



## **A triple Helix Approach to the Future Innovation Flagship of Europe: Exploring the Strategic Deployment of the European Institute of Innovation and Technology**

**Jofre, Sergio; Andersen, Per Dannemand**

*Published in:*

Proceedings of the Triple Helix VII 7th Biennial International Conference on University, Industry and Government Linkages

*Publication date:*

2009

*Document Version*

Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*

Jofre, S., & Andersen, P. D. (2009). A triple Helix Approach to the Future Innovation Flagship of Europe: Exploring the Strategic Deployment of the European Institute of Innovation and Technology. In *Proceedings of the Triple Helix VII 7th Biennial International Conference on University, Industry and Government Linkages* (Vol. VII, pp. 1-6). University of Strathclyde.

---

### **General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

## **A Triple Helix approach to the future innovation Flagship of Europe: Exploring the strategic deployment of the European Institute of Innovation and Technology**

Sergio Jofre and Per Dannemand Andersen  
Section of Innovation Systems and Foresight  
Department of Management Engineering  
Technical University of Denmark  
[sejo@man.dtu.dk](mailto:sejo@man.dtu.dk)

### **Abstract**

This paper explores the strategic context of the implementation of the European Institute of Innovation and Technology (EIT). The analytical framework is based on a comparative study of National Innovation Systems (NIS) and the particular Triple Helix of University-Government-Industry relationship in the European Union and its closer competitors, Japan and the United States. Main results suggest that the innovation systems in this study are in a transition stage at different degrees of change. Such transitions, broadly motivated by the challenge of globalization and sustainable development, are transforming the profile of the triple helix relationships. This transformation is bringing the American and the Japanese innovation system to an unprecedented level of commonality and the EU to a yet uncertain stage of transition characterized by the conflict between national and supranational priorities, and the different innovation capabilities of its Member States. The paper argues that in such conditions, the current strategy to deploy the EIT is not appropriated and an alternative strategy is proposed.

**Keywords:** Innovation, Innovation Eco-System, Innovation Systems, Innovation Strategy, Knowledge Triangle, Triple Helix, NIS, EIT

---

Copyright of the paper resides with the author(s). Submission of a paper grants permission to the 7<sup>th</sup> Triple Helix International Scientific and Organising Committees to include it in the conference material and to place it on relevant websites. The Scientific Committee may invite papers accepted for the conference to be considered for publication in Special Issues of selected journals.

## 1. Introduction

The paper explores the strategic context of the implementation of the European Institute of Technology (EIT) from the perspective of National Innovation Systems (NIS) and the Triple Helix of University-Government-Industry relationship. The analytical framework is given by a comparative study of NIS in the EU and its closer competitors the US and Japan, with emphasis on the particular features and developments of their respective Triple Helix models. Based on the results of this analysis, the paper suggests strategic recommendations regarding the EIT deployment. The work aims an additional contribution to the innovation and Triple Helix literature and research. The study is based on observations and considerations made during an ongoing EU project (See Endnotes).

## 2. Background

The increasingly faster pace of economic globalisation has utterly changed the world economic order, bringing together unprecedented opportunities and challenges. This new order demands countries to strengthen their inventiveness and capability to adapt to ever changing environments, and to quickly react to emerging social needs and preferences, and therefore to *innovate* more (EC, 2006a). Although the European Union (EU) has already implemented several action plans and programmes aiming the improvement of its technological and non-technological innovation capability, its average performance in the international context is yet weak, particularly if compared to rival economies such as Japan and the US (EC, 2008a). A recent initiative to foster Europe's innovation performance is the establishment of the European Institute of Innovation and Technology – EIT (EC, 2006b; 2008a). The EIT is the first attempt to integrate the three dimensions of the “Knowledge triangle” of education, research and innovation. Although inspired by best practice examples observed in the US innovation system such as the Massachusetts Institute of Technology (MIT), the EIT deployment does not consider the establishment of a physical institute but a supranational network of pre-existing institutions. The EIT structure and performance will be based on collaborations known as “Knowledge and Innovation Communities” (KICs) or “highly integrated public-private networks of universities, research organisations and businesses” (See EC, 2006b). The EIT's activities and its strategic management will be coordinated through a Governing Board representing actors from all sides of the “knowledge triangle” and financed by an initial budget around EUR 300 million during the period 2008-2013. KICs, selected by the EIT *Governing Board*, will consider EU research priorities. Likely, the first areas covered by the Institute would be climate change, renewable energies, and next generation Information and Communications Technology. The KICs will work through seven-year “Strategic Innovation Agendas” (SIA) outlining the Institute's long-term priorities and financial needs. The first SIA is expected before the year 2011. Whether the EIT's concept will bring the expected outcomes, remain an open question. However the EIT is at an early stage of development and therefore, strategic choices can be taken in order to aid a successful and sustainable deployment.

