

Systems of Innovation – Perspectives and Challenges

Chapter 7 in *The Oxford Handbook of Innovation*,

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To be published by Oxford University Press, 2004

I will address:

- the emergence and development of the systems of innovation (SI) approach,
- its strengths and weaknesses,
- the criticism that it is ‘undertheorized’,
- the constituents (components and relations among them) of SIs,
- the main function of SIs,
- activities in SIs,
- the boundaries of SIs,
- how the SI approach can be made more ‘theory-like, i.e. how its rigour and specificity could and should be increased, e.g. with regard to statements about relations between variables,
- proposals for further research.

Källor till ökad arbetsproduktivitet:
(enligt tillväxträkenskaperna)

- Mer kapital per anställd < $1/4$
- Bättre utbildning < $1/4$
- Restposten > $1/2$

Ökad arbetsproduktivitet är huvudkällan till långsiktig ekonomisk tillväxt.

Restposten (enligt E.Denison) =

Kunskapsmässiga framsteg =

Teknologisk kunskap +

Företagsledarkunskap +

Organisatorisk kunskap

Detta inkluderar kunskap som producerats på olika sätt:

- genom organiserad forskning
- av enskilda uppfinnare
- genom erfarenhet och lärande i arbetet.

Men kunskap som sådan bidrar inte till ökad produktivitet. Den måste **föras in i produktionen.**

Detta sker genom **innovationer** av olika slag.

William J. Baumol: “The Free-market Innovation Machine – Analyzing the Growth Miracle of Capitalism”, Princeton University Press, 2002:

“It can be argued that virtually all the economic growth that has occurred since the eighteenth century is ultimately attributable to innovation” (p. 13)

He also mentions, though, investment in human capital and investment in plant and equipment, and then adds:

“For the bulk of the population of earlier periods of history, bare survival was the critical problem, and it left only minimal resources for investment in education and productive capacity. Only the productive surpluses that innovation began to make possible.....made feasible the enormous increases in investment in inanimate and in human capital that are widely judged to have contributed greatly to economic growth. (p. 13)

“...in key parts of the economy the prime weapon of competition is not price but innovation.” (p. ix)

Innovationer =

= nyskapelser av ekonomiskt värde

= ”nya kombinationer”

Innovations are here defined as new creations of economic significance, primarily carried out by firms.

They include **product** innovations as well as **process** innovations.

Product innovations are new – or better – products (or product varieties) being produced and sold; it is a question of *what* is produced. They include new material **goods** as well as new intangible **services**.

Process innovations are new ways of producing goods and services; it is a matter of *how* existing products are produced. They may be **technological** or **organizational**.

In this taxonomy, only goods and technological product innovations are material; the other categories are non-technological and intangible.

Produktivitetens årliga ökning är någon eller några procent i de flesta branscher.

I två branscher har den under andra halvan av 1990-talet varit högre än i alla andra.

Årlig produktivetsökning:

	USA	Frankr.	Sverige
Datorer	39	33	8
Teleprod.	23	20	35

An alternative, and more abstract, definition of (national) systems of innovation includes ‘all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations’

These determinants include, of course, the relations among the factors mentioned.

Obviously, this definition also takes into consideration the actions of both firms and governments.

The three perspectives – national, sectoral and regional - may be clustered together as variants of a single **generic** systems of innovation approach.

These different variants of systems of innovation coexist and complement each other.

Whether the most appropriate conception of the system of innovation, in a certain context, should be national, sectoral or regional, depends to a large extent on the questions one wants to ask.

The SI approach places innovation and learning processes at the centre of focus.

The SI approach adopts a holistic and interdisciplinary perspective.

The SI approach employs historical and evolutionary perspectives, which makes the notion of optimality irrelevant.

The SI approach emphasises interdependence and non-linearity.

The SI approach can encompass both product and process innovations, as well as sub-categories of these types of innovation..

The SI approach emphasises the role of institutions.

These six characteristics are, by academic analysts, policy-makers, and firm strategists, often considered to be strengths of the SI approach and therefore partly explain its rapid diffusion.

