Digitalisation and organisational innovation

1. The five characteristics of innovation
2. Types of innovation
3. Schumpeter and the economy of innovation

4. The rise, crisis and transformation of the Fordist model
5. Varieties of capitalism
6. The (new?) role of the state
7. Growth regimes

8. Networks and innovation: the structural approach
9. The professionalisation of inventive activity
10. The Post-Fordism and the rebirth of SMEs and independent entrepreneurs
11. The “socio-cultural approach” to creativity
12. Complex network theory
13. The musicals industry
14. The Silicon Valley hub

15. National innovation systems
16. Different types of skills and learning models
17. Sectoral innovation systems
18. Creative distruction and creative accumulation

19. Big Data

1. The five characteristics of innovation

- What do we mean by “**innovation**”?
- The verb ***to innovate*** and the noun ***innovation*** describe the transformation of an existing state of things, to create something new.
- This idea refers both to the **action of change** and to its **outcome**. It also suggests that innovation implying a **contextualisation** and a **diachronic comparison**.
- Innovation needs to be collocated within the context in which it occurs, and its results can be understood only by comparing what existed previously with what follows its introduction.
- These simple considerations give us a **process-oriented** and **relational idea** of the concept.

1. Innovation is **processual**
2. Innovation is **relational**
3. Innovation is **different from change**
4. Innovation should be **distinguished from invention**
5. Innovation does **not always bring positive results**

1. Innovation is processual

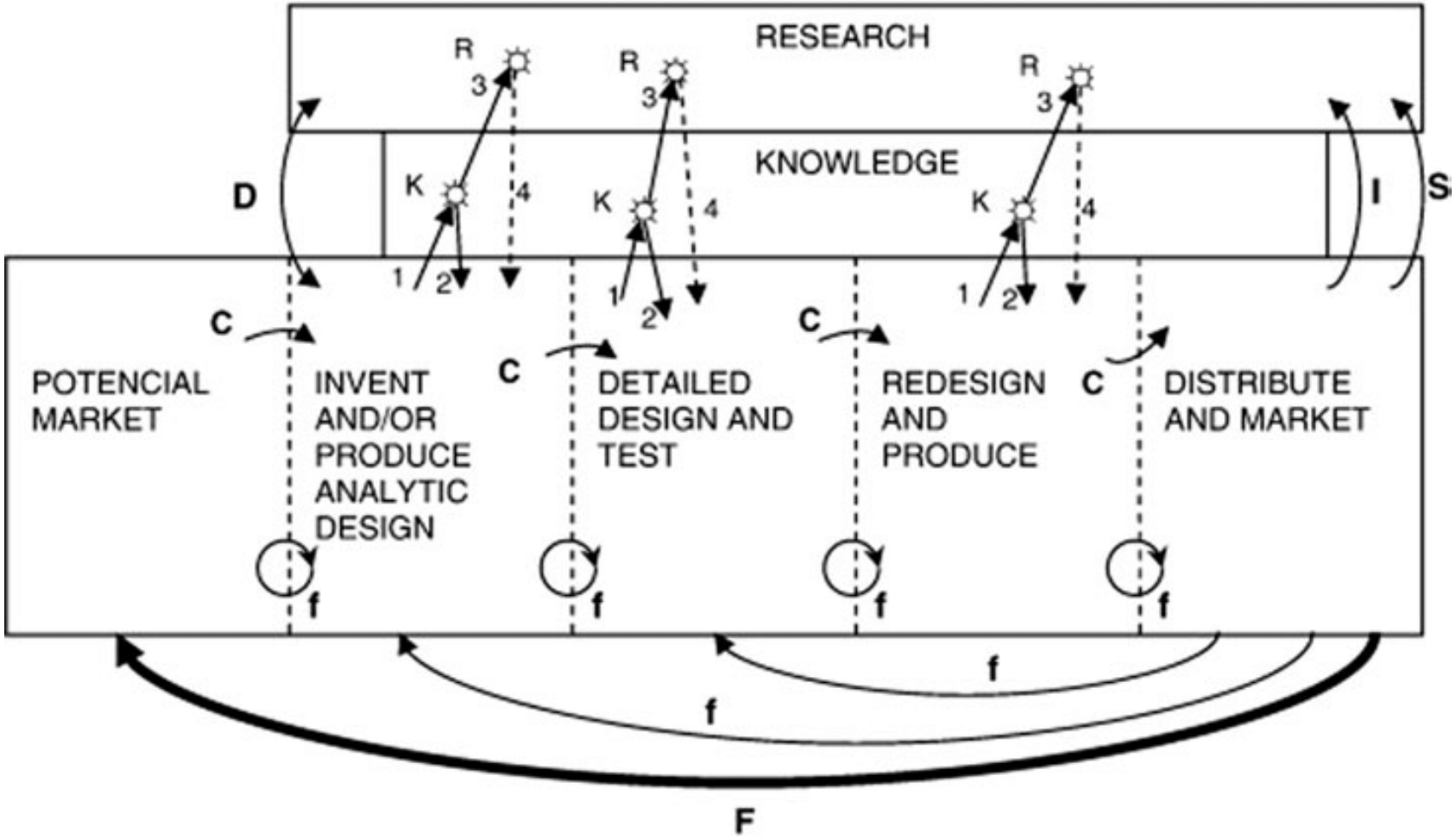
- Innovation is a **complex activity** made up of a series of **interconnected phenomena**. It includes many activities and transitions that scholars have often combined into phases (Rogers, for example, indicates **six phases).**
- The division of the innovation process into different stages has only an **analytical purpose**: it is useful to define the ideal-typical categories and reference points for the analysis of specific cases.
- This division does not mean that innovation always follows a **linear order**, with each stage clearly separated from the others.
- Moreover, although innovation always includes the creation, diffusion, and use of new knowledge, this knowledge does not always come from formal research. It often develops from the **practical experience** of suppliers and users of certain goods and services.

