EMERGENCE AND DEVELOPMENT OF THE NATIONAL INNOVATION SYSTEMS CONCEPT

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1. Introduction

- NIS is the “set of institutions that (jointly and individually) contribute to the development and diffusion of new technologies.
- It is a system of interconnected institutions to create, store, and transfer the knowledge, skills, and artifacts which define new technologies.
- Social constructivist approach to trace the story of the NIS concept from its origins through its eventual dissemination to other sites.
- I adopt a sociological and historical perspective to bring to the fore features of NIS not commonly accorded sufficient attention.
- What we know about the emergence and development of the Innovation Systems concept from both an innovation studies perspective and a broadly S&TS perspective

2. Conceptual framework and review of the literature

- Social constructivist perspective, the focus on the NIS concept is a departure from the customary sites and objects of analysis in the sociology of science and technology, which have hitherto been dominated by the examination of scientific knowledge and material artifacts.
- NIS concept is not a material technology in the same way that Bakelite, bicycles, and nuclear missiles are, as a concept it still impinges on human consciousness and behavior, and is, therefore, a proper target for analysis.
- Science in Action (1987),focuses attention exclusively on representational issues. Armed with his version of 'technoscience' sociotechnical networks comprising such heterogeneous domains as 'science', 'technology', 'science policy', and 'commercial endeavors'
- S&TS standpoint are the 'New Production of Knowl- edge' approach of Gibbons (1994) and the 'Triple Helix Model'
- Studying the relationship between innovation research and the pro- duction of policy language by international and national policy agents.
- How international organizations (in particular, the OECD) and regional public administrations (in their case, that of the province of Quebec, Canada) apply NIS legitimation and dissemination processes.

3. Methods

- I interviewed many of the individuals making up the core group of scholars associated with Innovation Systems research during the autumn of 2003.

Formal interviews: emergence of the NIS concept

Name of person interviewed	Institutional affiliation at time of interview	Major role in development of NIS concept (publication, policy role, or other role)[a]	Date and location of interview
1. Christopher Freeman	University of Sussex, England	Freeman (1987)	24 October 03, Brighton, England
2. Richard Nelson	Columbia University, USA	Nelson (1993)	10 November 03, New York, USA
3. Bengt-Åke Lundvall	Aalborg University, Denmark	Lundvall (1992)	20 October 03, Aalborg, Denmark
4. Charles Edquist	Lund University, Sweden	Edquist (1997), Edquist and McKelvey (2000) and Edquist (2005)	21 October 03, Lund, Sweden
5. Maureen McKelvey	Chalmers Univ. of Tech., Sweden	Edquist and McKelvey (2000)	18 October 03, Alingsås, Sweden
6. Keith Smith	Chalmers Univ. of Tech., Sweden	Smith (1997); Finnish Technology Policy; OECD	13 October 03, Gothenburg, Sweden
7. Staffan Jacobsson	Chalmers Univ. of Tech., Sweden	Jacobsson (1997a,b)	17 October 03, Gothenburg, Sweden
8. Rod Coombs	University of Manchester	Coombs et al. (1987), Coombs (2001); PREST Group, Univ. of Manchester	23 October 03, Manchester, England
9. Stanley Metcalfe	University of Manchester	Metcalfe (1995, 1997) and Metcalfe and Miles (2000)	23 October 03, Manchester, England
10. Franco Malerba	Università Bocconi, Milan, Italy	Malerba (2004)	27 October 03, Milan, Italy
11. Francois Chesnais	Retired	Chesnais (1993); Responsible for the publication of the OECD (1992) volume and former OECD principal administrator of the Directorate for Science, Technology and Industry (DSTI)	29 October 03, Paris, France
12. Jean Guinet	OECD, Paris, France	Guinet (1995, 1996); Current OECD and principal administrator of the Directorate for Science, Technology and Industry (DSTI)	28 October 03, Paris, France

3. Methods

- I also conducted a number of informal but in-depth conversations with other relevant individuals who have been influential in the development of the Innovation Systems concept in both academia and policymaking.

