge-intensive entrepreneurship ventures are different from **new technology based firms, new firms in high-technology sectors or fast-growing innovative firms.**

Today I will provide a general discussion on the role, the features and the challenges concerning knowledge-intensive entrepreneurship.

This presentation takes stock from the work done by many people.  
I want to mention four of them





# Knowledge-Intensive Entrepreneurship and Innovation Systems

Evidence from Europe

*Edited by*  
**Franco Malerba**



Routledge Studies in Global Competition



ROUTLEDGE STUDIES IN INNOVATION,  
ORGANIZATION AND TECHNOLOGY

# Dynamics of Knowledge- Intensive Entrepreneurship

Business strategy and public policy

Edited by Franco Malerba,  
Yannis Caloghirou,  
Maureen McKelvey and  
Slavo Radosevic





Elgar

EDITED BY

Franco Malerba, Sunil Mani  
and Pamela Adams

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# The Rise to Market Leadership

New Leading Firms  
from Emerging Countries





# TO DAY I WOULD LIKE TO DEVELOP THE FOLLOWING POINTS

- Why is Knowledge-intensive entrepreneurship conceptually and theoretically relevant ?
- How to implement empirically the notion of Knowledge-intensive entrepreneurship ?
- What do we empirically know about Knowledge-intensive entrepreneurship ?
- How relevant are innovation systems for Knowledge-intensive entrepreneurship ?
- Do differences in sectoral innovation systems matter for knowledge-intensive entrepreneurship ?
- Conclusions: The future research challenges
- The broad policy implications





# 1. Why is Knowledge-intensive entrepreneurship conceptually and theoretically relevant ?

# Knowledge-Intensive Entrepreneurship (KIE)

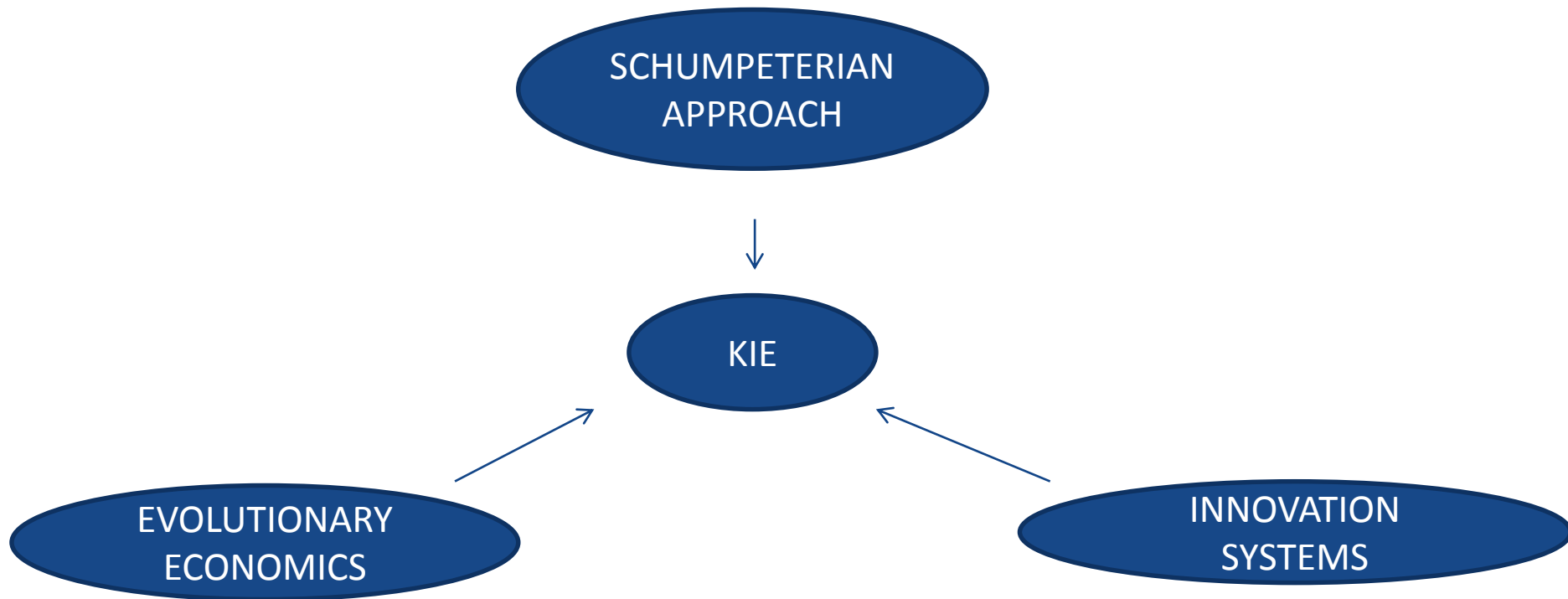
***KIE refers to new learning organizations that generate new knowledge or use, transform or recombine existing knowledge and are problem solvers through innovation systems and knowledge networks***



# Knowledge Intensive Entrepreneurship (KIE)

is the integration of three theoretical pillars

For a broader discussion see Malerba and McKelvey (2017)



# Pillar 1: Schumpeterian view of entrepreneur

*The Schumpeterian entrepreneur, creating opportunities through innovation, disrupts existing technologies and markets but also fosters economic development*

**Audretsch, Buenstorf, Feldman, Foster, Garnsey, Loasby, Metcalfe, McKelvey, Shane, Venkataraman**



# Pillar 1: Schumpeterian view of entrepreneur (2)

Carrying out new combinations

Facing uncertainty – and adapting to change

Taking risks but also reaping profits

Acting as a disruptive, dis-equilibrium force

Driving wider processes of innovation, economic development,  
which in turn can lead to creative destruction



# Pillar 1: Schumpeterian view of entrepreneur (3)

## The Schumpeterian entrepreneur

:

- Reacts in response to, and creates, opportunities
- Turns ideas into business
- Makes new combinations
- Innovates
- Takes risks
- Aims to obtain profit
- Puts in motion processes of creative destruction



## Pillar 2: Evolutionary economics

*An evolutionary economics understanding of the distinctive role of knowledge – specifically its creation, diffusion and use – in economic processes and co-evolution*

Nelson and Winter, Dosi, Canter, Klepper, Metcalfe, Murmann, Pyka, Witt





## Pillar 2: Evolutionary Economics (2)

KIE ventures are involved in the generation of new knowledge as well as in the use and transformation of existing one.

KIE activity takes place in knowledge regimes in terms of scientific and technological opportunities, cumulativeness of technology and characteristics of the knowledge base.

KIE ventures are young organizations with learning, routines and problem solving activities.



## Pillar 3: Innovation systems

*An innovation systems approach focuses upon relationships, networks, non-firm actors, and institutions*

Carlsson, Cooke, Edquist, Lundvall, Malerba, Nelson, Rosenberg



## Pillar 3: Innovation Systems (2)

KIE learning and problem solving take place not just through internal capabilities, but also through innovation systems and knowledge networks