- Despite that, for many years, research on economic innovation was based on the so-called **linear model of innovation**, which describes a fixed and ordered sequence of stages.
- The process begins with basic research, continues with applied research, moves into the development phase, and ends with production and market diffusion.
- This model shows innovation as a **one-way process** that flows from upstream (basic research) to downstream (the market).

- Against this backdrop, Kline and Rosenberg (**1986**) developed the so-called **chain model**. They showed that innovation is an uncertain, complex, and non-linear process, which often does not begin with research activity.

- In this model, there is **interaction** and **cross feedback** between the different stages. Important ideas for research often come from later phases, such as development or the market.

- Innovation therefore has a **circular** and **recursive** nature. It would be wrong to limit the ‘creative’ dimension only to the first stage, the input phase.



C: central chain of innovation
f: feed-back loops) to depict the trial and error nature of the process
F: feed-back from testing the idea in the market
K and **R**: knowledge and research

2. *Innovation is relational*

- Innovation is a relative concept: it must always be understood in relation to a specific **period** and **context**.

- Innovation also depends on the contribution of other **actors**, either **directly** or **indirectly**. Their input matters both in the creation phase (through the exchange of ideas and interpretations) and in the implementation phase.

- In order to have an impact on the context, it must also be **accepted** and **diffused**, and this occurs through the mediation of interpersonal relationships, as sociological studies on diffusion show.

3. *Innovation is different from change*

- Change is a **broader** and more **general concept**. It refers to transformations that are not necessarily innovative.
- Innovation always includes change, but it aims to introduce something new.
- As Schumpeter explained, it means ***“doing new things or doing things that are already being done in a new way.”***

4. Innovation should be distinguished from invention

- Invention means creating a new product or process, while innovation means putting that new idea into practice for the first time. As Schumpeter said, "***the inventor produces ideas, the entrepreneur gets things done.***"

- Schumpeter made this distinction by separating the figure of the **inventor** from that of the **innovative entrepreneur**.

- The **inventor's** work focuses on the progress of knowledge, while the **entrepreneur's** activity has direct economic value: "*getting new things done*" *is not only a distinct process but it is a process which produces consequences that are an essential part of* ***capitalist reality***'.

- However, the line between invention and innovation is **not always clear**. In some industries, such as biotechnology or software, inventive and innovative activities often overlap.