## 3. Analytical Framework

Innovation literature provides a variety of analytical frameworks and multi-lateral collaborations models in which the EIT future deployment can be analyzed. However, these references often involve large systems with well-defined aggregation levels such as for example the geographic boundaries of nations and regions, industry sectors, or specific technologies (See Teixeira, 2008). In this context, the complex supranational character of the European Union entails a challenging political, cultural, and economic environment for the establishment of a “virtual” institution aiming a deep reform of Europe's (broadly nationally-oriented) education, research and business innovation systems. This impasse remarks the challenge of redefining and reinforcing a supranational innovation system in line with national demands and their particular environments, and calls for new theoretical and empirical developments enabling proper policy actions.

The concept of innovation systems assumes that flows of technology and information among people, companies and institutions are crucial to the innovative process. At national level, innovation and technology development are the result of a complex set of interactions between agents producing, distributing and applying different types of knowledge. Literature suggests that the innovative performance of a country greatly depends on the particular arrangement of these agents within the collective knowledge system and the technologies they

use. These agents are primarily private enterprises, universities, public research institutes, and the people within them. The linkages between these agents can take the form of joint research and publications, personnel exchanges, cross-patenting, purchase of equipment and a variety of other channels. The particular educational, economic and political environments of countries might define the characterization, role and interaction of agents within the innovation system (Etzkowitz and Leydesdorff, 2000). University (education), industry (economy), and the government (politics) drive the resultant framework given by the interaction of these environments. Understanding the dynamics of their relationship gives an insight into characteristic functions and operations in the innovation system. In the analytical perspective of NIS, the role of these three agents is valued in terms of the outcome of innovation – value and welfare creation – therefore, the NIS analysis inherently focuses on economy and emphasizes the role of industry over government and university. A complementary analytical concept that regards NIS from a slightly different perspective is the Triple Helix Model of innovation (e.g. Etzkowitz and Leydesdorff, 2000), that emphasises the role of university in the innovation system and its co-dependency with and within government and industry. The model supports the hypothesis that universities, governments and industry play an equally important role in innovation and that their interdependency and (co)evolution is what defines the outcomes of the innovation system over time. In a historical context, most countries have formerly based their innovation systems in a triple helix in which governments did greatly influence the performance of and the relationship between university and industry. In such a model, each agent performs within its defined set of competences and roles do not overlap. Nowadays, most countries are in transition to – or fully developing a – triple helix model in which each of the innovation agents perform and fulfil more than a single function, and intermediary or hybrid institutions, and tri-lateral networks emerge.

The identification and assessment of functions of innovation systems – or “what the system does or how it works in comparison to how it is composed or structured” (Bergek et al, 2005) – is acquiring relevance among innovation scholars during the last years. Function and structure are attributes of a common object, the system, and therefore they are mutually dependant. However, this relationship is ambiguous, and systems with different structure can be similar in terms of function and vice-versa. Although this implies that there is no optimal structure to assure a well performing system, it is yet possible to compare whether a system perform better or worse through the assessment of its functions (Markard and Truffer, 2008). Although, there is no broad consensus on a particular set of functions, an often-cited analytical reference suggest the entrepreneurial activities, knowledge development, knowledge diffusion, guidance of the search, market formation, resource mobilisation, and creation of legitimacy/counteract resistance to change (See Hekkert et al, 2007).

#### **4. The Study**

This study uses NIS as an analytical framework to compare patterns and trends the development of innovation systems in the US, Japan and the EU. The comparison provides a qualitative reference to identify strategic issues regarding the innovation systems' functions and structure. A complementary analysis is based on the characterization of the university-government-industry relationship in order to identify driving factors in the management of education, research and business innovation. A further was analysis was conducted in order to develop a strategic approach to the future EIT deployment in the context of a triple helix model entailing considerations at both the national and the supranational levels. Data was gathered from available literature.

