

# Innovation- Exploring the knowledge base

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Presenter :  
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# Outline

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- S-curve in research?
- Cluster method?
- Apply to more filed
- (entertrip..)

# Highlights

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- Develops a **new method for researching interdisciplinary scientific fields** that takes into account books as well as journal articles.
- Identifies **the core publications, contributors** and research institution in innovation studies.
- Analyses the **changing character** of the innovation literature and its users over time.
- Shows that **most central works on innovation**, as identified by experts in the field, are published in books rather than in journals.

# The Authors



**Jan Fagerberg**

- Born on 1951 (age 65)
- Professor at the University of Oslo (TIK) , Norway & Ålborg University & Lund University
- Graduated from University of Bergen (economics) in 1980
- D. Phil. from the University of Sussex in 1989



**Morten Fosaas**

PhD, University of Oslo



**Koson Sapprasert**

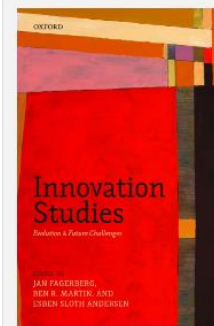
Research Fellow ,University of Oslo



The Triple Challenge for Europe, 2015



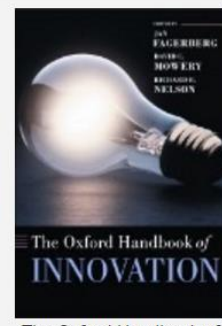
Innovation, Technology and Economic Change, 2015



Innovation Studies Evolution and Future Challenges, 2013



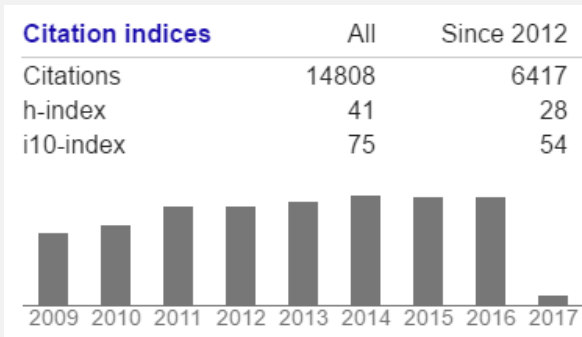
Innovation, Path Dependency and Policy, 2009



The Oxford Handbook of Innovation, 2005

# The Author – Jan Fagerberg

- 2003 • **Schumpeter** and the revival of evolutionary **economics**: an appraisal of the literature
- 2004 • **Innovation: A guide to the Literature**
- 2007 • The Competitiveness of Nations: Why Some Countries Prosper While Others Fall Behind?
- 2008 • **National Innovation systems**, capabilities and economic development
- 2009 • The evolution of **Norway's** national innovation system
- 2010 • The changing global economic landscape: the factors that matter
  - Innovation and Economic Development.
  - Christopher Freeman: Social science entrepreneur
- 2011 • **Innovation: Exploring the knowledge base (cited by 198)**
- 2012 • Technological Dynamics and **Social Capability**: US States and European Nations
- 2014 • The Triple Challenge for **Europe**: Economic Development
- 2015 • One Europe or Several? Causes and Consequences of the European Stagnation
- 2016 • The Triple Challenge for Europe: The Economy, Climate Change, and Governance, Challenge
  - **Innovation Systems and Policy**: A Tale of Three Countries
  - Innovation Policy: Rationales, Lessons and Challenges, Journal of Economic Surveys
  - **Global dynamics**, capabilities and the crisis



Field : The innovation of studies/policy/economics  
<http://www.janfagerberg.org/>  
(videos)

# Definition

- **“Innovation studies”**—The scholarly study of how innovation takes place and what the important explanatory factors and economic and social consequences are.
- Schumpeter: Dynamic force that causes continuous transformation of social, institutional and economic structures.
- Innovation as “new combinations” of existing knowledge and resources; the distinction between invention (new ideas) and innovation (implementing these in practice); the classification of innovations into product, process and organizational innovation and the keen interest in how radical their social and economic impacts are
- **“Knowledge base”** — a collection of information about a particular subject (according to Cambridge Dictionary)