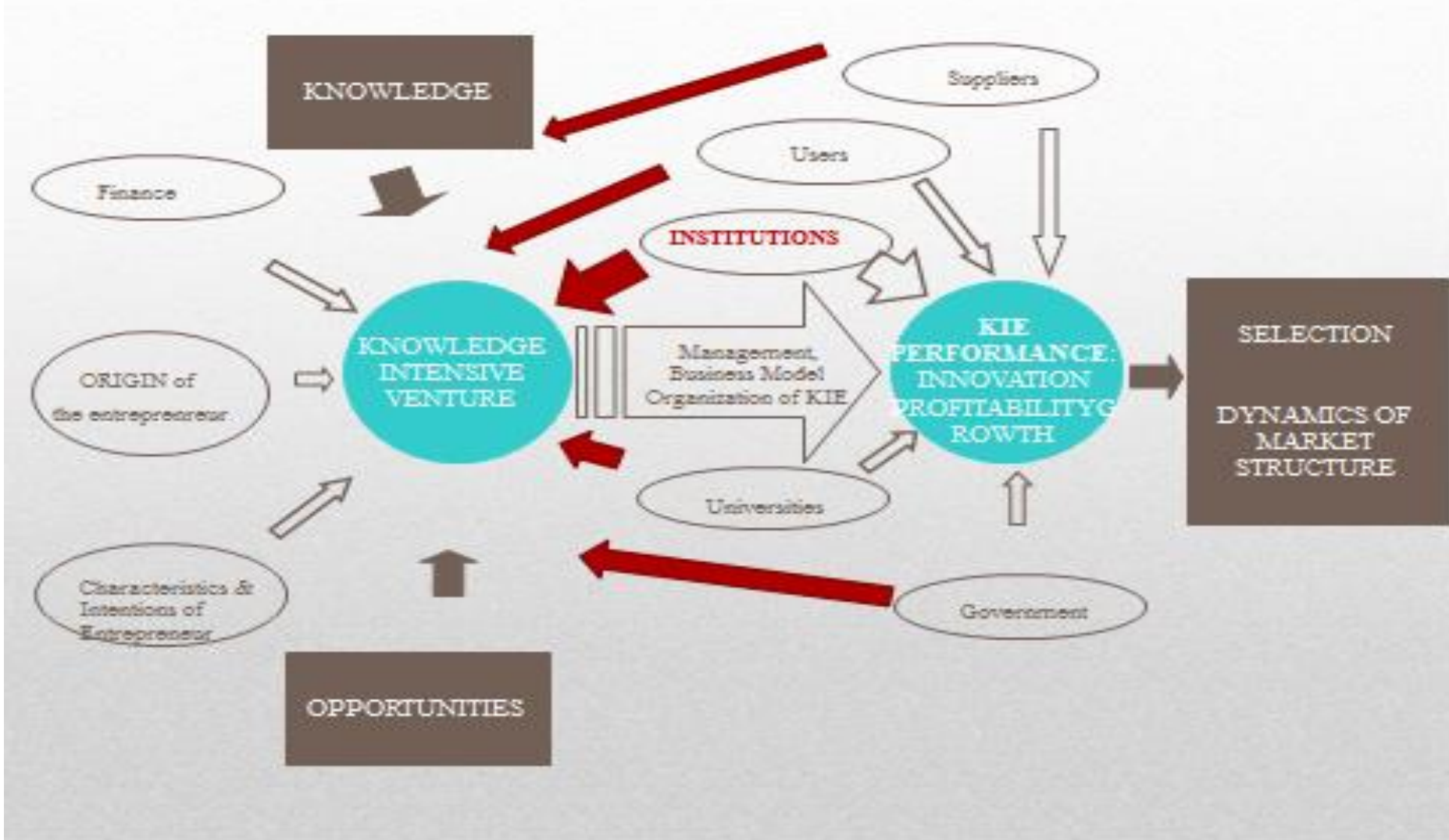
Knowledge networks provide KIE access to information, capabilities and solutions

Innovation systems and knowledge networks affect the generation of variety in products and technologies by KIE and the selection process in the market because they provide distinctive knowledge resources to KIE

Co-evolutionary processes take place between the knowledge by KIE, the innovation system and the knowledge context



# Visualization of the KIE process from Malerba and McKelvey (2017)





## 2. How to implement empirically the concept of knowledge-intensive entrepreneurship ?

## A definition useful for measuring KIE (taking the pillars discussed above into account)

*KIE are new independent firms that are innovative, have a significant knowledge intensity in their activity and exploit innovative opportunities in diverse evolving innovation systems.*



## Characteristic 1: New independent firms

A first key characteristic of the definition of KIE is that it represents new independent firms.

This excludes firms that have existed for a long period as well as corporate entrepreneurship, which occurs internally in an existing organization.



## Characteristic 2: Innovative

KIE must be innovative. Innovation can be categorized in many ways, ranging from product-process, to radical-incremental and service-product.

Thus, this characteristic excludes firms that sell standard goods and services or that only focus on traditional and established technologies.

Moreover, a profit motive has to be present in order to characterize KIE. It thus excludes categories like NGOs, lifestyle or hobby firms, and social entrepreneurship.





## Characteristic 3: Knowledge intensity

KIE needs to have a significant dimension of knowledge intensity in its activity.

Knowledge can come from many domains, including advanced science and technology but also market, design, creative and other types of knowledge.

A key aspect is the novelty of knowledge, as related to innovation. Thus, this characteristic excludes a firm which has a knowledge based on established technologies used without improvements or novel areas of applications.



## Characteristic 4: Exploiting innovative opportunities in innovation systems

These new ventures are exploiting innovative opportunities in innovation systems.

Opportunities may be driven by new sources of knowledge, the rapid development of (potential) markets or technologies or the combination of creative knowledge and design.

Opportunities emerge over time – and across countries and sectors.





### 3. What do we empirically know about knowledge-intensive entrepreneurship ?

# Extensive empirical evidence on KIE

**Books:** Malerba (2011), McKelvey and Lassen (2013a and 2013b), Malerba, Caloghirou, McKelvey and Radošević (2015), Hirsch-Kreinsen (2015)

**Survey:** Caloghirou et al., 2015

**Empirical analyses:** Countries, sectors and regions

**Case studies :** Eighty-six across sectors in EU countries



# Quantitative analyses based upon the database of the EU project AEGIS

4004 new firms in Europe surveyed in 2011

**Selected and primary matching to definitional criteria:** firms younger than 8 years old and independent, stratified sample by sector and country.

**Detailed survey questionnaire (CATI)** on origin, innovation, strategy, knowledge intensity, business model and organization of new firms



# MAIN RESULTS FROM THE AEGIS SURVEY (1)

Caloghirou, Protogerou and Tsakanikas (2015)

- Most of the new firms have less than 50 people
- 2 out of 3 firms have at least one employee with a university degree
- 5 out of 9 firms founders hold a university degree
- Technical knowledge and managerial skills are the most important expertise of the founders
- 43% of firms sell some products abroad



# MAIN RESULTS FROM THE AEGIS SURVEY (2)

- Quality as well as price competition is important
- Market risk and funding are the main barriers to survival and growth
- Relationship with customers, interacting with suppliers and recruiting skilled workers are the main networking activity
- 20% of firms participated in strategic alliances



