Digitalisation and organisational innovation

Lesson 8. Innovation systems

Introduction

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1. An integrated approach

- From the late 1980s, more **integrated** analytical perspectives started to emerge in Innovation Studies.

- **First**, scholars widely accepted the idea that knowledge is a key driver of development (knowledge economy), and that learning processes are essential to improve the competitiveness of firms, regions and nations (learning economy).

- ***Lisbon Agenda***: "*to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion*" (Presidency conclusions, Lisbon European Council, 23 and 24 March 2000)

- https://www.europarl.europa.eu/summits/lis1_it.htm

- **Second**, all approaches adopt a **systemic perspective**: innovation is seen as an emergent (and only partly intentional) result of a system of heterogeneous plurality of actors, both economic (firms, research centers, ecc.) and non-economic (universities, governments, etc.), institutions and relations (networks), with outcomes that may be planned (or unintended), positive (or negative).

Assumptions

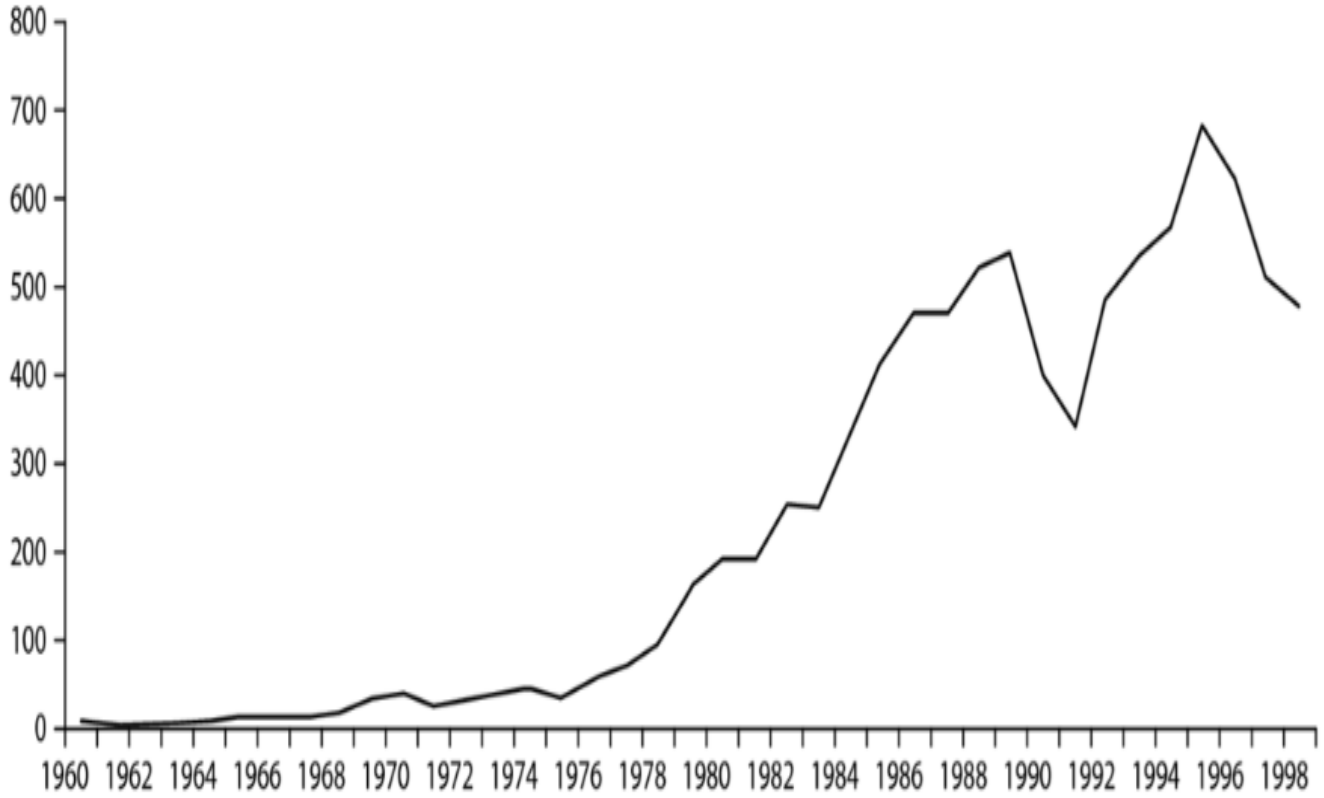
- Systemic approaches respond to new economic phenomena that show the growing complexity and interactive nature of innovation processes:

1. The first concerns the **changes in production models** (micro level) and in the regulation of the economy (meso and macro levels).
2. The second is the **development of high-tech sectors**, something that highlights a growing 'scientification' process in relation to technology.
3. A third phenomenon is the **growth of inter-company partnerships**.
4. A fourth phenomenon is related to **economic globalisation** and the **reorientation of public policies**.