# The Background

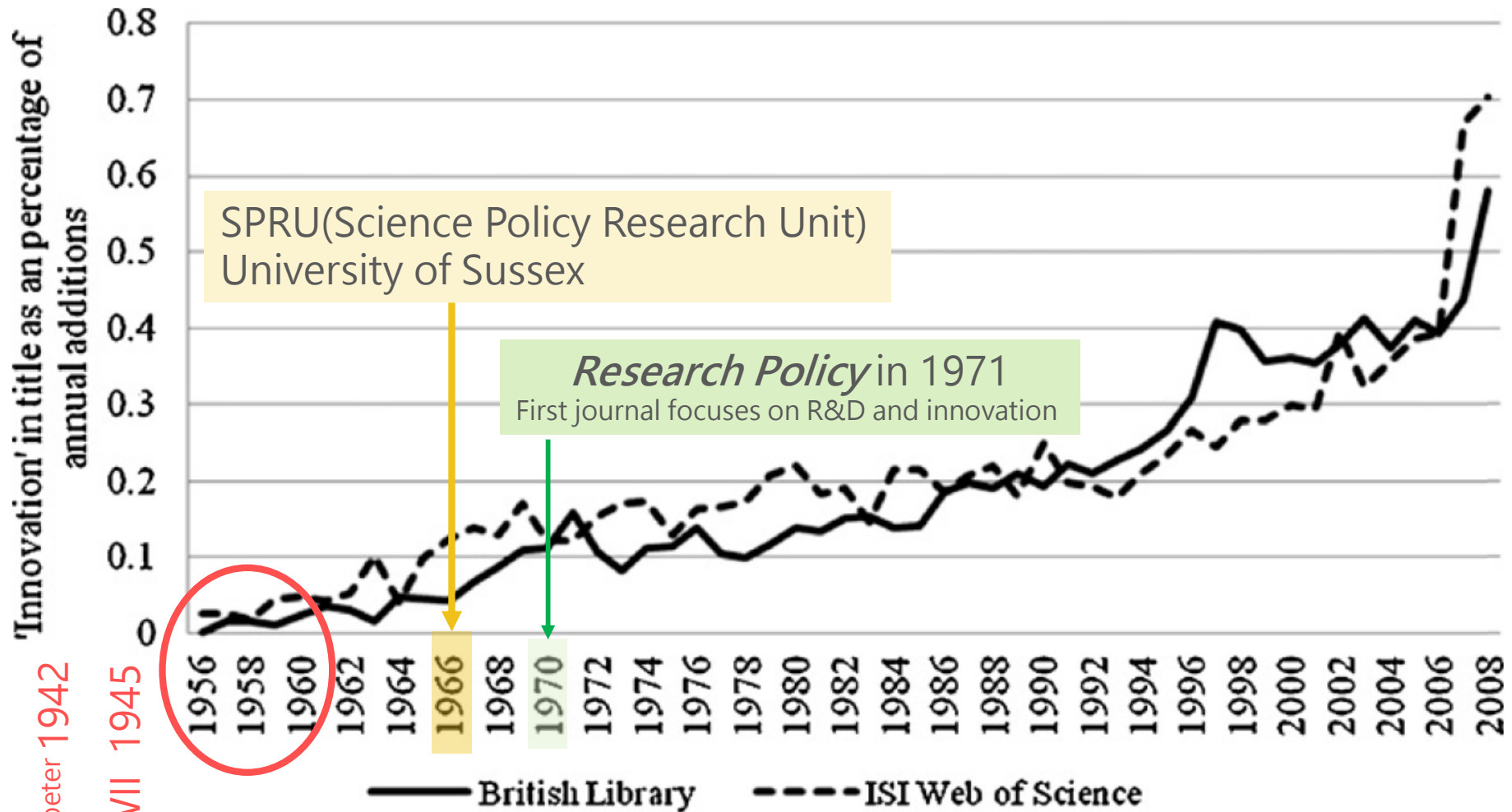


Fig. 1. Growth of the literature on innovation.

Schumpeter 1942

WWII 1945

New scientific fields continue to emerge, within and across existing disciplines. What's the "processes" of "innovation studies" knowledge base ?

- What's the **core literature** on innovation?
- Who are the **core contributions** ? (authors/environments)
- Who are the **users** of this literature?
- What's the **structure** of the knowledge base?
- What's the **changing character** over time?
- What's the possible **challenges** for its continuing development?



### Data base

1. Scrutinize 11 **handbooks** (277 chapters, 21,313 references).
2. Avoid the repeat count : Clean the references / Chose the first edition of same book.
3. Avoid the occasionally cited : Cited in at least three different handbooks.
4. Provide a fairer comparison: J-index (>3.25)

$$J = \frac{A \times 100}{M}$$

(A : Actual number of citations)  
(M : maximum citations = 277)

## Sensitivity Analysis

### Considering:

- The quality of the editorial work may vary.
- The different orientations of the handbooks.

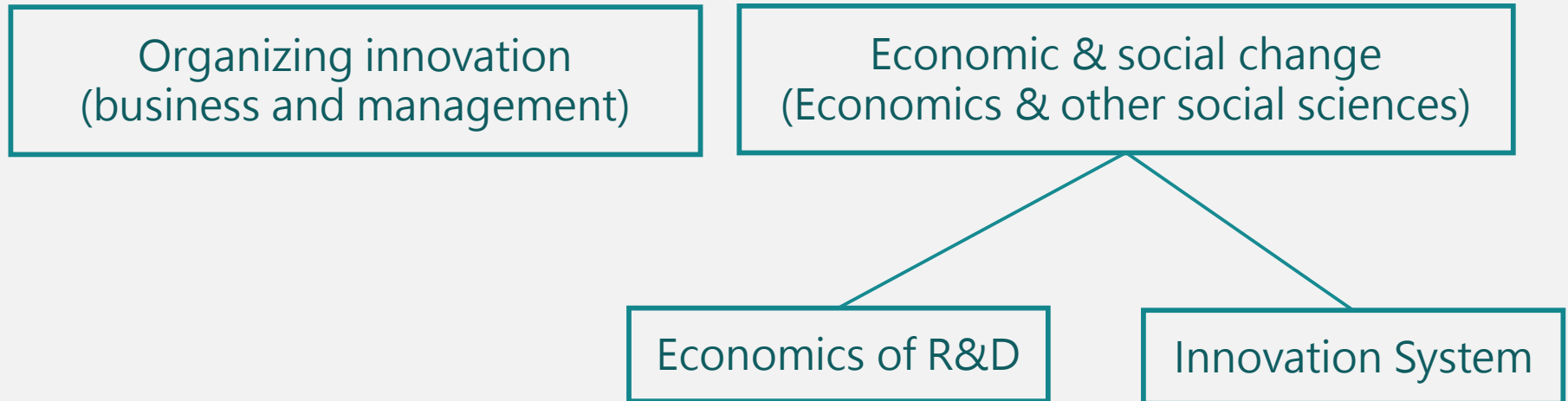
### Hence:

- The core knowledge should be cited by at least 3 different handbooks.
- Conduct Three robustness tests (強度檢驗):
  - 1) Recalculate J-index
  - 2) The handbooks were removed one by one and recalculated the J-indexes rankings
  - 3) Move the handbooks published during the 1990s

## Cluster method (集群分析)

Exploratory tool that sorts similar objects into groups (clusters)

1. The same type of characteristic
2. They have similar users



# Reference works (handbooks)

Name of author/(year)	Title	Thematic orientation	Publisher	Chapters (references)
Cozijnsen and Vrakking (1993)	Handbook of Innovation Management	Management/Organisation	Blackwell	9 (280)
Dodgson and Rothwell (1994)	Handbook of Industrial Innovation	General/Industrial	Elgar	35 (1247)
Stoneman (1995)	Handbook of the Economics of Innovation and Technological Change	Economics of Innovation	Blackwell	13 (1630)
Shavinina (2003)	International Handbook on Innovation	General/Industrial	Elsevier	71 (4303)
Fagerberg et al. (2004)	The Oxford Handbook of Innovation	General/Industrial	Oxford	22 (1688)
Poole and Van de Ven (2004)	Handbook of Organisational Change and Innovation	Management/Organisation	Oxford	13 (1958)
Karlsson (2008)	Handbook of Research on Innovation And Clusters	Geography & Development	Elgar	24 (1465)
Shane (2008)	Handbook of Technology and Innovation Management	Management/Organisation	Wiley	16 (1494)
Lundvall et al. (2009)	Handbook of Innovation Systems and Developing Countries	Geography & Development	Elgar	13 (974)
Hall and Rosenberg (2010)	Handbook of the Economics of Innovation	Economics of Innovation	Elsevier	29 (4518)
Gallouj and Djellal (2010)	The Handbook of Innovation and Services	General/Industrial	Elgar	32 (1756)