5. *Innovation does not always bring positive results*

- The word innovation carries a strong **emotional** and **evocative power** and often creates a **bias**. People tend to believe that all changes linked to innovation are always positive.
- As a result, innovation is often seen as a synonym for **progress**.
- This way of thinking is misleading because it mixes two levels that should stay separate: the **intentions and expectations** for improvement, and the **evaluation of the results** produced.
- The introduction of something new is not always positive and does not always lead to the desired results.
- Innovation can fail or produce **unexpected effects** that may not be beneficial for the innovators or for society as a whole — for example, nuclear energy and the atomic bomb.

2. Types of innovation

- The reference point for defining innovation is the **Oslo Manual**, which guides data collection for surveys conducted across European Union countries.

- There are four main types of innovation:

1. **Product innovation**, refers to the creation of new goods or services, or to significant changes made to existing ones.
2. **Process innovation**, involves changes in the way goods or services are produced or delivered.
3. **Organisational innovation**, introduces new ways of structuring and managing business operations.
4. **Marketing innovation**, relates to changes in product design or packaging, in promotion and market placement, or in selling prices methods for goods and services.

- Every change in these activities must include some degree of novelty, although the level of newness can vary greatly. In the literature, two main types of innovation are usually identified:

1. **Incremental innovation**, which introduces small improvements or limited changes in the production or use of a product or service.

2. **Radical innovation**, which brings a much higher level of newness. It reshapes the knowledge and expertise previously used in a specific field and can sometimes even create entirely new markets.

- Examples of the first type of innovation include the constant updates made to cars, televisions, and computers. Manufacturers introduce these changes to improve design or performance, attract new customers, and stay ahead of competitors.

- Examples of the second type include the launch of the first cars, televisions, and personal computers — products that completely changed their markets (i.e. Smartphone).

- However, incremental innovation should not be **underestimated**. In quantitative terms, it makes up most of all economic innovations, and in qualitative terms, many small, cumulative improvements can lead to major transformations over time.

- In addition to single innovations, we must also consider broader **technological changes**. Shifts in technological systems represent large-scale transformations that affect several economic sectors and include many interrelated innovations — radical, incremental, and organisational.
- One example is the development (in the first half of the twentieth century) of new techniques for producing **synthetic materials**, which came together with innovations in the petrochemical and machinery industries.
- **Technological revolutions**, called techno-economic **paradigm** shifts, can **reshape the entire process of economic development**.
- The best-known example is the revolution of the late eighteenth century, marked by the invention of the **steam engine**.

3. Schumpeter and the economy of innovation

- Although Schumpeter (1883-1950) was trained within the Austrian School of economics and shared several assumptions of neoclassical theory, he was also influenced by the **historical school** and by **Marxist** and **sociological perspectives**.
- These multiple influences led him to pay close attention to the **non-economic factors** of development.
- The importance of these social and institutional elements already appears in ***The Theory of Economic Development*** (1912), where he explains economic growth by placing the **entrepreneur** at the centre of the explanation.
- In doing so, Schumpeter distanced himself from traditional neoclassical economics, which he saw as **static** and unable to explain the **key driver of capitalist development**: **innovation**.

- The essay begins with a description of the “**circular flow of economic life**”, a situation of **market equilibrium** that determines the quantity and price of the goods produced.
- In this context, economic **growth** is based on established **routines** and **habits**. The changes that occur are continuous, marginal, and incremental, and they do not significantly alter the overall **structure** of the system (the framework of “given conditions”).
- However, this static theory cannot fully explain the processes of **development**.

- Traditional economic analysis cannot explain the **radical changes** that drive development and the **cyclical evolution** of capitalist economies.

- For these changes to occur, **innovation** is needed in the way of the "materials and forces" of production are combined: in other words, "***new combinations of productive means must be introduced***".

- These innovations can include: (1) the creation of new goods unfamiliar to consumers; (2) new methods of production or marketing; (3) the opening of new markets; (4) the discovery of new sources of raw materials or semi-finished products; and (5) the reorganisation of an industry, for example through the creation or destruction of a monopoly.

- **Entrepreneurs** are the ones who create these innovations, offering a creative response to the challenges they face.