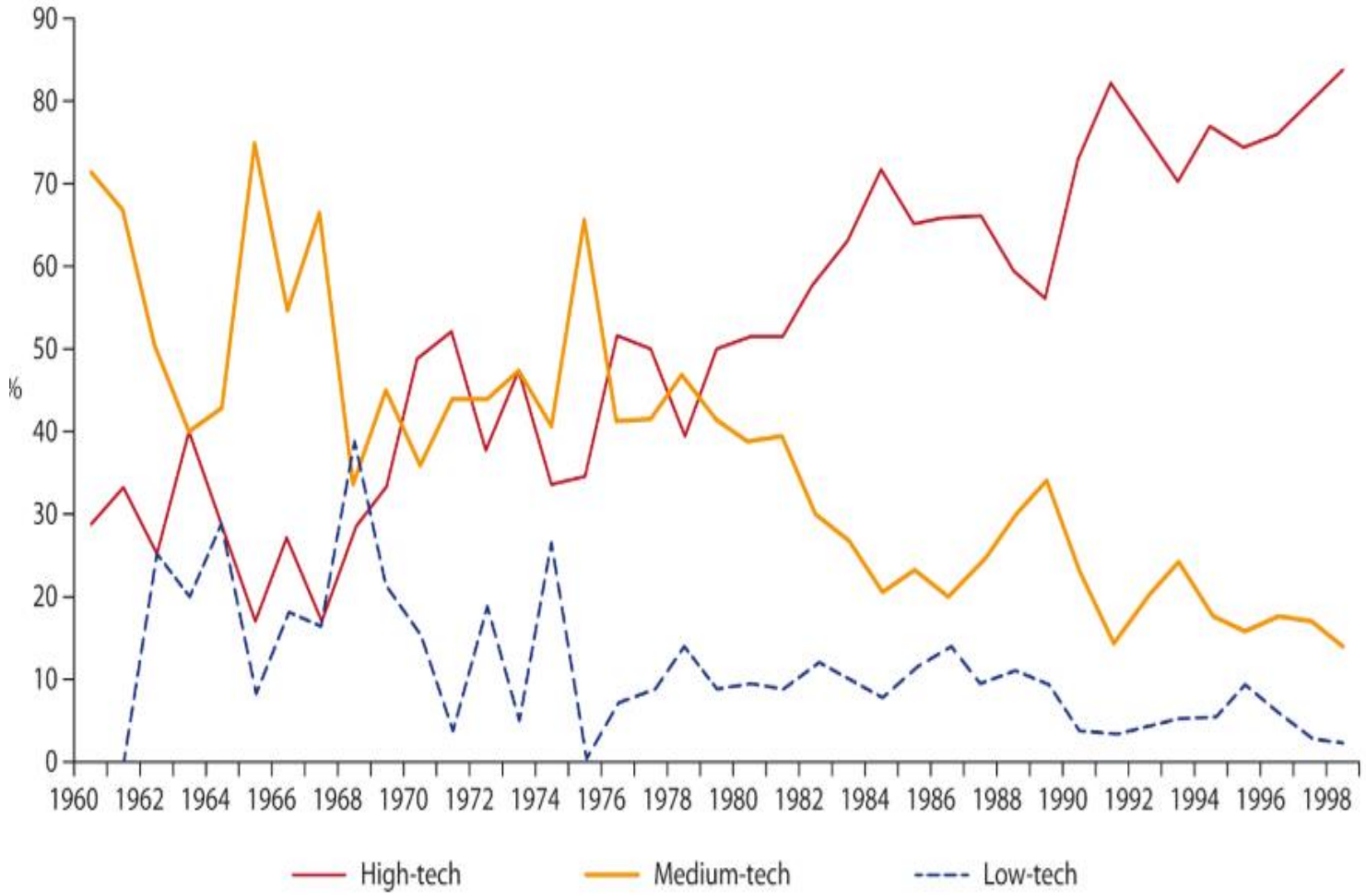
The growth of inter-company partnerships

- The growth of inter-company partnerships (especially in the field of R&D) is due to the increasingly **diverse** and **interdependent** nature of the **specialised knowledge** necessary for **innovation.**

The growth of inter-company partnerships in R&D (1960–1998). Source: Hagedoorn [2002, 480].