Broad and balanced representation:

Fairly general orientation

Organization and management

Economics of innovation

Innovation in services and development

# Top 20 contributions

## Topics and approaches

J-index: In the innovation field  
Citations: in the world of science field (Web of science)

No	Author	Country	Title	Type	Year	J-index	Citations (ISI/Year)
1	Nelson R & Winter S	USA	An Evolutionary Theory of Economic Change	Book	1982	18.8	165.0
2	Nelson RR	USA	National Innovation Systems	Book	1993	15.7	61.0
3	Porter ME	USA	The Competitive Advantage of Nations	Book	1990	14.4	166.9
4	Schumpeter JA	Austria/USA	The Theory of Economic Development	Book	1912/1934	14.1	39.5
5	Rogers EM	USA	Diffusion of Innovations	Book	1962	14.1	204.3
6	Lundvall B-Å	Denmark	National Innovation Systems–Towards a Theory of Innovation and Interactive Learning	Book	1992	13.4	59.3
7	Freeman C	UK	The Economics of Industrial Innovation	Book	1974	12.6	30.4
8	Cohen W& Levinthal D	USA	Absorptive Capacity	Article	1990	11.9	124.3
9	Pavitt K	UK	Sectoral Patterns of Technical Change	Article	1984	11.6	23.2
10	Arrow K	USA	Economic Welfare and Allocation of Resources for Invention	Book Chapter	1962	10.5	26.0
11	Saxenian A	USA	Regional Advantage:	Book	1994	9.9	87.3
12	Freeman C	UK	Technology Policy and Economic Performance: Lessons from Japan	Book	1987	9.7	20.2
13	von Hippel E	USA	The Sources of Innovation	Book	1988	9.7	52.6
14	Christensen C	USA	The Innovator's Dilemma	Book	1997	9.5	88.4
15	Teece DJ	USA	Profiting From Technological Innovation	Article	1986	9.4	46.5
16	Kline S & Rosenberg N	USA	An Overview of Innovation	Book Chapter	1986	9.4	15.0
17	Henderson R & Clark K	USA	Architectural Innovation	Article	1990	9.4	49.2
18	Rosenberg N	USA	Inside the Black Box	Book	1982	9.0	37.1
19	Schumpeter JA	USA	Capitalism, Socialism and Democracy	Book	1942	7.9	64.0
20	Tidd J; Bessant J; Pavitt K	UK	Managing Innovation	Book	1997	7.7	40.3

**Theoretical** : Schumpeterian: (4) · Firm level: (1) (8)

**Application**: Various factors (e.g. country's innovation and performance): (2) (3) (6) (12)  
Taxonomy of innovation in different sectors and industries (9) (17)

**Overviews**: Synthetic interpretations : (5) (7) (14) (20)

# Top 20 contributors

Rank	Authors	Affiliation(s)	No of works in core	Country	Total J-index	Total ISI/yea
1	Nelson R	Columbia/Yale/RAND	7	USA	37.6	175.3
2	Freeman C	SPRU	8	UK	35.5	88.0
3	Rosenberg N	Stanford	8	USA	33.4	95.9
4	Schumpeter JA	Harvard/Graz	3	USA/ Austria	27.4	160.4
5	Porter M	Harvard	3	USA	24.9	352.7
6	Griliches Z	Harvard	5	USA	24.2	93.7
7	Von Hippel E	MIT	3	USA	20.2	54.3
8	Lundvall B-Å	Aalborg/OECD	2	Denmark/France	19.1	76.9
9	Pavitt K	SPRU	3	UK	15.5	44.5
10	Chandler AD	Harvard	3	USA	14.8	182.3
11	Rogers EM	Ohio State Univ.	1	USA	14.1	204.3
12	Teece DJ	Berkeley	3	USA	12.8	97.4
13	Winter S	Yale	3	USA	12.5	96.9
14	Cohen W	Carnegie Mellon	4	USA	12.4	96.5
15	Romer P	Yale	2	USA	12.3	182.3
16	Dosi G	SPRU	4	UK	11.9	69.3
17	Arrow K	Stanford	1	USA	10.5	26.0
18	Jaffe A	Harvard	3	USA	10.3	54.5
19	Saxenian A	Berkeley	1	USA	9.9	87.3
20	Mansfield E	Pennsylvania	3	USA	9.9	29.6

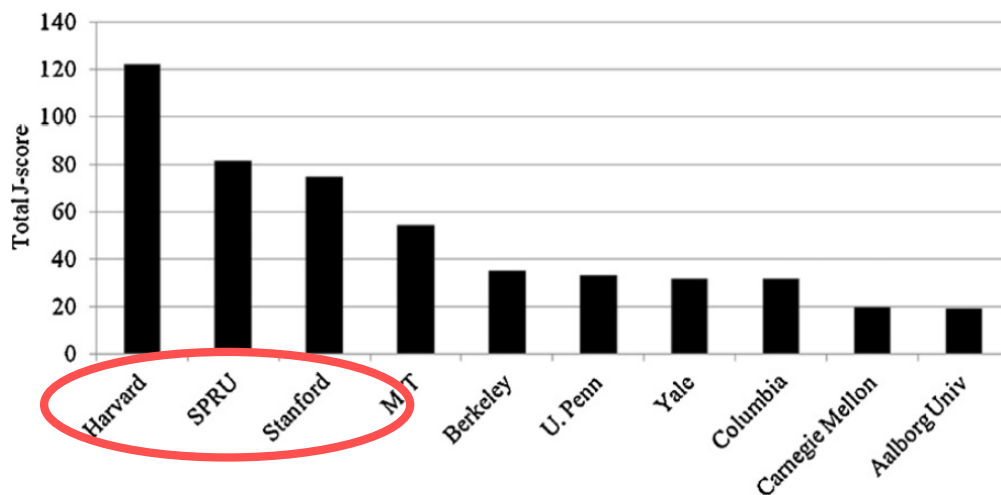


Fig. 2. Top 10 research environments, 1950-2008.