#### **5. Results**

In order to illustrate and compare the innovation performance of the subjects, the results of two international indexes – evaluating and analysing different functions, inputs and outputs of innovation systems were analyzed and contrasted. Table 1 summarises the results of both indexes – The European Innovation Scoreboard and the Global Innovation Index – for the EU27, the US and Japan. A further analysis of functional performance suggest that the lower capitalization of innovation in the EU broadly regards constrains to the functions of knowledge diffusion, guidance of the search and (financial and human) resource mobilization, confirming earlier findings and conclusions in the Aho Report (See EC, 2006c). These “input functions” are evenly balance with the outputs in the Japanese and American NIS due to a higher maturity and coherence of the systems enabling a faster transformation of knowledge into tradable goods.

The comparative assessment of the characteristics and functions of NIS is summarised in Table 2 (also See NAP, 2009; National Science Board, 2008; Eurostat, 2008; UNU-MERIT, 2007; RAND, 2006; Motohashi 2005).

**Table 1 Compared Innovation Performances of EU, US and Japan**

Comparative Innovation Performance by Country/Region (2007)						
Performing Country/Region	SII Index*	SII Rank (37 countries)	Comparative Rank	Global Innovation Index GII**	GII Rank (107 countries)	Comparative Rank
US	0.53	9	2	5.80	1	1
JP	0.60	6	1	4.48	4	2
EU (27)	0.45	17	3	(3.31)*	(28)**	3

Source: \*European Innovation Scoreboard 2007 (EC, 2008b); \*\* World Business/ INSEAD (Dutta and Caulkin, 2007)  
Notes: ( ) \* Calculated average ( ) \*\* Estimated rank

**Table 2 Basic Characteristic of NIS and their Functions in the US, Japan and the EU**

	Innovation System		
	US	Japan	EU
Focus	Job creation, economic growth, productivity, Wealth creation, competitiveness, Comparative advantage, higher living standards	Profit, growth and welfare, quality of life	Global competitiveness, economic growth, higher living standards
Historic strategy	Rapid creation and introduction of key technologies supported by excellence in basic and applied research, high resource mobility and rapid market formation	Constant improvement of the manufacturing process and product quality through rapid importation, adaptation and improvement of foreign technology	Coordination and integration of national policies and national research communities
Current strategy	Innovation Ecosystem: emphasizes co-evolution and system's adaptability to changes	Innovation ecosystem: emphasizes co-evolution and system's adaptability to changes	Network of excellence: emphasizes diversity and virtual networking
Functions			
Knowledge creation	Very high: supported by a considerable R&D intensity	Highest: supported by highest OECD R&D intensity	High: Yet R&D intensity is lower than in US and Japan
Knowledge diffusion	Very high: driven by active organizational networking and a mature IPR system.	High: notably influenced by open-innovation and embedded tacit knowledge in workforce	Lower: due to IPR constrains
Guidance of search	High: short to medium-term, influenced by academy, local and federal governments	Very High: long-term, notably guided by government and industry through S&T plans	Moderate: short to medium-term, coordinated with national priorities
Market formation	Very high: nationally and globally-oriented, effective IPR and deregulation policies	Moderate to High: nationally-oriented driven by large industrial conglomerates	Moderate: nationally-oriented, IPR constrains and market fragmentation
Entrepreneurial involvement	Very high: with high venture capital and subsidies	High: with less venture capital but higher subsidies	Moderate: less venture capital and subsidies
Resource mobilization	Very high: dependent on foreign input	Low: nationally-oriented	moderate: nationally/ regionally-oriented, net loses to the US
Legitimacy	High	High	High
Main socio-economic recipients of R&D investments	Defence, health, and space research	Academic research, energy, and non-academic research	Academic and non-academic research and defence
Systems' s status	Transition (Early)	Transition (Advanced)	Transition (Early)
Driving trends	Decreasing global competitiveness, decreasing knowledge creation rate and resource mobilization, national security, and sustainable development,	Decreasing global competitiveness, aging population, sustainable development and climate change agendas	Decreasing global competitiveness, demographic and environmental changes, market integration, sustainable development and climate change
Corrective actions/attempts	Policy revision with focus on comparative innovation performance, reform of education and migratory policies, budgetary plans and research priorities	Long-term S&T Plan focusing on: 1) Expansion of government support to R&D; 2) transformation of national universities and research institutes into corporate institutions; 3) strengthening university-industry collaboration; and 4) strengthening IPR protection	Implementation of a basic action plan regarding education, research and innovation in coordination with national agendas in Member States
Own source			