Inter-company partnerships in R&D by sector (1960–1998). Source: Hagedoorn [2002, 482].



Economic globalisation and the reorientation of public policies

- The emergence of new international competition from recently industrialised countries makes it clear that:

1. Innovation is the **winning strategy** to compete with countries with low labour costs;
2. The role of **public policies** is crucial to support innovation;
3. The policies must, however, be rethought within a more **integrated** and **systemic framework** (OECD 2005).

2. Many contribution but no single theory

- The contributions presented do not form a **formal theory** (a shared and coherent set of concepts and propositions that explain precise relationships between variables).

- Instead, they offer an **analytical** and **conceptual framework** that directs research towards one single object of research (innovation), even if articulated on different levels.

- In other words, this is analytical reasoning produces “abstract causal models”, but remain empirically grounded and historically sensitive. This recalls Merton’s middle-range theories and Weber’s ideal types.

- The differences within these systemic approaches start from the **foundational dimensions** used to define innovation systems:

1. **Spatial or geographical criteria**, which distinguish between national, regional and local systems;
2. **Industrial or technological criteria**, which classify systems by production or technological sectors;
3. **Types of actors and relationships**, as in the case of the triple helix model.

3. National systems

- The first formulations of **national innovation systems** (**NIS**) appeared in the 1980s. They stressed the **active role of governments** in building technological infrastructure to support economic development. This idea became fully established in the 1990s.

- Beyond academic debate, the concept spread widely in **policy circles** thanks to its adoption by international organisations such as the OECD, the European Commission and several national governments.

- **What explains this success among both scholars and policy-makers?**

- The **first** reason is that this approach brought together several earlier contributions and became a confluence point for new theoretical reflections. The crisis of the "linear model of innovation" and the rise of "evolutionary economics" encouraged the search for new conceptual tools.

- In this context, innovation was placed at the centre of a "**new theory of development**" that combined the study of economic structures and institutional settings, both to explain the different paths and specialisations of advanced economies and to offer guidance to national governments.

- This leads to the **second** reason for the rapid success of the new systemic approach.

- NIS also became a **policy concept**, a useful tool not only for research but also for public policies.

- From the start, NIS stood at the boundary between two communities (the scientific and the policy-making), thanks to the role of certain leading scholars who worked in both fields.

What exactly are NIS?

- There are various definitions.
- Nelson and Rosenberg describe them as *'a set of institutions whose interactions determine the innovative performance of national firms*'.
- Lundvall defines them as '*the elements and relationships that interact in the production, diffusion and use of new and economically useful knowledge, and that are located within or rooted inside the borders of a nation state*'.
- Edquist argues that NIS include '*all important economic, social, political, organisational, institutional and other factors that influence the development, diffusion and use of innovation*'.

- These definitions differ in some respects, but they share a few **key theoretical assumptions**.

1. The first assumption is that national economies show different specialisations, not only in production and trade, but also in **knowledge**.

- These productive and cognitive specialisations are **interdependent and co-evolve** together in a path-dependent way: they follow trajectories shaped by history and previous experience, and they change slowly not only through economic shifts but also of learning processes.

2. The second assumption is that knowledge is “**sticky**”: it does not move easily and circulate from one place to another. It is embedded in people, in organisational routines, and in relationships between firms and institutions.
3. The third assumption is that individuals, firms and organisations never innovate alone; therefore, studying innovation requires an **interactionist perspective**.
4. The fourth assumption is that the (heterogeneous) plurality of actors and institutions involved in innovation demand a holistic, interdisciplinary and historical-evolutionary approach.

The idea of a system

- The key concept in this approach is the idea of a **system**, understood as an interconnected set of elements that work toward a common goal. A system essentially consists of two parts: (a) **component** and (b) **relations**.

- The (a) components of the system are organisations and institutions. Organisations are the actors (formal structures) that operate and interact within the system, while institutions are the formal and informal rules that guide action and regulate interaction.

- ‘*Institutions are sets of common habits, norms, routines, established practices, rules or laws that regulate relations and interactions between individuals, groups and organisations*’.

- Examples include intellectual property laws (patents, trademarks, etc.), patterns of cooperation and competition between firms, collaboration practices between firms and universities, and rules governing scientific research and innovation funding.