Country	Contributor	%
USA	13	65%
European	4	20%
UK	3	15%

# Knowledge users: Top 20 journals

Literature

Rank	Journal	Per cent Cumulative	Subject-area(s)	% Cumulative	Subject-area(s)
1	RESEARCH POLICY	3.4	3.4	Management; Planning & Development	
2	STRATEGIC MANAGEMENT JOURNAL	2.4	5.8	Business; Management	
3	INTERNATIONAL JOURNAL OF TECHNOLOGY MANAGEMENT	1.3	7.1	Engineering, Multidisciplinary; Management; Operations Research & Management Science	
4	ACADEMY OF MANAGEMENT REVIEW	1.3	8.4	Business; Management	
5	JOURNAL OF MANAGEMENT STUDIES	1.2	9.6	Business; Management	
6	ORGANIZATION SCIENCE	1.2	10.7	Management	
7	ACADEMY OF MANAGEMENT JOURNAL	1.1	11.9	Business; Management	
8	TECHNOVATION	1.1	13.0	Engineering, Industrial; Management; Operations Research & Management Science	
9	ADMINISTRATIVE SCIENCE QUARTERLY	1.1	14.0	Business; Management	
10	ORGANIZATION STUDIES	1.0	15.0	Management	
11	REGIONAL STUDIES	0.9	16.0	Environmental Studies; Geography	
12	TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	0.9	16.9	Business; Planning & Development	
13	MANAGEMENT SCIENCE	0.9	17.7	Management; Operations Research & Management Science	
14	R & D MANAGEMENT	0.8	18.5	Business; Management	
15	INDUSTRIAL AND CORPORATE CHANGE	0.7	19.2	Business; Economics; Management	
16	TECHNOLOGY ANALYSIS & STRATEGIC MANAGEMENT	0.7	19.9	Management; Multidisciplinary Sciences	
17	HUMAN RELATIONS	0.6	20.5	Management; Social Sciences, Interdisciplinary	
18	SMALL BUSINESS ECONOMICS	0.6	21.2	Business; Economics	
19	JOURNAL OF INTERNATIONAL BUSINESS STUDIES	0.6	21.8	Business; Management	
20	CAMBRIDGE JOURNAL OF ECONOMICS	0.6	22.4	Economics	

Management and business studies are very important  
It also Includes regional issues, economics journal.

Aggregated into 10 groups : Social sciences and humanities ; Management ; Economics ; Business ; Engineering ; Information and computer Science ; Planning & development ; Geography and Environment ; Health ; Political Science

# Knowledge users : Orientation/Specialisation

Literature

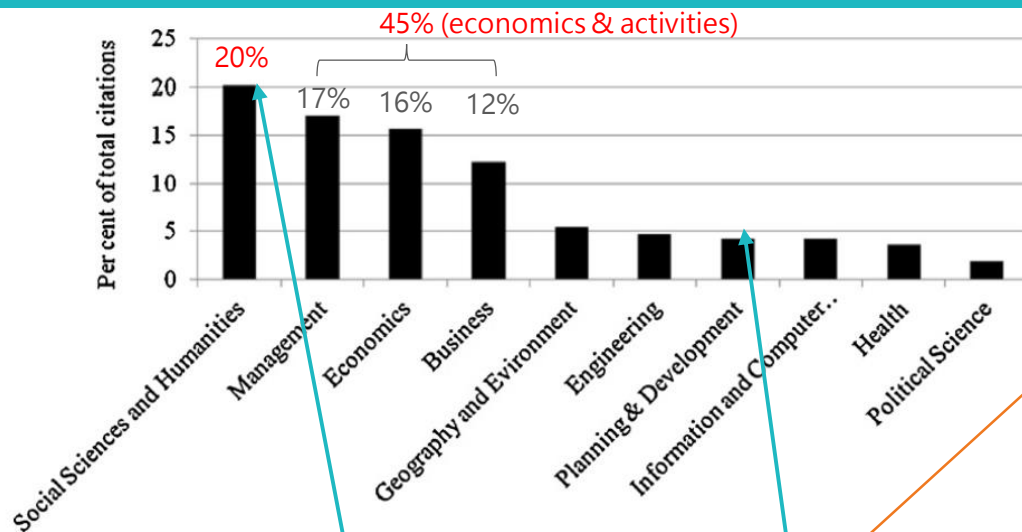


Fig. 3. Knowledge users: Disciplinary orientation (Top 10 subject-areas).

90% of the total citations to the core literature in the Web of Science

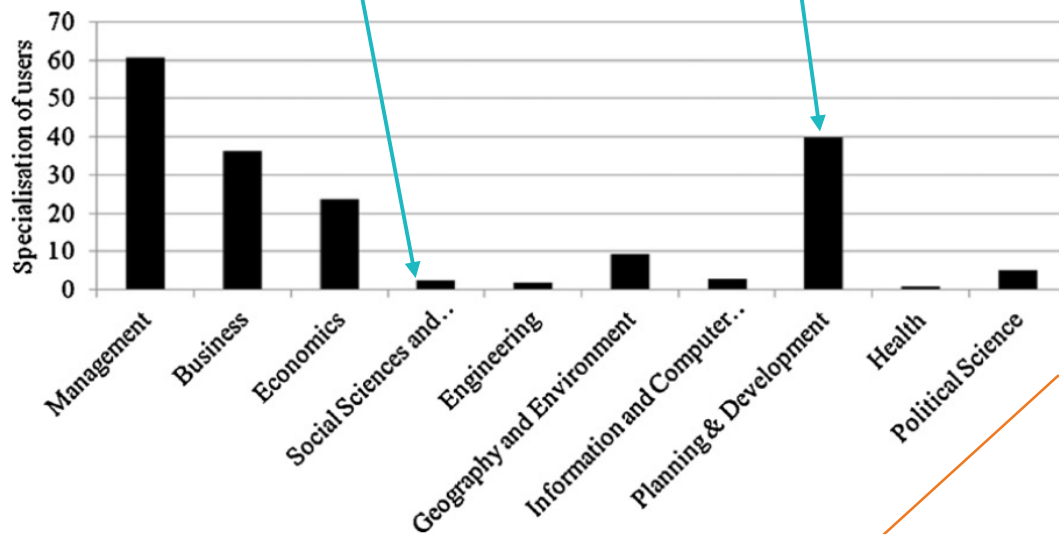


Fig. 4. Specialisation of knowledge users (6-year average, 2003–2008).

Adjust for the different subject areas size, more specific.