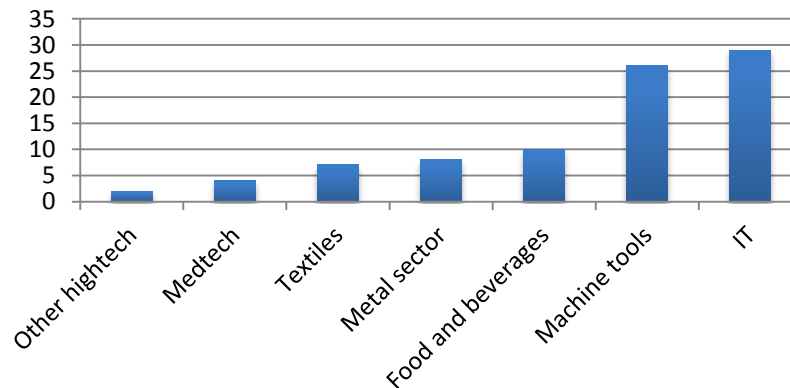
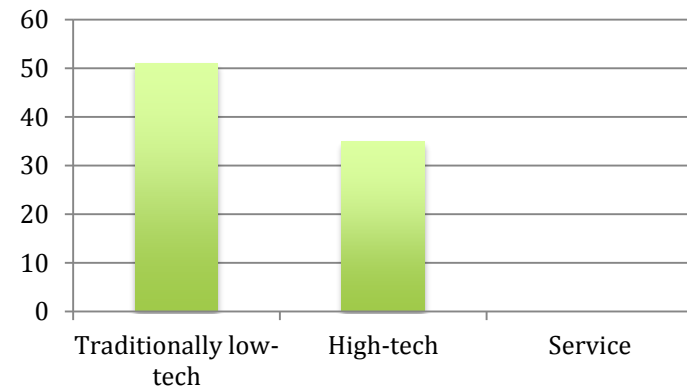
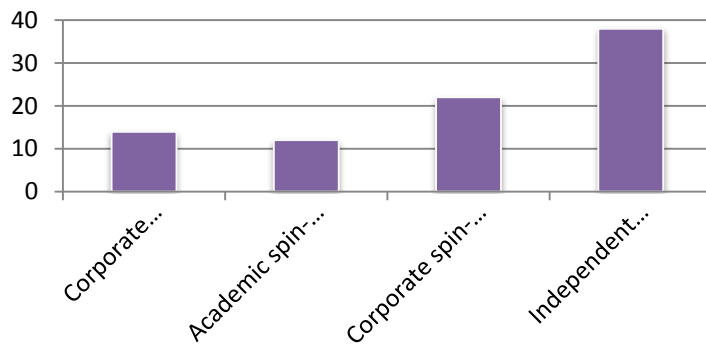
# MAIN RESULTS FROM THE AEGIS SURVEY (3)

- 2 out of 3 firms spend at least 1% of their sales on R&D
- 2 out of 3 firms have introduced product innovations
- Significant organizational innovation in 74% of firms
- Confidentiality agreements and lead times advantages are widely used
- Patents and copyrights are not





The survey results are confirmed in 86 case studies of KIE ventures from Malerba et al. (2015) and McKelvey et al. (2015).



# The 86 case studies confirms interesting patterns w.r.to

Phase 1: Accessing resources and ideas

Phase 2: Managing and developing the KIE  
venture

Phase 3: Evaluating performance and output



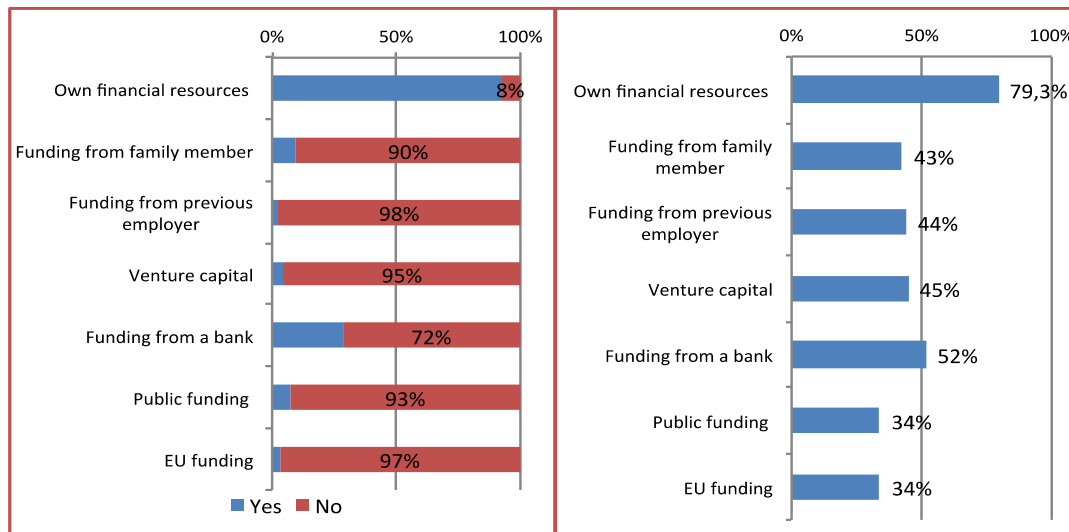
# Phase 1– accessing resources and ideas

- The characteristics of the entrepreneur affect affect the founding and the development of KIE
- Funding comes primarily from founder/family.
- If formal funding is present, it is accessed through networks



## Similar findings can be found in the AEGIS survey

Sources of funding for setting up a company → **on average 80% of funding came from the founders' own resources**



## Phase 2 - Networks

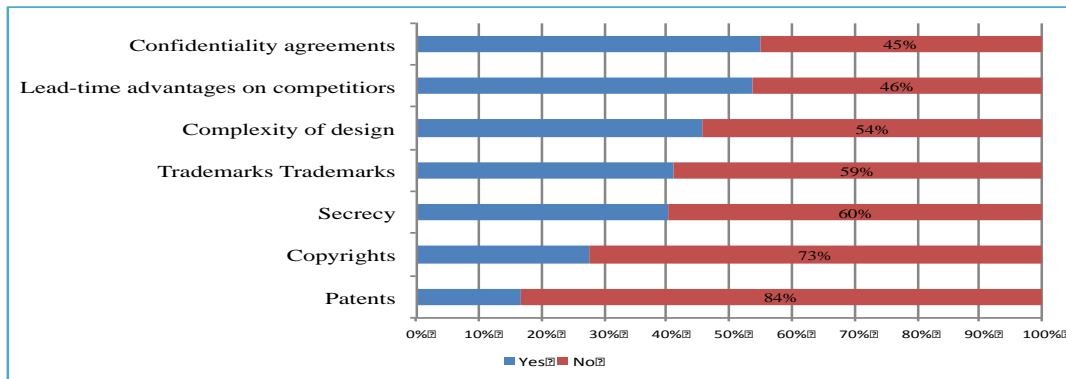
- In most cases customers are identified as the most important link
- The growth patterns are related primarily to internationalization and market expansion



# Phase 3: performance and output

- Patents are uncommon (only in 19 cases)
- Performance measures vary over time, following the KIE venture early growth and life cycle
- Same result in the AEGIS Survey

Firms use mainly informal ways to protect intellectual property rights





## 4. How relevant are innovation systems for knowledge-intensive entrepreneurship ?

Within the 4004 firms surveyed within AEGIS, in Malerba and McKelvey (2017) we divided new firms into KIE firms and non-KIE firms.

## QUESTIONS SELECTED

**Innovative firms (Q 27):** whether the company has introduced new or significantly improved goods or services during the past three years (Yes/no)

**Knowledge intensity: Education (Q 5):** whether the educational attainment of the founder was at least a bachelor degree or more

**Knowledge intensity: Skills (Q 8):** Whether the main areas of expertise of the founder(s) were technical and engineering or product design





We identify KIE as being innovative and having (1) education equal or greater than bachelor or (2) technical and engineering knowledge and product design skills

In terms of AEGIS firms:

Innovative firms: include 2548 AEGIS firms (Y/N indicator)

Education OR Technological and Design Skills firms: include 3858 AEGIS firms

The combination of these dimensions gives a total of 2454 KIE firms (out of 4004 AEGIS firms)

# The examination of the two groups of firms

KIE firms: 2454 firms

Non-KIE firms: 1550 firms



# **Finding 1: KIE ventures are distributed across sectors and across countries**

KIE ventures exist across all sectors – manufacturing, services, creative industries, high tech and low tech

KIE ventures are present in all the European countries considered

Therefore KIE do not just exist in high-tech sectors and in advanced countries



KIE	0	1	Total
Advertising	2.52	3.14	2.90
Aerospace	0.06	0.00	0.02
Architecture and Design	9.35	7.01	7.92
Basic Metals	0.65	0.86	0.77
Chemicals	0.97	1.47	1.27
Computer and related activities	10.00	14.79	12.94
Computed and office machinery	0.45	0.53	0.50
Metal Products	5.23	5.42	5.34
Food & Beverages	7.10	7.62	7.42
Labor recruitment	1.74	0.69	1.10
Paper & printing	15.23	15.57	15.43
Radio-television	0.58	1.06	0.87
Research	1.35	2.04	1.77
Business Services	23.68	18.95	20.78
Technical Testing	1.61	1.43	1.50
Telecommunications	0.52	0.65	0.60
Textile	5.61	4.97	5.22
Wood & furniture	6.52	5.38	5.82
Other	6.84	8.27	7.80
Total	100.00	100.00	100.00
<i>N</i>	1550	2454	4004