- (b) **Relations** refer to the links that connect the different components of the system. The NIS approach places strong emphasis on interaction, and considers both market and non-market relations between the actors involved.

- NIS studies define system boundaries using a **geopolitical criterion**, taking nation states as the units of analysis. This choice is based on two main reasons.

1. First, national economies differ greatly in economic, political, social and cultural terms, and these differences shape the institutional and organisational features of each innovation system: the resources devoted to scientific research, the dominant specialisations, the ways innovation is produced, and the results obtained.

2. Second, many policies that support – directly or indirectly – the innovative capacity of firms and regions are still designed and implemented at the national level.

- The main function of NIS is to '**develop**, **diffuse** and **use innovations**'. The activities are carried out by various organisations and represent their specific contribution to innovation.

The role of theorisation

- As we saw at the start of the lesson, there is no shared definition of this concept. The contributions do not form a formal theory, but rather an analytical and conceptual framework.

- One major difference concerns the degree of theorisation required in this field: some scholars see a **lack of theory** and call for greater rigour in the definition and operationalisation of concepts, while others view the **theoretical and analytical flexibility** of the approach as an advantage.

- Nelson's book (1993) compares different national cases and focuses mainly on actors in science-based innovation, whereas Lundvall (1992) adopts a broader scope and is more theoretically oriented.

National Innovation Systems: A Comparative Analysis

- The book edited by Richard Nelson, examines 15 national economies to show the similarities and differences in the institutions and mechanisms that support innovation.
- The cases include major industrial economies (US, Japan, Germany, France, Italy and the UK), several small high-income countries (Denmark, Sweden, Canada and Australia), and some newly industrialised states (South Korea, Taiwan, Argentina, Brazil and Israel).
- Although the case studies follow **different methods**, they all focus closely on R&D and its funding, with attention to three main actors: firms, universities and governments.
- The role played by these institutions, and the different combinations found in each country (the specific institutional mix) shape the features of national innovation systems and influence their performance.

National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning

- The book edited by Lundvall (1992), does not present a comparative study of national cases. Instead, it offers a theoretical and conceptual framework of innovation systems, based on research on economic development carried out by a group of economists at Aalborg University in Denmark.
- The starting point is the claim that, in the new economic context, the key resources for competition are knowledge and learning processes.
- Lundvall argues that a new phase of capitalism has begun, marked by rapid economic change led by technology, where the success of firms, regions and nations depends on their **ability to learn** (that is, to create and/or absorb new knowledge). This is what he defines as a **learning economy.**

- In modern capitalism, innovation is:

1. **Constitutive and ubiquitous:** it is spread throughout the economic fabric and involves continuous processes of learning;
2. **Gradual and cumulative:** it consists of ‘new combinations’ based on previously available knowledge, opportunities and components which are combined in a different way, introducing a variable level of radical discontinuity with the past;
3. **Processual**: it is not a single event but a chain of activities that affect one another, making the classical distinction between invention, innovation and diffusion less clear.
4. **Interactive and collective:** learning is configured in relational terms (interactive learning) and knowledge is a common good that is shared within networks and organisations.

The learning economies

- For these reasons, Lundvall argues that we need a **new analytical model centred on learning**, which creates and acquires knowledge useful for innovation.
- He sees learning as a process of **building skills** and identifies four types of knowledge, each linked to different abilities:

1. **Know-what** and (2) **know-why** refer to knowledge of facts (natural, social, etc.) and the principles that explain them, and depend on cognitive skills.
3. **Know-how** refers to the practical skills, required to perform specific tasks.
4. **Know-who** refers to social skills – knowing who has certain expertise and being able to build effective relationships ('who knows what' and 'who knows how to do what').

- These types of knowledge are learned in different ways.
- The first two are more **formal** and can be acquired through study.
- The other two, however, are partly **tacit**, harder to codify, and are learned through practical experience and social interaction. Their circulation does not follow normal market channels, because trust strongly shapes how they are shared.

- Lundvall therefore adopts a broad definition of NIS, one that includes not only the institutions and organisations involved in scientific and technological research, but also all parts of the economic and institutional system that affect learning processes embedded in **routine activities**.
- These ‘ordinary’ activities generate three types of learning economies:

1. **Learning by doing** improves the production process;
2. **Learning by using** increases the efficiency of complex systems;
3. **Learning by interacting** produces refinements and innovations through relationships with other actors (e.g. producers, suppliers, consumers).