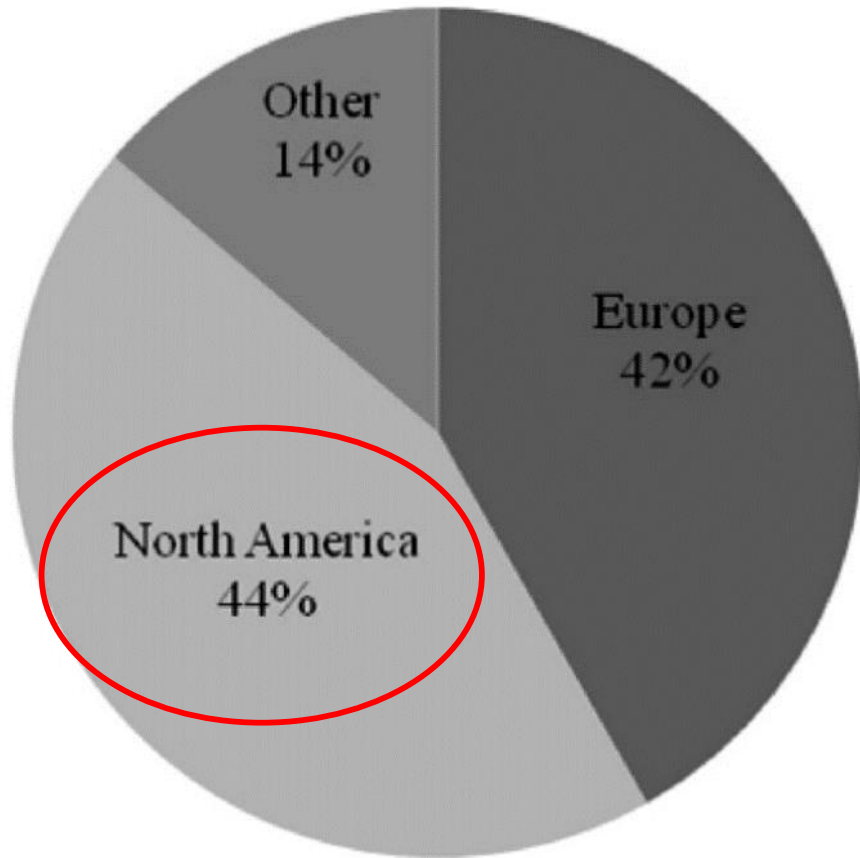


Fig. 5. Knowledge users: Where they work.

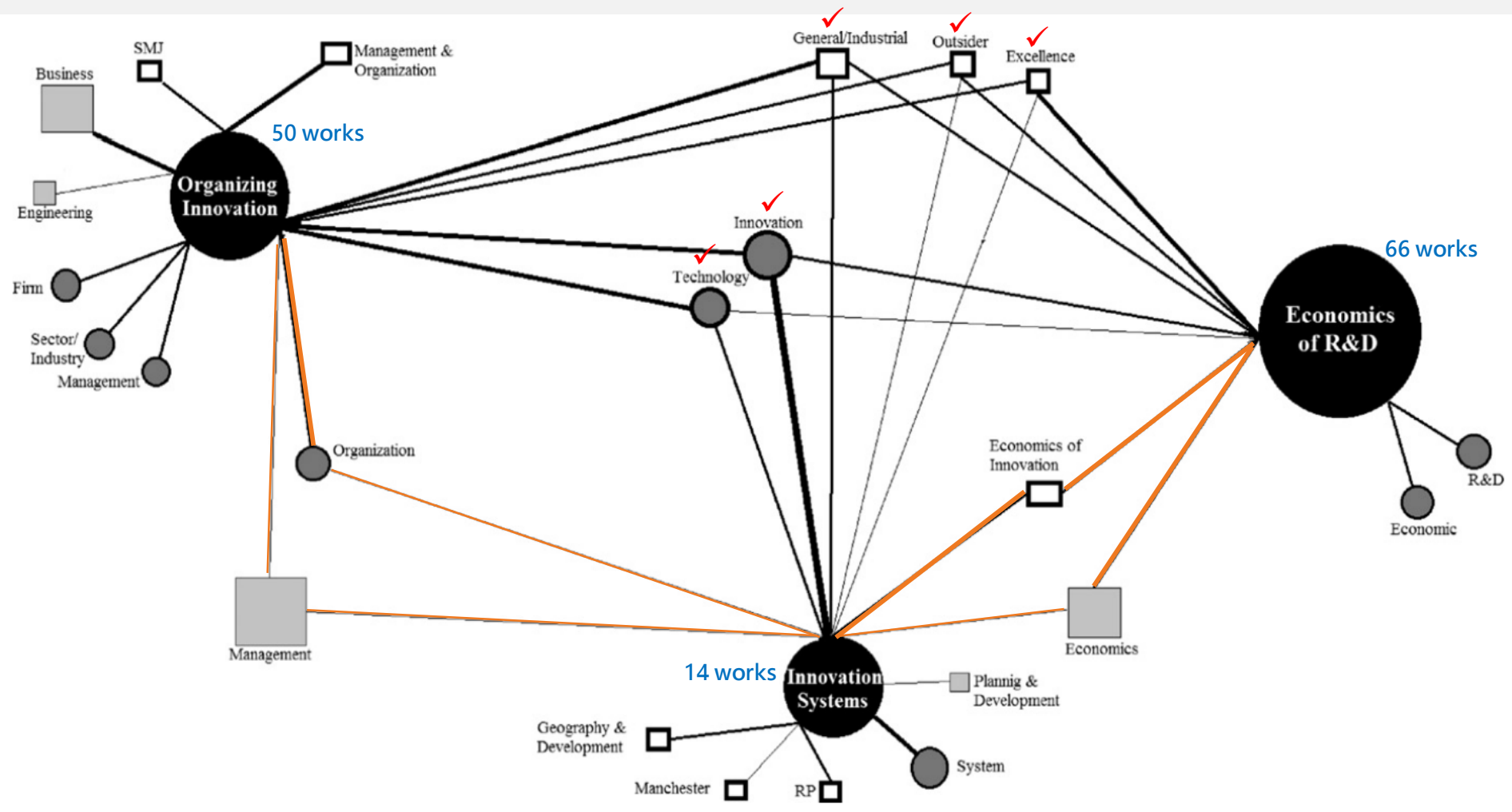
- Source: 89,099 papers published after 1997 ( since much information is missing before 1997)
- This result differ from a web-based survey (Predominant Europe)