## **Finding 2:**

# **KIE firms are different from non-KIE firms: KIE ventures interact more with innovation systems**

KIE firms interact more with innovation systems than non-KIE firms

Measured in the Survey in two ways:

- Sources of knowledge (Question 24)
- Collaboration agreements (Question 26)

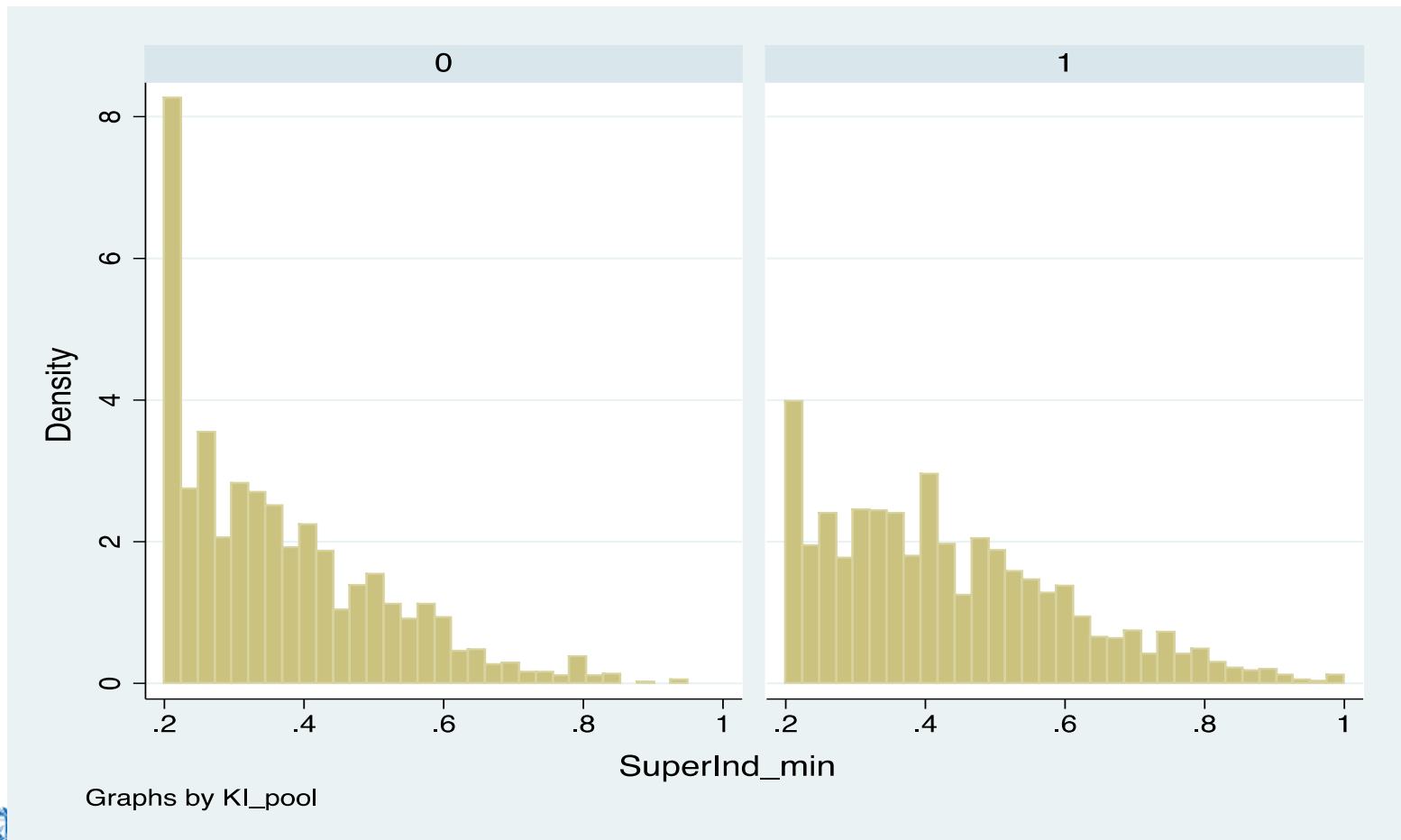


# SYNTHETIC INDICATOR

for questions 24 (4,5,6,11) and 26 (1,2,3)

Ranksum test: difference between KIE non KIE is significant at 1%

KIE =1



Graphs by KI\_pool



# Differences also exists between KIE and non-KIE if we look at specific sources of knowledge for innovation

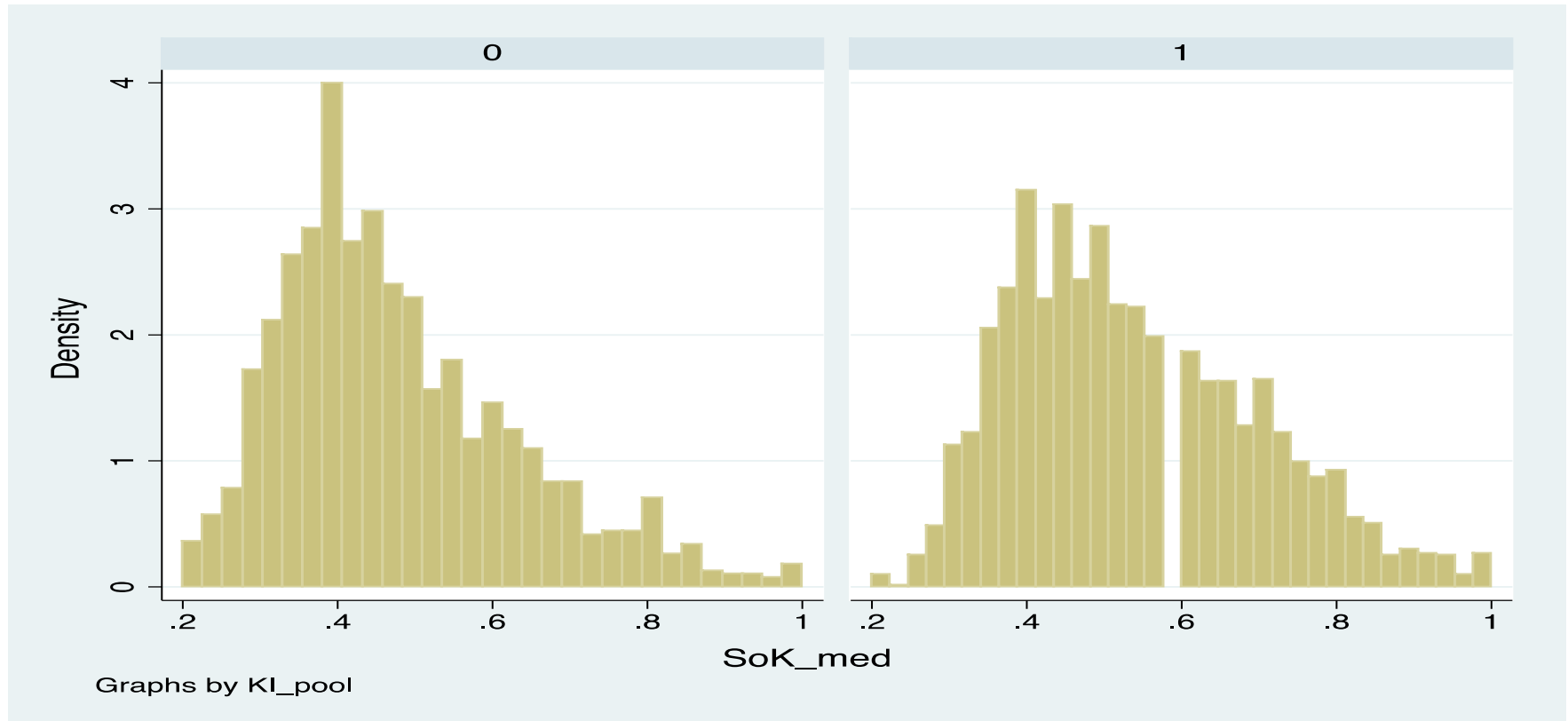
- Customers
- Suppliers
- PROs
- Universities
- External labs and R&D firms
- Participation in nationally funded research programs
- Participation in EU funded research programs



# INDICATOR Q24 (1,2,4,5,6,9,10,11)

Ranksum test: Difference between KIE and non KIE  
significant at 1%

KIE = 1





# **Finding 3: Sectoral and national differences exist in the way KIE firms relate to innovation systems**

KIE firms in different countries and in different sectors interact differently with the actors in the innovation systems

National innovation systems and sectoral innovation systems matter!