4. Sectoral systems

- We have focused on innovation systems defined on a geographical basis. Other authors have proposed a different approach, based on **production sectors**.
- The main idea is that technological change and innovation depend on the specific features of each industry. This view is known as the **sectoral innovation systems** (SIS) approach.
- This approach is grounded in evolutionary economics, which evidence how technological transformations are central to explaining economic change;

The main component of SIS

1. **Knowledge and technology**. New knowledge is the foundation of technological change and each sector has its own knowledge base and specific learning processes.
2. **Agents and networks**. The main actors in sectoral systems may be individuals (such as consumers, entrepreneurs, or scientists) or organisations (such as firms, universities, research centres, and government agencies). The analysis focuses not only on these actors but also on their interactions — the formal and informal cooperation ties that connect them and help combine their different knowledge, skills, and specialisations.
3. **Institutions**. These include norms, routines, habits, practices, rules, laws, and standards that shape how actors think and behave. These rules vary in their level of formality and strength: some emerge from interactions between actors (like contracts), while others impose external constraints (like laws).

- The first factor mentioned above (knowledge and technology) is the central and distinctive element of this approach. The main idea is that each SIS is built on a different "**technological regime**".
- This concept refers to the "**technological environment**" in which firms operate.
- It varies according to the conditions under which technological change occurs, such as: **1) opportunity**, **2) appropriability**, the **3) degree of cumulativeness of technological progress** and the characteristics of the **4) knowledge base**.

The “technological regime”

1. Conditions of **opportunity** describe the likelihood of innovating for any given amount of money invested in research. A high (or low) level of opportunity defines a technological environment with broad (or limited) potential for innovation, and therefore creates strong (or weak) incentives to invest resources.
2. Conditions of **appropriability** concern the ability to protect the results of innovation in order to obtain the related economic benefits. A high level of appropriability means that, through tools such as patents, secrecy, continuous innovation, or control of key resources and complementary services, a firm can protect itself from imitation and turn its innovative activities into profit.

3. Conditions of **cumulativity** refer to the extent to which past knowledge is important for producing new knowledge in the future. In other words, they show how much new technological solutions depend on those introduced earlier. Cumulativity may relate to the cognitive dimension (technological level) or to the experience and expertise built up within a specific organisation (company level), an industry (sectoral level) or a geographical area (local level).
4. **Knowledge base** refers to the know-how needed for innovative activity, which varies according to its nature (more or less specific, tacit, complex or independent) and to the ways it is transmitted (formal or informal).

- The **combination** of these elements defines the "technological regimes" of different sectors, and each regime is linked to **specific models of innovation**.

Sectoral models of innovation: creative destruction and creative accumulation

- We can return to Schumpeter's ideas and distinguish between two models.

1. The first is the model of **creative destruction** (*Schumpeter Mark I*), typical of markets with low entry barriers (***new entries***). These markets include many SMEs, where innovation comes mainly from entrepreneurial initiative. SMI is characterised by high innovation opportunities, low appropriability and low cumulativity (at company level).
2. The second is the model of **creative accumulation** (*Schumpeter Mark II*), found in markets with high entry barriers, where innovative processes are dominated by the R&D laboratories of large companies (***incumbent firms***). It features high appropriability and high cumulativity.