The assessment suggests that NIS in Japan and the US has co-evolved in a context of competitiveness and mutual learning. Important policy reforms in the US – e.g. IPR legislation – were to some extent implemented as a consequence of the increasing technological competitiveness of Japanese firms in the 70s, while some lessons gathered from the economic success of Japan’s innovation strategy during the 80s – e.g. lean production – inspired some policy reforms. In turn, the success of the American innovation model on taking the lead over disputed computer technologies in the 90s inspired in part, the yet ongoing NIS reform in Japan. This latest reform brought both NIS – and their triple helix profiles – to an unprecedented level of commonality supported by a strong bilateral cooperation. Currently the US is contemplating further policy actions in areas such as education and human resource mobility, following some examples observed in the current Japanese policy strategy. Table 3 summarizes observed paths and trends in the respective triple helix of university-government-industry composition in the three subjects.

**Table 3 Compared Triple Helix characteristics and trends in Japan, the US and the EU**

Triple Helix	Performing Countries /Regions		
	Japan	US	EU
University	<p><b>Trends:</b> Privatization with corporate status: aiming more administrative autonomy and funding diversification, involvement of faculty staff in entrepreneurship, increasing excellence in education and research, and infrastructure modernization. focusing on attracting and keeping foreign skills, increasing (international) postdoctoral positions, increasing selectiveness of admission, recruitment of young scientist, creation of in-house Technology Licensing Organisations (TLOs); increasing volume, quality and impact of scientific production; increasing collaboration with industry (staff mobility, technology licensing, services and training). Tendency to increase scientific production and research support with industry, and number of patents applications.</p> <p><b>Role:</b> Historically low to Moderate (aiming higher)</p>	<p><b>Trends:</b> Autonomy and decentralization: aiming research and education excellence. Focus on high impact research, funding diversification, intense competition for human and financial resources nationally and internationally, highly selective standards for enrolment and admission, and increasing entrepreneurship capability and effective in-house IPR support. Scientific production rate tending to decrease in proportion to decreasing enrolment of foreign labour and enrolment of national students</p> <p><b>Role:</b> High (aiming to sustain)</p>	<p><b>Trends:</b> Public with focus on national priorities: open admission and low tuition fees schemes, rigidity of funding schemes, low incidence of non-EU foreign skills, recruitment and admission predominantly within nationals. Aiming excellence on education and research, more autonomy and funding diversification, increasing scientific production and international impact, national and international networking, attracting and keeping foreign skills, increasing and diversifying collaboration with industry, optimization of IPR mechanisms, increasing human resource mobility</p> <p>Tendency to: decrease admission and graduation rate, number of aging faculty and decrease labour pool, scientific production and international impact of publications</p> <p><b>Role:</b> Historically high (tends to decrease)</p>
Government	<p><b>Trends:</b> Undergoing reform of administrative bodies (less divisions, more autonomy and power), design of long-term and consensual S&amp;T and R&amp;D plans and strategies, encouraging and mediating industry-academy collaboration, aiming social consensus, aiming less “interference”, increasing funding of R&amp;D.</p> <p><b>Role:</b> Historically high (aiming Moderate)</p>	<p><b>Trends:</b> Dictating and keeping “rules of the game” through regulation and Deregulation, facilitating Innovation environment, setting up national priorities, aiming more “presence”, aiming more funding to R&amp;D</p> <p><b>Role:</b> Moderate (aiming Higher)</p>	<p><b>Trends:</b> Funding, coordination and basic orientation of communitarian R&amp;D and S&amp;T policies, formation and regulation of the communitarian market, aiming higher R&amp;D investments, aiming higher coherence of communitarian S&amp;T policies and national innovation policies.</p> <p><b>Role:</b> Moderate (aiming Higher)</p>
Industry	<p><b>Trends:</b> Highly organized and localized, nationally-oriented, with high incidence in Government’s S&amp;T policies and strategies (tends to sustain); strong “in-house” R&amp;D and High embedded tacit knowledge (sustaining); long-term and large-size networks; low human resource mobility; low Venture Capital formation.</p> <p>Tendency to increase: risk capital, recruitment of foreign skill, international networking, outsourcing of basic research and collaboration with academy</p> <p><b>Role:</b> Historically very High</p>	<p><b>Trends:</b> Independent and competitive, highly localized, and internationally-oriented. Diversified R&amp;D with lower embedded tacit knowledge, high labour mobility and foreign skill dependency, short-term collaboration networks, and active collaborating in Basic research, efficient in-house IPR support, and considerable venture capital formation</p> <p>Tendency to: decrease foreign labour recruitment, increase networking and collaboration span, and increase outsourcing</p> <p><b>Role:</b> Very High</p>	<p><b>Trends:</b> Highly fragmented, geographically dispersed, and nationally-oriented. Low incidence in the S&amp;T policy design at EU level but higher at national level, dynamic and complex networking structure, highly skilled labour force with low incidence of foreign skills, dynamic but inefficient collaboration with academy due to prevailing IPR structure.</p> <p>Tendency to: increase number and weigh of SMEs, reduce skilled labour pool, aging labour market.</p> <p>Aiming to: increase foreign recruitment and outsourcing, increase global competitiveness, and improve IPR mechanisms</p> <p><b>Role:</b> Historically High</p>
Own source			