# The structure of the knowledge base

Cluster	Organising Innovation	Economics of R&D	Innovation Systems
Works (authors)	50 (83)	66 (102) ✓	14 (18)
Thematic focus	Innovation (62%) Organisation (50%) Sector/Industry (48%) Firm (42%)	Economics (63%) R&D (36%) Innovation (32%) Technology (32%)	Innovation (100%) System (56%) Technology (38%) Macro (31%)
Most central works ( <i>J</i> -index)	Nelson and Winter (1982) (18.8) Rogers (1962) (14.1) Cohen and Levinthal (1990) (11.9)	Porter (1990) (14.4) Schumpeter (1934) (14.1) Freeman (1974) (12.6)	Nelson (1993) (15.7) Lundvall (1992) (13.4) Freeman (1987) (9.7)
Most important affiliation	Harvard (16%) MIT (12%)	Harvard (16%) Stanford (11%)	SPRU (28%) Stanford (17%)
Location of authors	North America (75%) Europe (20%)	North America (77%) Europe (20%)	Europe (67%) North America (33%)
Most important citing journal	Strategic Management Journal	Research Policy	Research Policy
Largest citing field	Business (30%) Management (21%)	Economics (34%) Social Sciences & Humanities (28%)	Management (22%) Economics (22%)
Specialisation	Business (77.0) Management (61.2)	Economics (61.3) Business (29.4)	Management (65.7) Planning & Development (64.1)
Location of citers	North America (49%) Europe (38%)	Europe (44%) North America (42%)	Europe (67%) North America (17%)

# Relationships between literature clusters and variables

**Black circles:** Literature clusters **Grey circles:** Thematic priorities(keywords)  
**Line:** link Clusters and the variables, Thicker line, stronger the relation (cut off 0.25)  
**Grey Squares:** Disciplinary orientations (citing field) **Empty squares:** the remaining variables



# The evolution of the core literature

The core literature, three time periods.

No.	Author	Country	Title	Type	Year	J-index	Citations (ISI/Year)
Before 1970							
1	Rogers EM	USA	Diffusion of Innovations	Book	1962	14.1	204.3
2	Schumpeter JA	Austria/USA	The Theory of Economic Development	Book	1934	14.1	56.3
3	Arrow K	USA	Economic welfare and the allocation of resources for invention	Book Chapter	1962	10.5	26.0
4	Schumpeter JA	USA	Capitalism, Socialism, and Democracy	Book	1942	7.9	81.3
5	Burns T & Stalker GM	UK	The management of innovation	Book	1961	7.6	55.7
1970–1989							
1	Nelson R & Winter S	USA	An Evolutionary Theory of Economic Change	Book	1982	18.8	165.0
2	Freeman C	UK	The Economics of Industrial Innovation	Book	1974	12.6	30.4
3	Pavitt K	UK	Sectoral patterns of technical change	Article	1984	11.6	23.2
4	Freeman C	UK	Technology Policy and Economic Performance	Book	1987	9.7	20.2
5	Von Hippel E	USA	The Sources of Innovation	Book	1988	9.7	52.6
1990–2008							
1	Nelson R	USA	National Innovation Systems: A Comparative Study	Book	1993	15.7	61.0
2	Porter M	USA	The Competitive Advantage of Nations	Book	1990	14.4	166.9
3	Lundvall B-Å	Denmark	National Systems of Innovation	Book	1992	13.4	59.3
4	Cohen W & D Levinthal	USA	Absorptive capacity: A new perspective on learning and innovation	Article	1990	11.9	124.3
5	Saxenian A	USA	Regional Advantage	Book	1994	9.9	87.3

# The evolution of the research institutions

Period	Total <i>J</i>	<i>J</i> per Work	No of Scholars	No of Institutions	No of Countries
1950-1969	98.9	5.5	25 15%	13	2
1970-1989	261.0	5.7	51 32%	17	4
1990-2008	316.9	5.4	82 53%	44	11

} 85% Broder

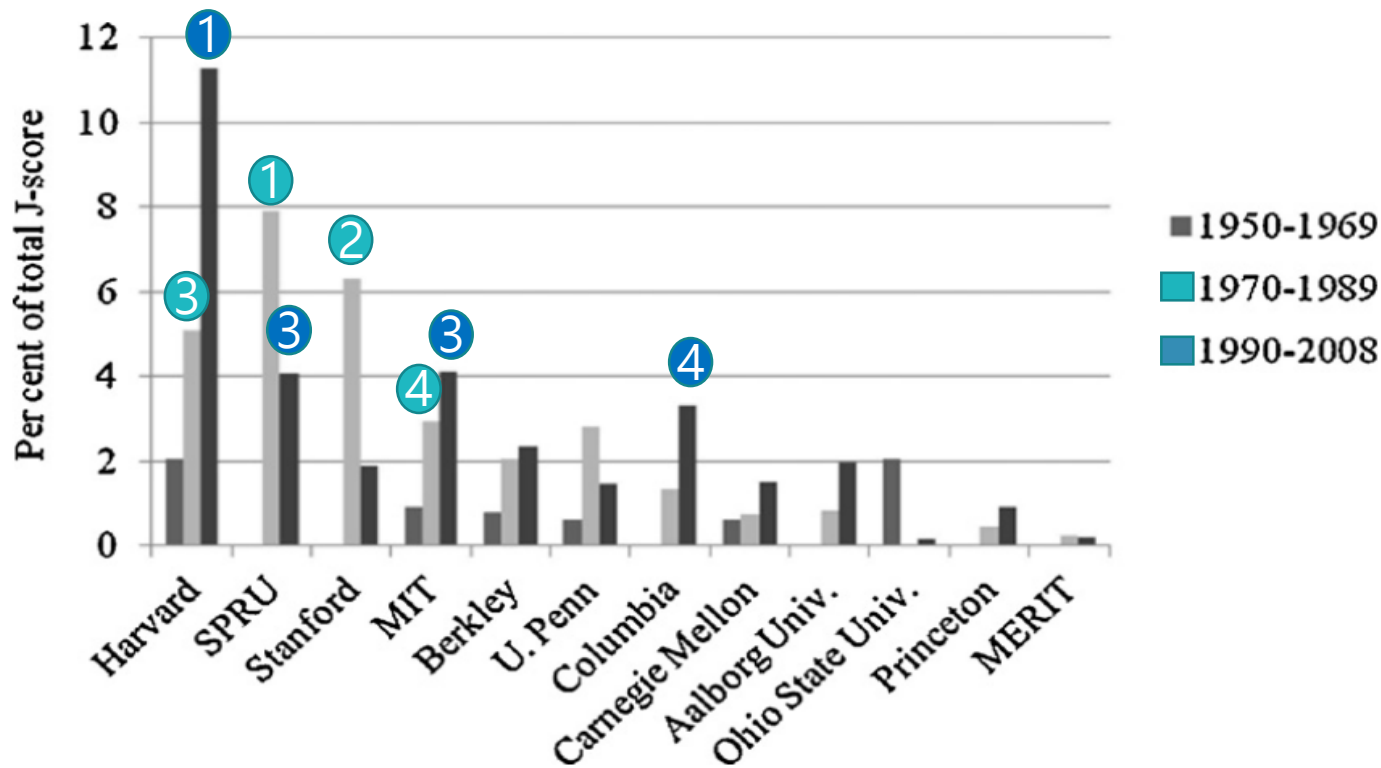


Fig. 7. Top research environments, three periods.