The results do not change if we use a more strict indicator of KIE or a broader indicator of KIE

### **A more strict indicator of KIE (SUPER-KIE)**

It includes answers: Firms that are Innovative (2548) & have Education AND technological AND design Skills (917)

Total: **643 firms**

### **A very broad indicator of KIE (BROAD-KIE)**

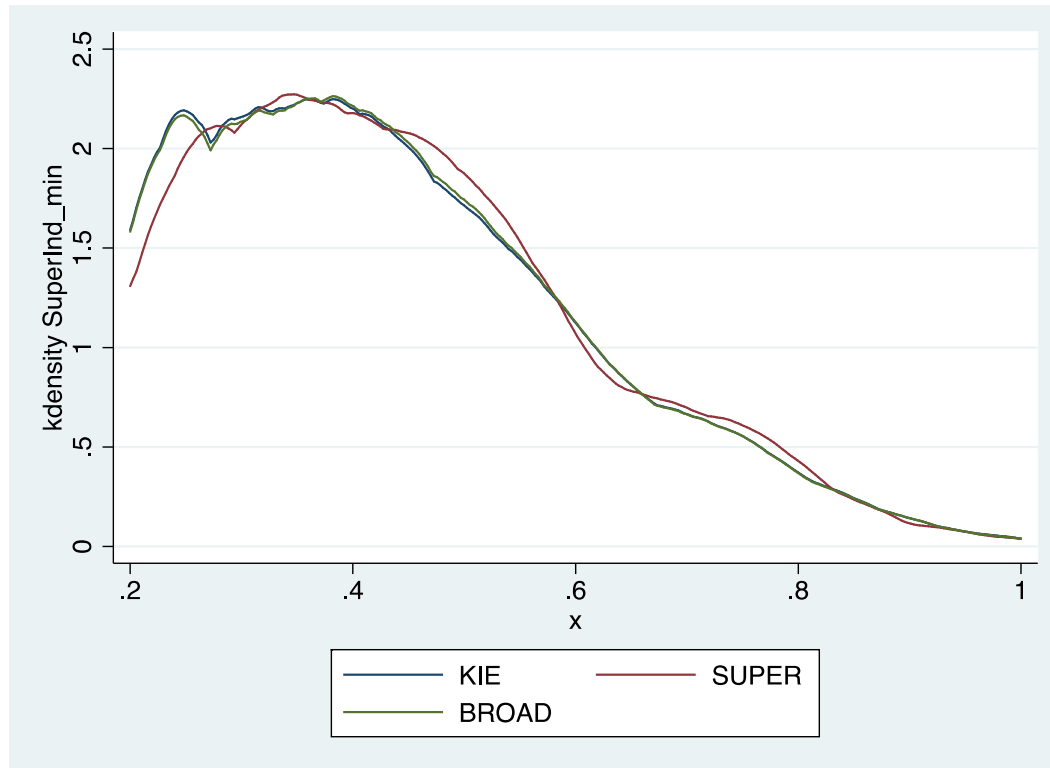
It includes answers: Firms that are innovative (2548) & have Education OR technological OR design Skills (3961)

Total: **2522 firms**

We report here differences across the three indicators

For more in-depth analysis see Malerba and McKelvey (2017)





Differences in the synthetic indicators (Q 24 and Q 26)

## Wrap up : KIE firms vs non-KIE firms

KIE ventures rely heavily upon knowledge networks related to innovation systems.

KIE links their internal capabilities to external search as accessed through sectoral, regional and national innovation systems.

KIE ventures are involved in the creation of diverse opportunities through innovation systems.





## 5. Do difference in sectoral systems matter for knowledge-intensive entrepreneurship ?

# A TAXONOMY OF SECTORAL SYSTEMS FOR KIE

One taxonomy is proposed in Fontana, Malerba and Marinoni (2015).

The analysis is based on data from the AEGIS survey of 4,004 newly established firms in 2001-2007 in 10 EU countries.



From the AEGIS survey KEY dimensions of sectoral systems are:

- knowledge and its sources
- benefits coming from relationships and networks
- type of participation in formal agreements
- instruments of IP protection.

On each question a **factor analysis** has been performed in order to pinpoint the main characteristics of the sectoral systems. The factors were extracted using the principal components method.

Then **profiles** of sectoral systems on the basis of the factors identified were created. Homogeneous groups were built with the purpose of minimizing the distance in scores of firms within a given cluster and maximizing the distance in scores among companies from different clusters.