Vi vet nu att de flesta innovationer på 2000-talet sker i **samarbete** mellan olika företag och individer: kunder, leverantörer, t.o.m. konkurrenter, plus andra slag av organisationer som universitet, forskningsorganisationer, etc. Företag innoverar inte i isolering.

Exempel: Av alla företag som gjorde en produktinnovation i Östergötland 1997-99, så gjorde 76 % det i samarbete med en annan organisation.

Detta interaktiva lärande har lett till att vi nu talar om **innovationssystem**. Detta begrepp har fått enormt genomslag. Man kan tala om nationella, regionala och sektoriella innovationssystem. De kompletterar varandra.

About half of all manufacturing firms (with 10 employees or more) carried out product innovations during a three-year period. With regard to interactive learning, about 76 percent of the innovating firms had developed the new product in collaboration with some other organisation in the regional system if innovation of East Gothia in Sweden.

The corresponding figure for national systems of innovation where the survey was carried out was as follows: Austria (62 %), Denmark (97 %), Norway (75 %) and Spain (83 %)

The SI approach is also associated with certain problems and **weaknesses**, which represent challenges for future research on systems of innovation.

The SI approach is still associated with *conceptual diffuseness*.

- One example is the term '*institution*', which is used in different senses by different authors: institutional rules and organizational actors.
- Another example is that the *boundaries of the systems* have not been specified.

With regard to *the status of the SI approach*, it is certainly not a formal theory, in the sense of providing convincing propositions as regards established and stable relations among variables. 'Systems of innovations' should be labelled an approach or a conceptual framework rather than a theory.

There are several possible attitudes and strategies that can be adopted in relation to the conceptual ambiguities and the low theoretical status of the SI approach.

One position is to consider it to be an advantage: the approach should not be made too rigorous; the concept should not be ‘overtheorized’ and it should remain an inductive one.

Another position is to argue that the SI approach is ‘undertheorized’ and needs to be tightened. The problems and weaknesses mentioned are ambiguities that should be sorted out, conceptual clarity should be increased and the approach should be made more “theory-like”.

Hence the international community within innovation studies is divided on this issue; we might even call it a controversy.

What is a system?

- A system consists of two kinds of *constituents*: There are firstly, some kinds of *components* and secondly, there are *relations* among them. The array of components and relations should form a coherent whole (which has properties different from the properties of the constituents).
- The system has a *function*, i.e. it is performing or achieving something.
- It must be possible to discriminate between the system and the rest of the world; i.e. it must be possible to identify the *boundaries* of the system. This means that we cannot neglect the question of the boundaries of the system; the distinction between 'inside' and 'outside' is crucial. If we, for example, want to make empirical studies of specific systems, we must, of course, know their extension.

Organizations and **institutions** are often considered to be the main components of SIs.

Organizations are formal structures that are consciously created and have an explicit purpose. They are players or actors. Some important organizations in SIs are firms, universities, venture capital organizations and public agencies responsible for innovation policy, competition policy or drug regulation.

Institutions are sets of common habits, norms, routines, established practices, rules or laws that regulate the relations and interactions between individuals, groups and organizations. They are the rules of the game. Examples of important institutions in SIs are patent laws as well as rules and norms influencing the relations between universities and firms.

We must also address what 'happens' in the SIs.

At a general level, the *main function*– or the 'overall function' – in SIs is to pursue innovation processes, i.e. to develop, diffuse and use innovations.

Activities in SIs are those factors that influence the development, diffusion and use of innovations. The activities in SIs are the same as the determinants of the main function.

Examples of activities are R&D as a means of developing economically relevant knowledge, or financing as an essential condition for the effective commercialisation and diffusion of such knowledge, i.e. its transformation into innovations.

A satisfactory explanation of innovation processes can be expected to be multi-causal in character. It should therefore include a specification of the relative importance of various determinants.

We should make a distinction between centrally important determinants and less important ones.

In addition, the different determinants cannot be expected to be independent of each other; they most probably support and reinforce - or offset - each other. Hence, it is important to also study the relations among various determinants of innovation processes. We might therefore need to establish 'a hierarchy' of causes á la E.H. Carr.