# The evolution of the frequent users

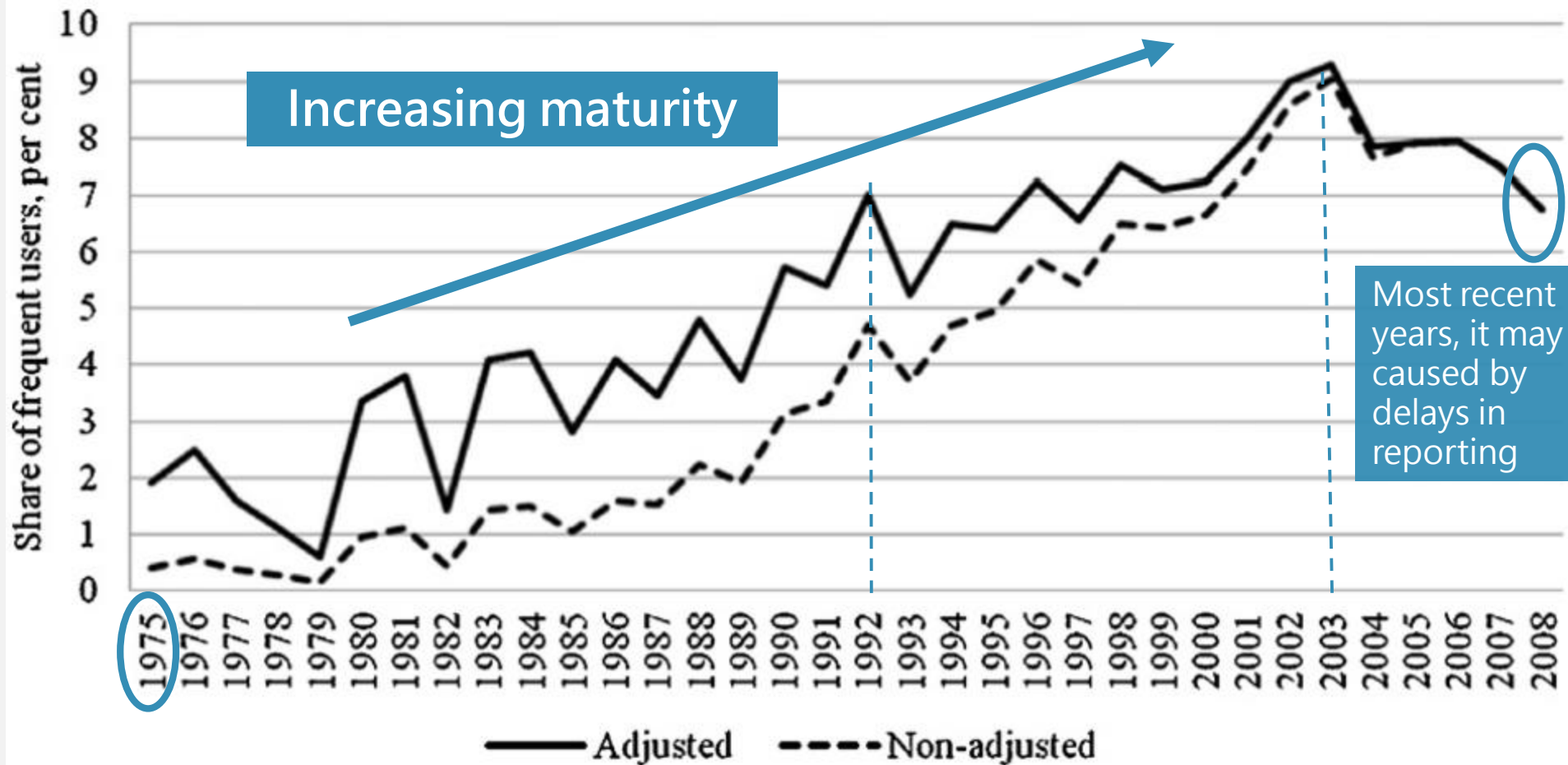


Fig. 8. Share of frequent users by year, 1975–2008.

83% of the users merely cite at most one or two of the core publications  
5% of the users cite 1/3 number of citations (frequent users)

# The core literature : frequent users vs. experts

The core literature: frequent users in the most recent period versus the experts.

	Experts' assessments	Rest of literature
	Top 20	
	Top 20	
	1. Nelson and Winter (1982)	24 Tushman & Anderson 1987
	2. Nelson (1993)	26 Marshall 1920
	3. Porter (1990)	27 Romer 1990
	4. Schumpeter (1934)	40 Nonaka & Takeuchi 1995
	6. Lundvall (1992)	64 Teece, Pisano & Shuen 1997
	8. Cohen and Levinthal (1990)	69 Penrose 1959
Frequent users's assessments	11. Saxenian (1994)	72 Williamson 1975
	13. von Hippel (1988)	109 Porter 1980
	15. Teece (1986)	112 Granovetter 1985
	17. Henderson and Clark (1990)	
	19. Schumpeter (1942)	
	Rest of top 20 core contributions	
	5. Rogers (1962)	Rest of the core literature (101 works)
	7. Freeman (1974)	
	9. Pavitt (1984)	
	10. Arrow (1962)	
	12. Freeman (1987)	
	14. Christensen (1997)	
	16. Kline and Rosenberg (1986)	
	20. Tidd et al. (1997)	

1990~2008

Experts: J-index

- **Experts > Frequent?**

Overview character e.g. Teaching purpose, more cited by handbooks (some of these are quite old) for research students than to the research frontier