# Constructing five profiles of sectoral systems

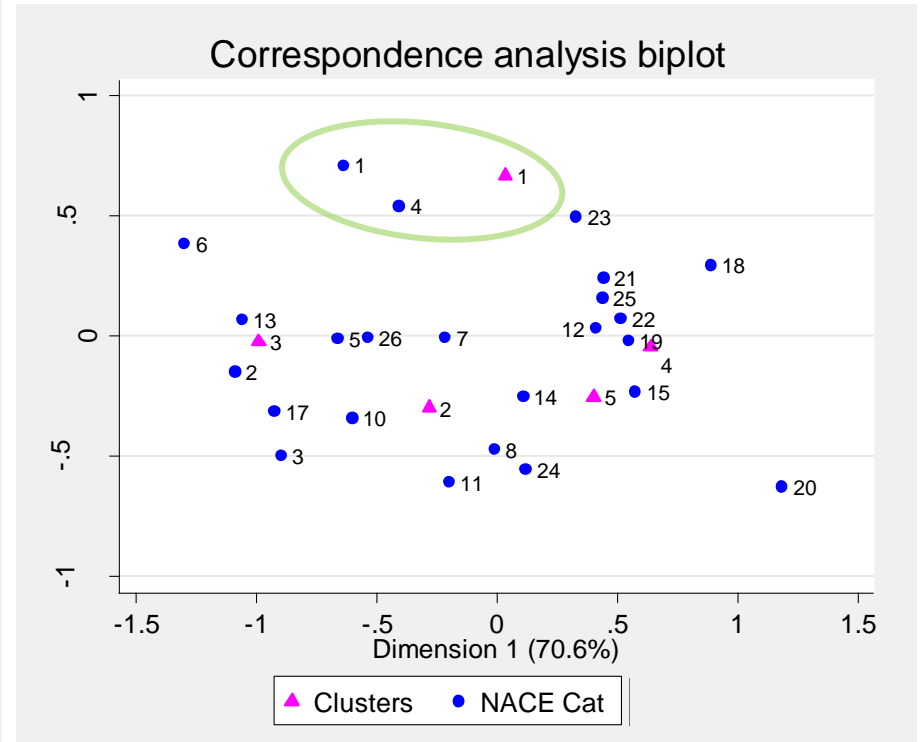
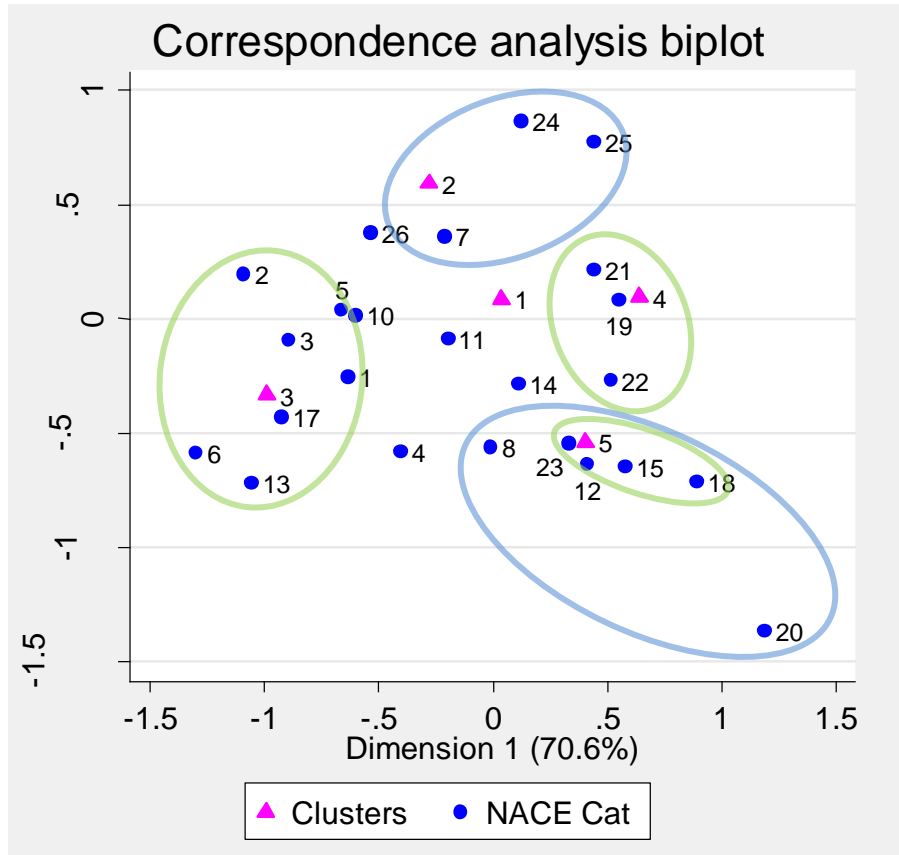
## Cluster Analysis on the factor scores

Questions	FACTORS	CLUSTERS				
		Diffused	Vertical Production assets	Vertical Complem. assets	Distributed Information Service	Distributed ST Knowledge
Sources of knowledge for business opportunity	Non mkt. and horizontal	-0.16	-0.52	0.35	-0.31	<b>1.43</b>
	Mkt. and vertical	-0.84	<b>0.56</b>	<b>0.58</b>	-0.21	0.03
	Events and publications	-0.13	-0.51	0.38	<b>0.67</b>	0.10
Benefits from ntw.	Ntw. to access complementary assets	-0.53	-0.37	<b>0.91</b>	-0.07	<b>0.94</b>
	Ntw. for production	-0.83	<b>0.92</b>	-0.14	<b>0.17</b>	-0.15
Types of formal agreements	Agreements for technological reasons	-0.51	-0.36	-0.09	<b>0.28</b>	<b>1.52</b>
Methods of IP protection	Tacit	-0.52	-0.31	-0.86	<b>0.95</b>	<b>0.49</b>
	Codified and formal	-0.09	-0.27	<b>0.48</b>	-0.31	<b>0.31</b>
	Informal	-0.38	-0.26	0.41	0.03	<b>0.24</b>

Note: Cells report the average factors score on the factors identified in the previous analysis; Columns identify the five profiles of sectoral systems resulting from the cluster analysis.



# Mapping profiles into industrial sectors



Cluster	Sector ID	NACE	Definition
<b>DIFFUSED</b>	1	15	Manufacture of food products and beverages
	4	19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
<b>VERTICAL / PRODUCTION ASSETS</b>	7	22	Publishing, printing and reproduction of recorded media
	24	74.4*	Advertising
	25	74.5*	Labour recruitment and provision of personnel
	26	74.8*	Call centers, photographic, graphic, secretarial activities
<b>VERTICAL / COMPLEM. ASSETS</b>	2	17	Manufacture of textiles
	3	18	Manufacture of wearing apparel; dressing and dyeing of fur
	5	20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
	6	21	Manufacture of pulp, paper and paper products
	10	28	Manufacture of fabricated metal products, except machinery and equipment
	11	29	Manufacture of machinery and equipment n.e.c.
	13	31	Manufacture of electrical machinery and apparatus n.e.c
<b>DISTRIBUTED INFORMATION</b>	17	36.1	Manufacture of furniture
	19	72*	Computer and related activities
	21	74.1*	Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holdings
	22	74.2*	Architectural and engineering activities and related technical consultancy
<b>DISTRIBUTE D ST KNOWLEDGE</b>	8	24	Manufacture of chemicals and chemical products
	12	30	Manufacture of office machinery and computers
	14	32	Manufacture of radio, television and communication equipment and apparatus
	15	33	Manufacture of medical, precision and optical instruments, watches and clocks
	16	35.3	Manufacture of aircraft and spacecraft
	18	64.2*	Telecommunications
	20	73*	Research and development
	23	74.3*	Technical testing and analysis