## 6. Discussion and concluding remarks

All innovation systems in this study are at a different degree of transition. Such transitions are broadly motivated by the challenge of globalization and sustainable development aiming an increasing capability to compete globally and sustain economic growth. However,

each system is deploying different strategies to accomplish such goals in accordance to their particular degree of maturity, organization, functionality, availability and use of resources and capabilities. The analysis suggests that at this point of transition in the Japanese NIS, the profile of the tripe helix of university-government-industry relationship is acquiring an unprecedented degree of commonality with the American system. This event is seen as the result of a long-term co-evolution of innovation policies and strategies between both countries due to a strong, yet constructive, technological and economic competition.

The analysis also suggests that the lower capitalization of innovation in the EU broadly regards deficiencies in the performance of the functions of knowledge diffusion, guidance of the search, and (financial and human) resource mobilization. Some of these deficiencies seem particularly connected to problems at the interaction between university-industry. However, it is necessary to remark that in the complex supranational composition of the EU innovation system, the profile of the university-industry relationship varies enormously. Although such functional constrains have been already acknowledged by the EU, observed trends in the strategic configuration of the European triple helix model suggest that only governance develops at a communitarian level, while university and industry continues to evolve nationally, increasing the system's fragmentation. This peculiarity remains a major strategic issue to be considered in further innovation policy developments.

An overall lesson gathered from the comparative analysis of NIS is that particular models of collaboration for university, government, and industry are less relevant than the benefit implicit in the creation of a system that encourage collaboration in both systematic and spontaneous ways. This is the benefit gathered through the constant and fluid creation, diffusion, and absorption of knowledge as economic and social inputs/outputs within the innovation system at any rate and time. An important additional lesson gathered from the co-evolution of NIS in Japan and the US, is that a collaboration model – although successful– becomes rapidly obsolete in the core of a system that does not adapt efficiently to its changing environment. This suggests that adaptability is not only an important condition for the triple helix relationship, but also a requirement for the system in which the relationship takes place.

Considering these observations, the strategic deployment of the European Institute of Innovation and Technology should not only tackle the unbalance between national and communitarian developments in the university-government-industry relationship but also the unbalanced innovation performance among Member States. Hence, the “Knowledge Intense Communities” that will integrate the institute should represent each Member State and their particular university-government-industry composition with respect to excellence in research, education and business innovation. In this strategic perspective, excellence emerges because of co-evolution – driven by constructive competition and mutual learning – and not by simple replication of best-practice examples. Consequently, the system's adaptability is not to be hindered by diversity but driven by it.