Important activities in SIs (1):

1. Provision of Research and Development (R&D), creating new knowledge, primarily in engineering, medicine and the natural sciences.
2. Competence building (provision of education and training, creation of human capital, production and reproduction of skills, individual learning) in the labor force to be used in innovation and R&D activities.
3. Formation of new product markets.
4. Articulation of quality requirements emanating from the demand side with regard to new products.
5. Creating and changing organizations needed for the development of new fields of innovation, e.g. enhancing entrepreneurship to create new firms and intrapreneurship to diversify existing firms, creating new research organizations, policy agencies, etc.

Important activities in SIs (2):

6. Networking through markets and other mechanisms, including interactive learning between different organizations (potentially) involved in the innovation processes. This implies integrating new knowledge elements developed in different spheres of the SI and coming from outside with elements already available in the innovating firms.
7. Creating and changing institutions - e.g. IPR laws, tax laws, environment and safety regulations, R&D investment routines, etc - that influence innovating organizations and innovation processes by providing incentives or obstacles to innovation.
8. Incubating activities, e.g. providing access to facilities, administrative support, etc. for new innovating efforts.

9. Financing of innovation processes and other activities that can facilitate commercialization of knowledge and its adoption.

10. Provision of consultancy services of relevance for innovation processes, e.g. technology transfer, commercial information, and legal advice.

The SI approach can be said to focus upon three kinds of learning:

- *Innovation* (in new products as well as processes) which takes place mainly in firms and leads to the creation of ‘structural capital’. Since structural capital is an asset controlled by firms, it is a matter of organisational learning.
- *Research and Development* (R&D) which is carried out in universities and public research organisations as well as in firms and leads to publicly available knowledge as well as knowledge owned by firms, other organisations as well as individuals.
- *Competence Building* (e.g. training and education) which occurs in schools and universities (schooling,

education) as well as in firms, and which leads to the creation of 'human capital'. Since human capital is controlled by individuals, it is a matter of individual learning.

A natural development of SI studies would be for research to focus increasingly on the relations among the three kinds of learning.

The increased emphasis on 'activities' argued for here - as compared to early work on SIs - certainly does not mean that we can disregard or neglect the 'components' of SIs and the relations among them.

Organisations perform the activities and institutions provide incentives and obstacles influencing these activities.

Hence, we need to focus on both activities and components in order to understand and explain innovation processes. And we need to address the relations between activities and components, as well as among different kinds of components.

Relations :

- Between components and activities
 - Between organisations and activities
 - Between institutions and activities

- Among components
 - Among organisations
 - Among organisations and institutions
 - Among institutions

Interactions among different organizations are crucial in learning processes that are normally the basis for the development of innovations. These relations may be of a market or non-market kind. The concept of interaction can be specified as including:

- Competition, which is an interactive process wherein the actors are rivals, and which creates or affects the incentives for innovation.
- Transaction, which is a process by which goods and services, including technology-embodied and tacit knowledge are traded between economic actors.
- Networking, which is a process by which knowledge is transferred through collaboration, co-operation and long term network arrangements.

The distinction between what is inside and outside the system is crucial - i.e., the issue of the boundaries of SIs cannot be neglected. It is therefore necessary to specify the boundaries if empirical studies of specific SIs – of a national, regional or sectoral kind – are to be carried out. One way to identify the boundaries of SIs is to identify the causes or determinants of innovations.

There are three ways in which we can identify boundaries of SIs:

1. spatially / geographically;
2. sectorally; and
3. in terms of activities.

Glossary of main terms

SI = system of innovation.

Constituents of SIs = *components + relations* among the components.

Main components in SIs = organisations and institutions.

Organizations = formal structures that are consciously created and have an explicit purpose. They are players or actors.

Institutions = sets of common habits, norms, routines, established practices, rules or laws that regulate the relations and interactions between individuals, groups and organizations. They are the rules of the game.

An SI has a *function*, i.e. it is performing or achieving something.

The *main function* in SIs is to pursue innovation processes, i.e. to develop, diffuse and use innovations.

Activities in SIs are those factors that influence the development, diffusion and use of innovations. The activities in SIs are the same as the determinants of the main function.