# A TAXONOMY

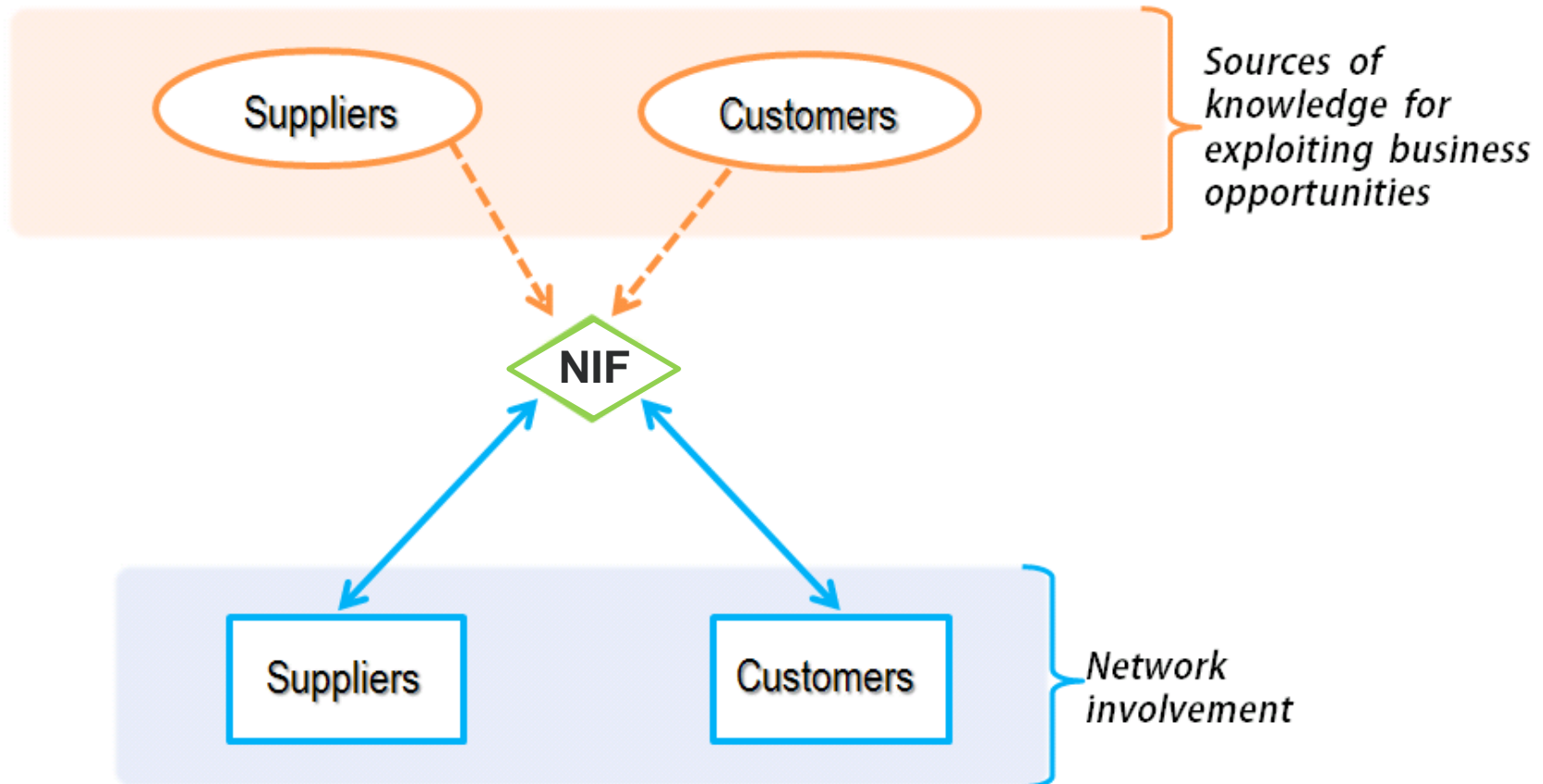
## 1. DIFFUSED SECTORAL SYSTEMS

High knowledge diffusion and atomistic structure  
Example: food, footwear, ...



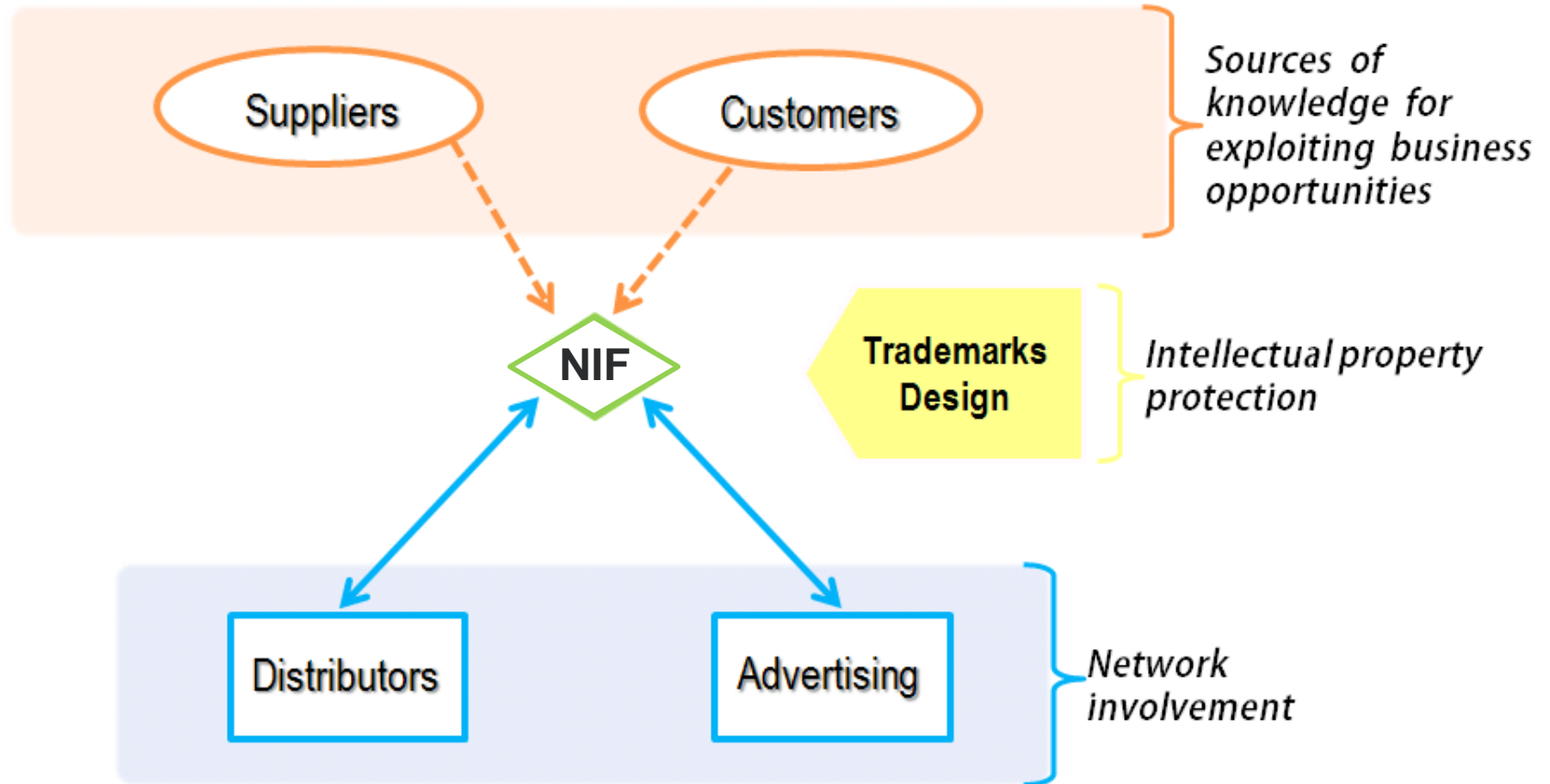
## 2. VERTICAL SERVICE BASED SECTORAL SYSTEMS

Vertical knowledge sources and vertical production networks:  
advertising, publishing, other traditional services