Table 2
Informal conversations: emergence of the NIS concept

Name of person interviewed	Institutional affiliation at time of conversation	Major role in development of NIS concept (publication, policy role, or other role)[a]	Date and location of conversation
1. Pekka Ylä-Antilla	ETLA, Helsinki, Finland	S&T Policy Council of Finland	26 November 03, Taipei, Taiwan
2. Birgitte Gregersen	Aalborg University, Denmark	Gregersen (1988); IKE Group, Aalborg, Denmark	27 November 03, Taipei, Taiwan
3. David Mowery	University of California, Berkeley	Fagerberg et al. (2005)	31 May 04, Lisbon, Portugal
4. Erik Reinert	The Other Canon Foundation, Norway	History of knowledge-based economic theory (Reinert, 1999, 2003)	11 June 04, Milan, Italy
5. Bo Carlsson	Case Western Reserve University, USA	Technological innovation systems (Carlsson, 1994,1995, 1996)	15 June 04, Copenhagen, Denmark

[a] See reference list for citations to these authors, where applicable.

4.1. Ambiguity surrounding the academic or policymaking origins of the NIS concept

- The concept arose simultaneously in academia and policymaking (with regards to the latter, specifically in the OECD) at around the same time.
- It wasn't really developed as a theoretical concept. It wasn't a properly elaborated conceptual apparatus. It was really developed as a policy concept"
- A report published by the Technology/Economy Programme (TEP) in the OECD in 1992.
- The book represented a systematic critique of orthodox economic theory for not considering the fundamental role and special character of technical change.
- National Innovation Systems' was first introduced in academic circles by Freeman in 1987 in his book on Japan, Lundvall in fact used the concept 'Innovation Systems' in 1985 in a booklet on user–producer relations published at Aalborg University

4.2. The NIS concept as a refutation of the neoclassical economics approach to the study of innovation

- Libertarians emphasize the central importance of personal freedom in economic and political affairs,
- Neoclassical economic thought permeated the policy sphere in the 1980s. This policymaking climate mirrored the academic climate and it,
- Christopher Freeman brought the concept of national systems up was in a paper he prepared for this working group at the OECD on science, technology, and competitiveness.
- the continued rise of (mainstream) neoclassical economics helped shift the focus away from long-run economic growth toward con-ditions of economic equilibrium.
- NIS concept has roots in the perceived inadequacy of neoclassical economic thought when treating technology
- They think of them in terms of being very peculiar objects, entities, which don’t fill the normal canons of an economic good

4.3. Formation of an NIS epistemic community

- in establishing ‘turf.’ These studies explicate the processes through which better and longer established disciplines form, differentiate, and even fracture.
- The idea of epistemic communities applies here because it captures the process by which the NIS concept is co-constructed in the political and scientific arenas.
- Informal networks – in the form of friendly relation- ships among researchers and decision-makers – are as important in linking research and policy, and effecting policy change, as formal structures.
- by occupying influential roles in policymaking bodies (notably the OECD) and academia, many of the early proponents of the NIS concept combined to function as a collective epistemic community, thereby forming the power base in both domains that the NIS approach enjoys today.
- These book projects sufficiently illustrate how the NIS epistemic community was formed through professional relationships linking policymakers and academics in order to effect change in both the academy and policy making bodies.

4.4. Flexible interpretations of the NIS concept

- The concept of a ‘National Innovation System’ has been in use for the past 20 years, even today it is subject to a remarkable variety of interpretations, making it function as a boundary object.
- Innovation Systems means different things for different people
- First, the approach inspired the ambition among its progenitors to transcend a narrow disciplinary focus
- A second source of the flexible interpretations is the state of flux in which the new field of innovation studies finds itself as it seeks to strengthen its multidisciplinary roots.
- complementary concepts emphasizing the systemic characteristics of innovation that focus on economic domains other than the nation state have emerge
- These concepts have been presented sometimes as alternatives and sometimes as complements to the NIS approach.
- NIS was established with the explicit goal of challenging the analysis of technological change put forward in neoclassical macroe-conomics, and this is why Freeman and other original proponents embrace a higher, macro-scale level of aggregation.