A formula to support such a strategy is to *translate* the triple helix of university-government-industry *relationship* simultaneously into a *function* and *organization*, a working institution as a “trilateral cell”, at each Member State. A leading university provides the ideal platform for a “trilateral cell”, particularly in less innovative countries, since it connects education and research, and can become a pole for entrepreneurship (business innovation). The analysis suggests that most innovation best-practice examples involve the participation of leading universities and regional poles of research and entrepreneurship are formed and consolidated around them. There is increasing evidence on the role these institutions can play in increasing resource mobilization, knowledge creation and diffusion, aiding market formation, and concentrating venture capitals. They natural connection with local business, their government and society, as the source of skilled work force and knew knowledge, offers an strategic advantage to reflect and induce changes in education, research and business innovation. An additional strategic advantage is that a trilateral institution connected to university, government and local business can sustain itself beyond the span of a thematic KIC, adding value to the communitarian funding and infrastructure to the respective State. Integrating “trilateral cells” across member states can increase the possibility (and capability) to transform diversity into a systemic advantage. If so, the capability to capitalize technological and non-technological innovations into products is likely to increase. The potential flexibility of such a system, and consequently its adaptability, could be to be high since the size of the network is relatively small and would integrate autonomous and self-supporting institutions. Eventually in such a “corporate” context, the balance between national and communitarian policies would become a matter of best practice in management rather than a political subject.

Finally, the strategic approach presented in this work requires further development. Future research activities will focus on managerial issues regarding the potential design and deployment of the proposed strategy, emphasizing on the “eco-system of innovation” concept.

## 7. Endnotes

This ongoing research is a parallel follow up of Work Package 1 (WP1) of the EU project “SUCCESS: Searching Unprecedented Cooperations on Climate and Energy to Ensure Sustainability”, Pilots Projects for Cooperation between European Institutes of Technology – Supporting Integrated Innovation Networks.

## 8. References

- Bergek A. Jacobsson S. Hekkert M. and Smith K (2007a). Functionality of Innovation Systems as a Rationale for, and Guide to Innovation Policy, RIDE/IMIT Working Paper no. 84426-006, Chalmers University, 2007
- Dutta S. and Caulkins S (2007). The World’s Top Innovators. World Business INSEAD site: <http://www.worldbusinesslive.com/Article/625441/the-worlds-top-innovators>
- EC (2008a). Establishing the European Institute of Innovation and Technology. 2006/0197 (COD): EIT 23/EDUC 215/RECH 395/COMPET 406/CODEC 1334, EC, Brussels
- EC (2008b). European Innovation Scoreboard 2007: Comparative Analysis of Innovation Performance. EC Publications Office, Luxembourg, 60p.
- EC (2006a). Putting knowledge into practice: A broad-based innovation strategy for the EU. COM (2006) 502 final, Brussels
- EC (2006b). Developing a knowledge flagship: the European Institute of Technology. COM (2006) 77 final, Brussels
- EC (2006c). Creating an Innovative Europe” EU22005, Luxembourg
- Etzkowitz H and Leydesdorff L (2000). The dynamics of innovation: From National Systems and Mode 2 to a Triple Helix of University-Industry-Government Relation. *Journal of Research Policy*, (29) 109-123
- Eurostat (2008). Science, technology and innovation in Europe. Statistical Books, EC, Brussels
- Hekkert M. Suurs R. Negro S. Kuhlmann S. and Smits R (2007). Functions of innovation systems: A new approach for analysing technological change. *Technological Forecasting and Social Change*, Vol. 74 (4): 413-432
- Markard J and Truffer B (2008). Technological innovation systems and the multi-level perspective: towards an integrated framework. *Research Policy*, 37(4):596-615
- Motohashi K (2005). University–industry collaborations in Japan: The role of new technology-based firms in transforming the National Innovation System. *Journal of Research Policy*, (34): 583–594
- National Science Board (2008). Science and Engineering Indicators 2008. National Science Foundation, Vol.1 Arlington, VA
- NAP (2009). 21<sup>st</sup> Century Innovation Systems for Japan and the United States: Lessons from a Decade of Change. National Research Council of the National Academy, The National Academy Press, Washington D.C.
- RAND (2006). The Pursuit of Excellence: A European Institute of Technology. Working Paper WR-346-RE, RAND Europe
- Teixeira A (2008). National Systems of Innovation: A Bibliometric Appraisal” FEP Working Paper No 271, CEMPRE, Universidade do Porto, 41p.
- UNU-MERIT (2007). R&D collaboration networks in the European Framework Programmes. Working Paper #2007-032 UNU-MERIT, The Netherlands