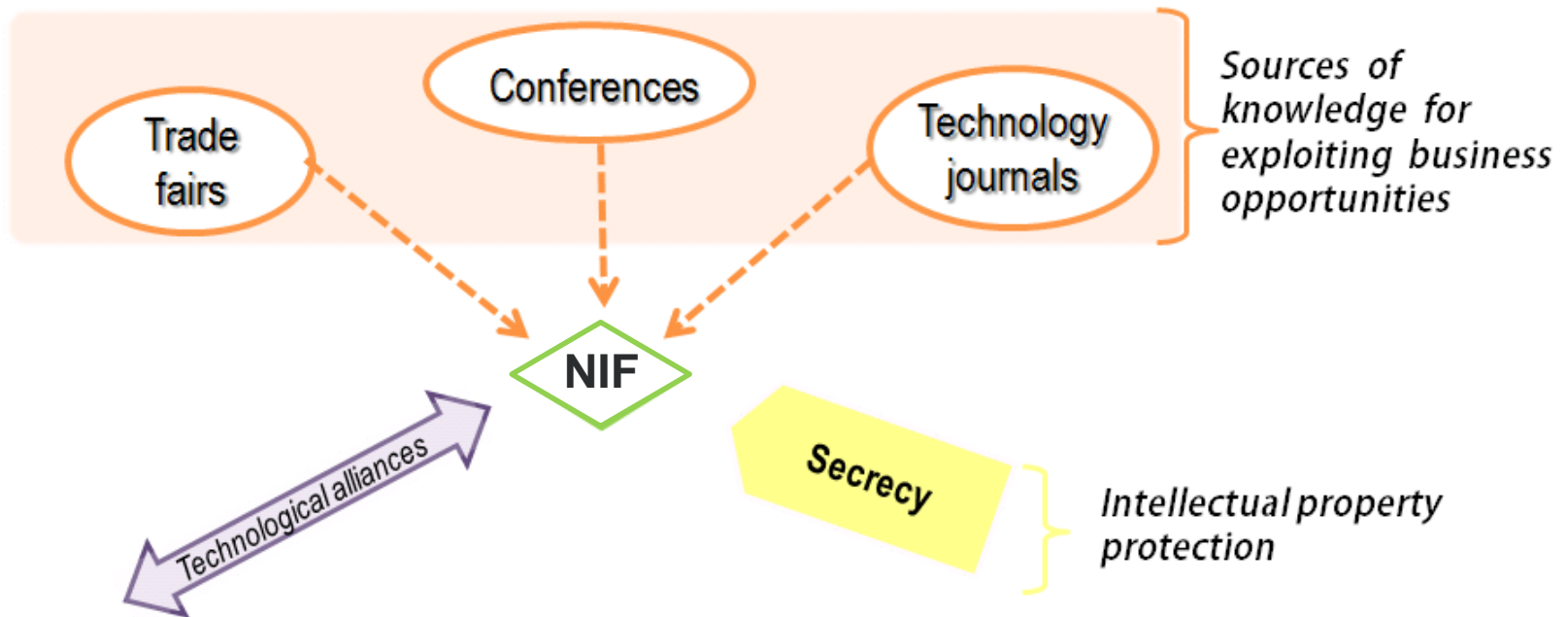
### 3. VERTICAL MANUFACTURING BASED SECTORAL SYSTEMS

Vertical knowledge sources and vertical complementary assets networks:  
machinery and manufacturing



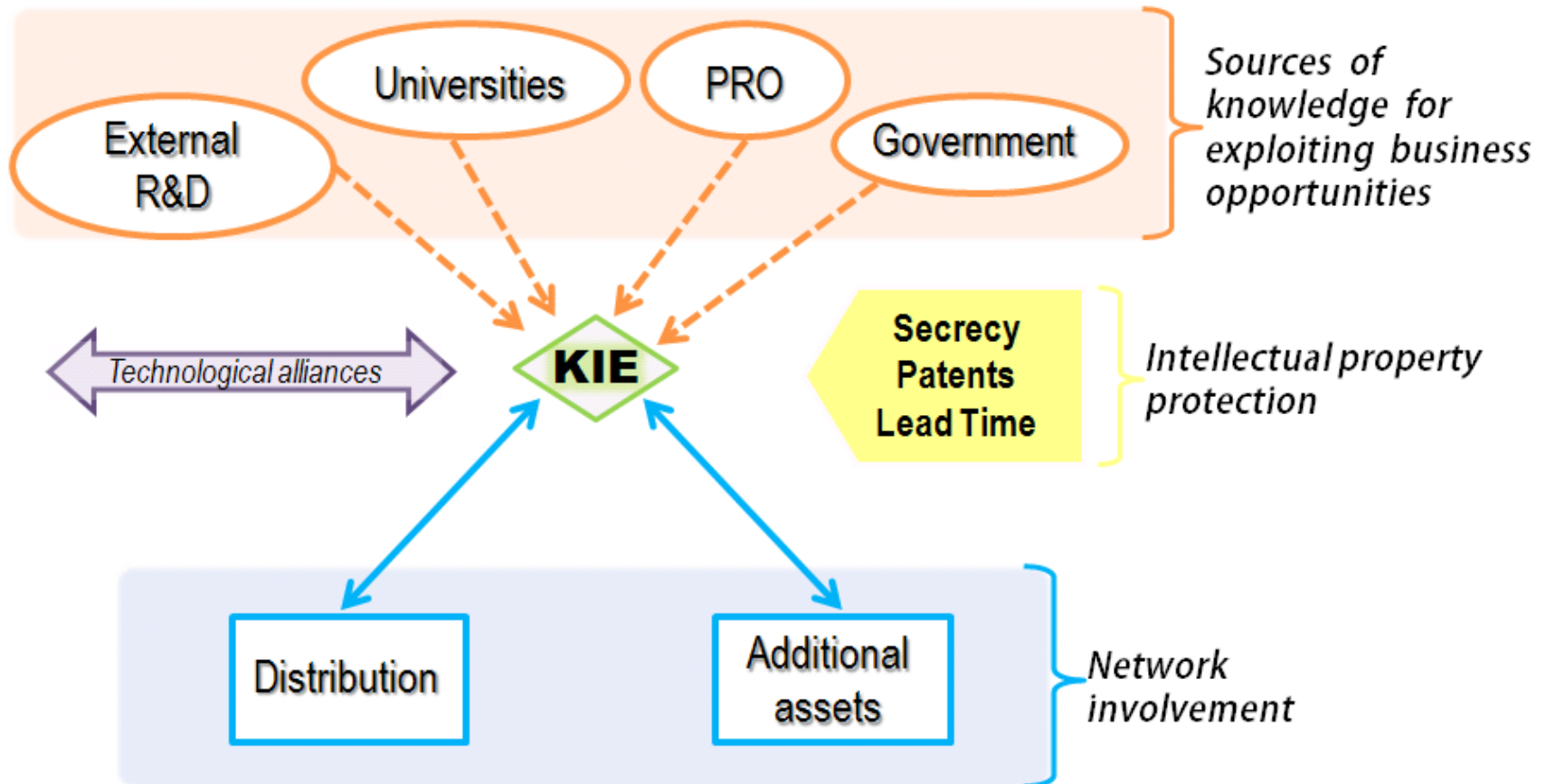
## 4. DISTRIBUTED INFORMATION-BASED      **SECTORAL SYSTEMS**

Distributed ICT problem solving services: KIBS



## 5. DISTRIBUTED KNOWLEDGE , SCIENCE AND TECHNOLOGY BASED SECTORAL SYSTEMS

Wide knowledge sources S&T based and complementary asset networks  
pharma, telecom





## 6. Future research challenges



# Future research agenda

- Link KIE to the process of economic development, economic growth and catching-up in specific countries – Brazil, Mexico, China, India and so on.
- Specify how co-evolution occurs between KIE ventures and innovation systems at the national, regional and sectoral levels
- Explore in depth the processes of knowledge generation and transformation by KIE – through internal capabilities and external networks
- Analyze how these knowledge processes of KIEs in turn affect opportunity recognition as well as KIE innovative performance





## 7. Very broad Implications for public policy

# Implications for public policy

## Finding 1:

KIE ventures are affected by innovation systems. Innovation systems are composed by many actors and several feedbacks and dynamic interactions

### Policy implications:

Not just one policy, but systems of policies, are needed to foster the formation, survival and growth of KIE.

Coordination among these policies is necessary.



# Implications for public policy (2)

## Finding 2:

The process of KIE development undergoes various stages, in which the relationship with innovation system may change

### Policy implications:

Policy needs to take into consideration the different roles of innovation systems in the origin/formation stage of KIE and in the subsequent stage of development and growth.

Policy measures may differ drastically among stages.



# Implications for public policy (3)

## Finding 3:

The interaction of the KIE ventures with innovation systems means that innovative opportunities are dynamically created in specific external contexts. But this relationship may greatly differ depending on the type of innovation system.

## Policy implications:

Policy needs to take into account differences in innovation systems.

Policies have to be aware of these differences. For example the features and effects of sectoral systems in high technology industries differ drastically from the features and effects of sectoral systems in low tech industries.



# Implications for public policy (4)

## Finding 4:

KIE ventures have internal capabilities, which link advanced knowledge (design, technology, science) to commercialization

### Policy implication:

Support education and skills development.

This means also that revitalizing industrial dynamism is possible in the so-called 'low tech' industries through the support of education and skill development



# Implications for public policy (5)

## Finding 5:

The relationships with the various actors and the institutional context of an innovation system influence the probability of growth and performance of KIE

## Policy implication:

Favor interactions and networks with customers, universities, venture capital and other elements of the innovation systems



# Knowledge-Intensive Entrepreneurship (KIE)