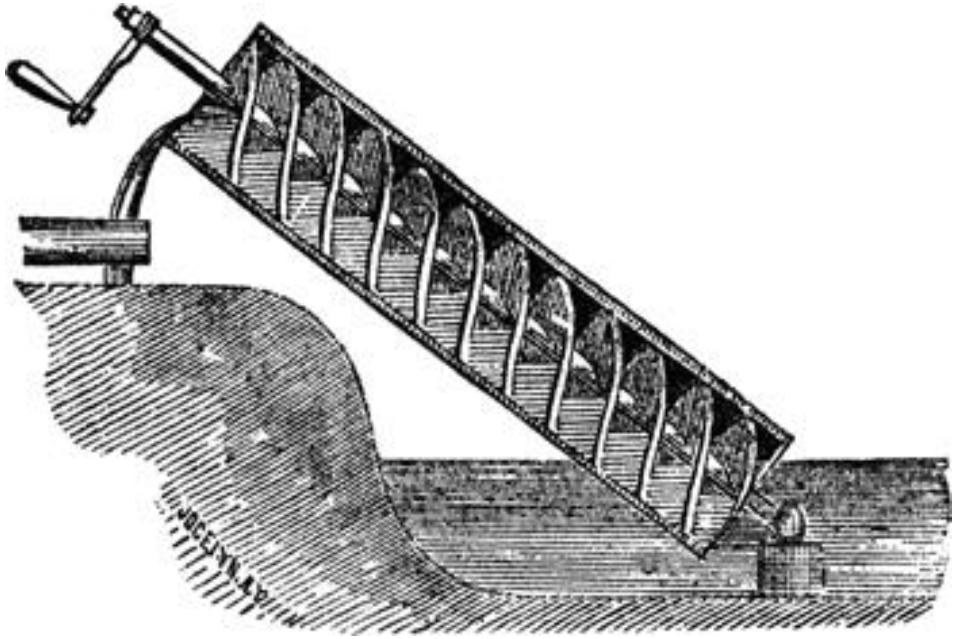
- However, models of innovation are not static. They change over time, following the life cycle of a sector and the evolution of its technological regime.
- In the early phase, when knowledge is still fluid, the technological trajectory is uncertain, and entry barriers are low, small and new firms drive innovation (a Schumpeter Mark I model prevails).
- When the sector enters a more mature stage and the technological trajectory becomes more stable, financial resources and economies of scale gain importance. As market entry barriers rise, large firms take the lead (a Schumpeter Mark II model emerges).

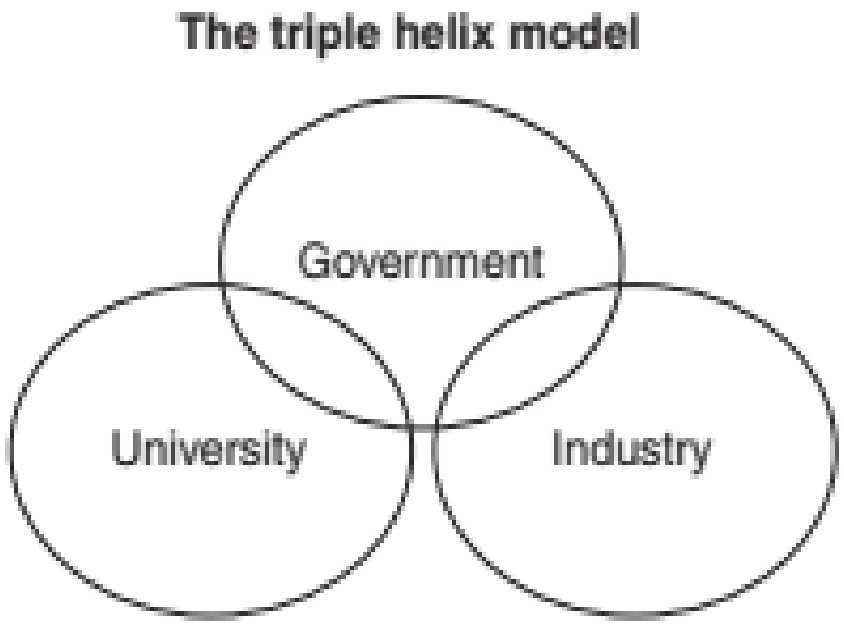
- This does not mean that sectors follow a linear path of evolution, in which they inevitably move from a Mark I to a Mark II model.
- Trajectories can also take the opposite direction, because strong changes in the technological regime (or market conditions) may allow new firms (new entries) to enter a sector previously dominated by large (incumbent) companies. These new entrants may use innovative technologies or respond to new types of demand.
- This development marks a shift from a Mark II to a Mark I model, or even to a hybrid form that combines elements of both.
- ***The evolution of the pharmaceutical industry***

5. The triple helix

- The triple helix (TH) model also stresses the systemic and interactional nature of innovation processes.
- However, it stands partly apart from the literature on national innovation systems, which TH scholars see as more suitable for studying incremental innovation, because it treats firms as the main actors and focuses on the path-dependent features of institutional systems.
- In contrast, the TH model centres on **radical innovation**, which produces major structural discontinuities.
- It proposes a **spiral model of innovation** that highlights interactions between three distinct institutional spheres (universities, industry and government) seen as the key pillars for innovation and growth.

- This new model develops from the convergence of two ideal-types of institutional structures.
- The first is the **statist model**, in which the government controls both universities and the economy; here the state plays the central role in promoting economic growth and social development.
- The second is the liberal**, laissez-faire model**, where the three spheres are independent and interact only weakly because rigid boundaries separate them. In this case, the market is responsible for promoting economic growth and social development.
- In the TH model (which evokes the image of a screw-type hydraulic pump, known as Archimedes' screw), the institutional spheres partially overlap, giving rise **to hybrid organisations**.