- **Frequent > Experts?**

Focus on firms has been a central topic on the frequent users

# The evolution of the user community

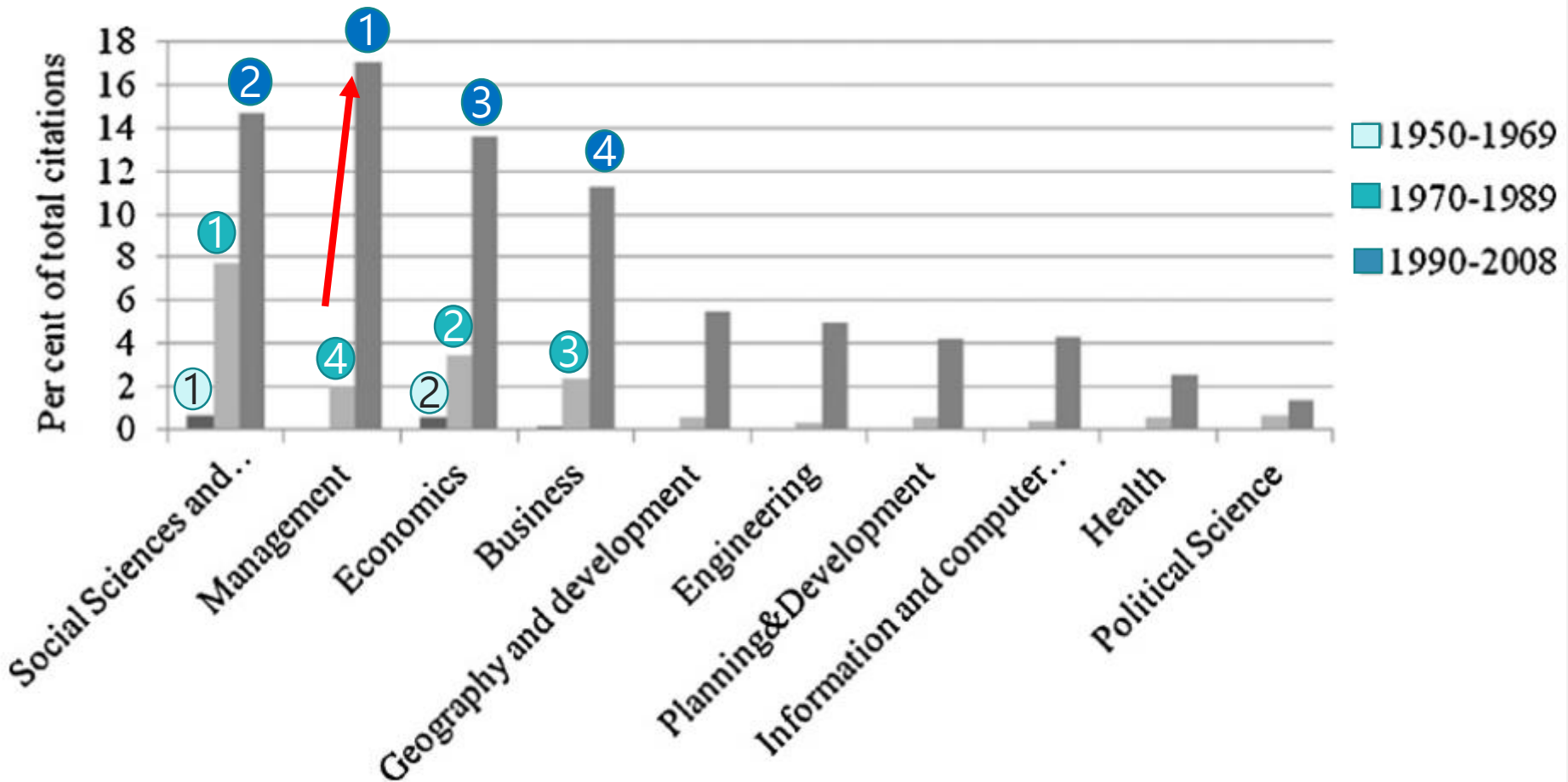


Fig. 9. The evolution of the user community, 1950–2008.



# Three Phases

## Early phase (–1970)

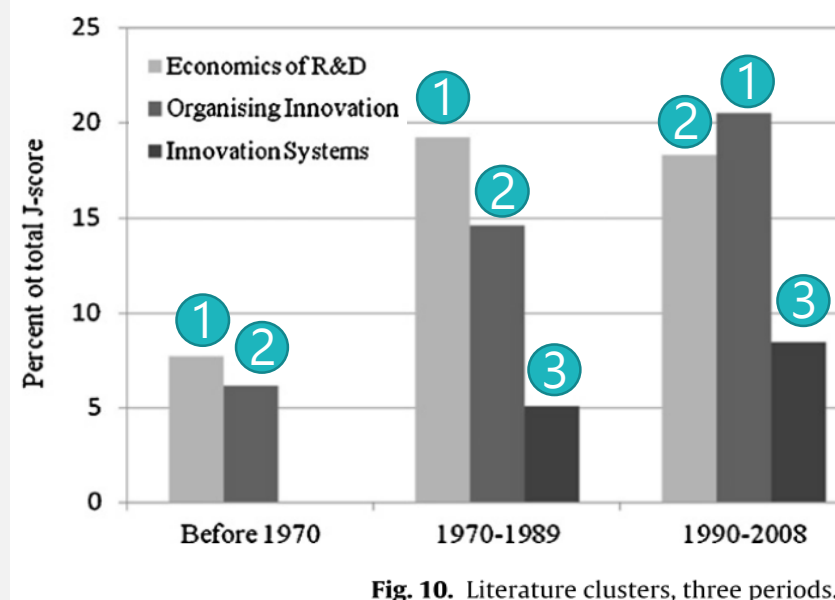
- Social science, economics and sociology
- Lack of the cross-disciplinary border
- Social support: US military, outside firms

## Growth Phase (1970-1989)

- SPRU (1966) was a turning point
- From a rather local affair to a global movement.
- “Stanford-Yale-Sussex synthesis”
- **Multi- and inter-disciplinary**  
(social sciences, engineering science..)

## Mature phase (1990-2008)

- Many associations and journals established (ISS, AMJ...)
- “Organizing innovation” grow rapidly
- **“Management”** becomes the largest user group (than social science/economics)



## Reflection

What **new forms of integration** that may be needed to ensure that the various parts of the field **stay connected** and the field as whole **continues to thrive** ?

# Discussion & Supplement

## Exploring more fields knowledge base?

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- Bhupatiraju, S., Nomaler, Ö., Triulzi, G., & Verspagen, B. (2012). Knowledge flows—Analyzing the core literature of **innovation, entrepreneurship and science and technology studies**. *Research policy*, 41(7), 1205-1218.
- Research Policy Volume 41, Issue 7(September 2012) **Exploring the Emerging Knowledge Base of 'The Knowledge Society'** Edited by Jan Fagerberg et al.