4.5. Disagreement surrounding over-theorization of the NIS concept

- one holds that the concept should be more deeply theorized and explained in greater detail in order to make it more precisely applicable
- the other argues that the approach's usefulness is a product of its being 'loose' and 'flexible'
- Edquist invokes science in justifying and legitimizing his project for making the approach more 'rigorous'
- by questioning the role of science and scientific theory within social science, Lundvall justifies the nebulous nature of the approach.
- parallel to Edquist's efforts, Lundvall is deploying his own networks and alliances to the full in order to further the NIS concept as he thinks it should be developed.
- Lundvall questions the value of taking a rigorously scientific approach in social science, defending a broader attitude and conceiving of the NIS concept as a loose umbrella approach.

4.6. Disagreement on the presence of an NIS in all countries

- One insisting that every country has an Innovation System and the other arguing on various grounds that the question turns on the presence of certain conditions.
- Falls into the second category as he states, “[The NIS concept] needs a certain socio-economic dimension.
- This disagreement is largely a function of the various definitions of an Innovation System or indeed of ‘innovation’ that are embraced by different individuals.
- If a country possesses a very weak system for generating “new” technologies, its system for diffusing technologies from abroad (the Internet,for example) must still be present.
- Innovation System in narrow terms as solely a mechanism for generating new technologies, then it is likely that many countries do not have an NIS.

4.7. Importance of the wider global geo-political context

- This wider context has affected the meaning ascribed to the NIS concept by the social groups making use of it.
- Such smaller countries are more reliant on external demand trends as well as shifts in global production and consumption patterns.
- The acceleration of the rate of production of knowledge that accompanied economic globalization required that companies intensify their participation in knowledge production networks to sustain their competitiveness.
- As a response to the pressing global economic and geo-political situation of the time at which it emerged, embedded within It are societal, political,and economic considerations (in addition to technical). The socio-cultural and political situation surrounding the epistemic community or social group who developed the NIS concept shaped its norms and values, which in turn influenced the meaning it was given.

4.8. The NIS concept as a refutation of the linear model of innovation

- the [National Innovation] Systems way was a way of, for the European Commission, to get away from linear-model type thinking
- the NIS approach] took us away from that rather sterile debate about the linear model to recognize that because it was more systemic, it was more messy, and therefore there were lots of feedbacks and so the idea of it being just a straight linear progression now begins to look very questionable

5. Conclusions

- eight ‘missing pieces’: features of the NIS concept that are downplayed in the NIS literature or ambiguities/‘debates’ within the field.
- I have identified the key social groups and, to use the term I adopt, the ‘epistemic community’ into which they coalesced, and traced their motivations in developing the NIS concept as a social technology. this makes the concept into a boundary object, further hastening its acceptance and use across this interdisciplinary community.
- Individuals involved in the debates often seek to ‘enroll’ new individuals into their groups so as to form a new scheme, encouraging others to follow.
- (National) Innovation Systems concept is embedded in social choices and negotiations about what counts as an innovation system, what should count as the delimiting criterion (whether on a national or some other scale), and how to draw borders.
- The social constructivist analysis presented here helps by drawing attention to the social factors and interpreta- tions that the actors have adopted and that will determine the future utility of the NIS concept.
- The NIS representation is flexible enough to permit all the various stakeholders, regardless of their positions, to arrive on the same page.

6.Supplement information

- Godin, B. (2009). National innovation system: The system approach in historical perspective. *Science, technology & human values*.
- This article develops the idea that the system approach was fundamental to OECD work, and that, although not using the term National Innovation System as such, the organization considerably influenced the above-mentioned authors.

Table 1

OECD Publications on National Innovation Systems

1995	National Systems for Financing Innovation
1997	National Innovation Systems
1999	Managing National Innovation Systems
1999	Boosting Innovation: The Cluster Approach
2001	Innovative Networks: Co-Operation in National Innovation Systems
2001	Innovative Clusters: Drivers of National Innovation Systems
2001	Innovative People: Mobility of Skilled Personnel in National Innovation Systems
2002	Dynamising National Innovation Systems
2005	Governance of Innovation Systems

Note: OECD = Organisation for Economic Co-operation and Development.

6.Supplement information

- Lundvall, B. Å. (2007). National innovation systems—analytical concept and development tool. *Industry and innovation*, *14*(1), 95-119.
- Here special attention is given to institutions and capabilities supporting learning. I point to the need to give more emphasis to the distribution of power, to institution building and to the openness of innovation systems.

Diagram 2: The frequency of learning organisations and the R&D-intensity in 15 European economies.