The triple helix model
Government
University
Industry

- This new configuration of relations produces significant changes in the institutional framework.
- At the **first level** (micro), transformations take place within each sphere (that is, within each helix) due to the hybridisation of institutional logics.
- Universities perform economic functions through the commercialisation of knowledge; companies take on responsibilities for advanced training and research; and governments promote research, becoming venture capitalists who finance innovation to support national competitiveness.
- At a **second level** (macro), changes concern the influence that each helix exerts on the others.

- A key example is the Bayh–Dole Act, approved by the US government in 1980. This law allowed American universities to own the patent rights from publicly funded research, giving a major boost to the commercialisation of scientific results and to the rise of entrepreneurial universities.
- At a **third level**, there is the creation of "**a new overlay of trilateral networks and organisations**" that emerges from interactions among the three helices, and is designed to generate new ideas and models for high-tech development.
- These processes occur mainly at the **regional scale**, although TH regions do not necessarily correspond to political or administrative borders.

6. Regional systems (cap. 6)

- Chapter 6 is devoted specifically to these issues (**regional innovation systems**).
- From an analytical point of view, two aspects must be highlighted:

1. **The geography of innovation**
2. **Knowledge as a club good**

6.1 The death of distance and the rediscovery of geography

- The revolution in ICT and the reduction of regulatory and tariff barriers on goods and capital have led some to predict the "**death of distance**."
- These debates suggest that recent technological change has fundamentally reshaped the development model.
- On the one hand, the economy relies increasingly on knowledge and **intangible assets** (such as creativity); on the other, production is being reorganised in space in ways that seem to reduce the role of **physical distance**.
- This resembles Thomas Friedman's (2005) idea of a "**flat world**," where geographical differences shrink and socio-economic relations become more homogeneous.

- Empirical evidence, however, points in **another direction**. Even today, the production of wealth and well-being does not occur everywhere.
- Companies (especially industrial firms) remain concentrated in specific areas where similar firms, specialised services, and a skilled workforce are located.
- Some of these “**industrial locations**” also have long-standing productive traditions that tend to persist over time.
- This renewed interest in territory is also central to the **geography of innovation**.

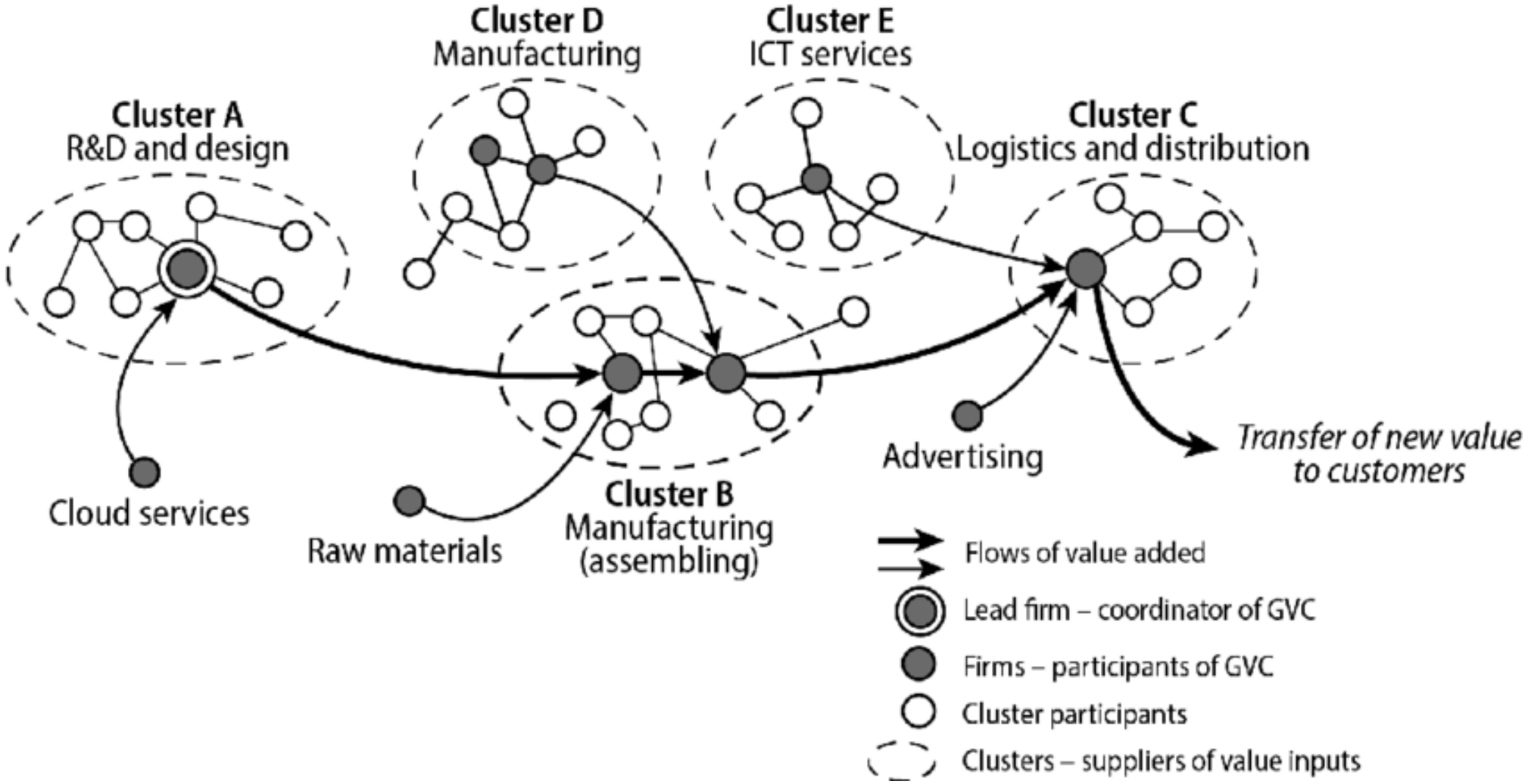
- Innovation does not occur randomly: it tends to **cluster** in places rich in resources closely tied to the socio-institutional context (universities, research centres, advanced services, etc.).
- The **spatial dimension** matters for innovation for two main reasons.

1. Innovation is a **joint process** of knowledge creation and application, and spatial proximity makes this easier.
2. **Knowledge spillovers,** the more or less voluntary circulation of information and know-how generated during research and innovation activities.

Knowledge spillovers

- Spillovers create positive **externalities** that also benefit actors who have not contributed to producing the knowledge.
- As a result, the innovative performance of companies depends not only on the resources they invest in their own research, but also on the resources invested by other firms (as well as by universities and research centres) in the same or related sectors.
- The ability to benefit from these spillovers, however, depends on being **close to the source of new knowledge**, and this proximity becomes even more important when innovation relies on (**non-codified**) **tacit knowledge**.

- **Tacit knowledge** comes from experience in specific contexts and is embodied, meaning that it is inseparable from the person who holds it and is transmitted through “dense communication” based on personal relationships.
- For these reasons, tacit knowledge finds it difficult to travel long distances: it is produced at the regional or local level and tends to remain there; in other words, it is spatially sticky.
- In a context of globalisation, the more codified knowledge circulates easily through global networks, the more tacit knowledge becomes a strategic asset that creates a competitive advantage that is hard to imitate.
- In short, the production and diffusion of new knowledge often occur locally, through learning-by-interacting processes.


Cluster D
Manufacturing
Cluster E
ICT services
Cluster A
R&D and design
Cluster C
Logistics and distribution
Cloud services
Raw materials
Cluster B
Manufacturing
(assembling)
Advertising
Transfer of new value
to customers
Flows of value added
Lead firm – coordinator of GVC
Firms – participants of GVC
Cluster participants
Clusters – suppliers of value inputs

6.2 Knowledge as a club good

- Knowledge is not really a public good, but is closer to a "**club good**": an asset shared privately by a limited group of actors (a club) who can use it exclusively through certain "exclusion mechanisms."
- These mechanisms allow only authorised users (who pay the related costs) to benefit from the good, while excluding all others.
- The **geography of innovation** builds on the idea that **territorial proximity** acts as one of these "exclusion mechanisms," since only firms located in a specific area can benefit from the productive resources and collective assets found there.

Critiques on regional systems approach

1. The borders of regions (and states) have an administrative nature rather than a functional one.
2. Cities (such as Milan, Lyon, London) and local clusters (such as Oxford) matter more than regions, which are often too large to be meaningful.
3. The role of regions in public policies supporting innovation is ambiguous. In the EU, most activity focuses on investments aimed at promoting convergence in weaker areas.

Thanks for the attention

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