- Capitalism is essentially **dynamic** and must be understood through **endogenous forces**: the new economic elements introduced by “**new men**” through “**new firms**.”
- This dynamism does not come from price competition between companies, but from **technological** and **organisational** competition: from “doing things differently” in the realm of economic life.
- When innovation succeeds, it brings profits to entrepreneurs, but these profits are **temporary**, because competitors soon imitate the new idea or product.

4. The rise, crisis and transformation of the Fordist model

- In the years after **World War II**, **large mass-production** companies had very positive growth prospects.

- These firms were able to take advantage of "**economies of scale**", producing large quantities of consumer goods, such as cars and household appliances, at lower costs.

- "**Fordism**" or "**Fordist–Taylorist**" was then based on **three principal characteristics**:

1. Firms were vertically integrated

- Companies began to include different productive stages, which were previously carried out by different firms.
- As production became more complex, firms faced greater risks, coordination problems, and higher financial needs — all of which led to a general growth in the **size of firms**.

2. Firms were committed to mass production

- The production focused of **standardized goods**, using special-purpose machines.
- This helped them to reduce their costs by taking advantage of **new technologies** that increased **economies of scale**. As production volumes grew, the cost per unit of product decrease.

3. Production was carried out by a relatively semi-skilled labor

- Labor was organized according to the Taylorist model: it was then highly **fragmented** and **specialized**. The work itself was sub-divided into simple and repetitive tasks, limiting workers' autonomy.

- The division between **conception** and **execution** was clear-cut and rigid, and the firm functioned like a large **bureaucratic organization**, based on **hierarchical control**.
- **Management** played a central role, coordinating, integrating and controlling all production activities.
- There was thus a separation between the **ownership** of the firm (often families or shareholders), and the **management**, which was entrusted to professional managers.

Social and economic tensions during the seventies

- In the **1970s**, several factors quickly and unexpectedly weakened economic growth and social stability in advanced capitalist countries: new industrial conflicts, rising inflation, lower growth rates, and higher unemployment.
- These changes challenged the main ideas and policies of **Keynesianism**, which seemed inadequate to deal with the combination of high inflation and high unemployment — a situation later called "**stagflation**."
- At the **micro level**, lower unemployment was linked to higher inflation, while at the **macro level**, it became difficult to control public spending as social protection systems expanded (as stabiliser).
- These problems were later reinforced by other factors (**structural** and **contingent**).

- Some of these problems were **structural**.
- As markets became **saturated**, the space for mass production narrowed. For example, in the United States, 99.9% of families owned a television in 1970, compared to only 47% in 1953. Almost every family had a refrigerator and washing machine, and the number of cars reached almost one for every two residents.
- **Competition** also increased, creating new challenges for firms in advanced countries as **newly industrializing countries** — especially in Asia — entered in global markets.
- Thanks to effective **state-planned policies**, these countries pursued industrialization strategies and grew rapidly, especially in **low-skilled mass production**, using low labor costs as a competitive advantage for exports to developed economies.

- Other factors were more **contingent**, but they still contributed to the worsening economic and social situation.

1. Mass production had profited from the low costs of energy. In **1973**, this situation suddenly changed when **oil-producing countries** formed a cartel to control exports, leading to a sharp rise in prices. In the short term, this created serious problems for advanced economies, especially those dependent on oil imports, and triggered strong inflation.
2. In **1971**, facing a growing balance-of-payments deficit, the United States suspended the **dollar's convertibility into gold** and devalued the currency, shifting from fixed to floating exchange rates. This caused instability and uncertainty, further increasing the difficulties of mass production firms.

- Together, these developments undermined the Fordist model, making its **decline unavoidable**.

The post-fordism and the flexible production

- But the decline of F. was also linked to **social** and **cultural** changes that conditioned the strategies of firms at the micro level. In richer countries, demand became more diverse and shifted toward **higher-quality goods**.
- This trend was supported by **incomes growth** but above all by the formation of **new** and **better-educated social groups** developing new lifestyles and consumption patterns.
- As a result, firms found new opportunities to produce more **diverse** and **customized high-quality goods**.
- Often it was these same firms which **oriented consumers** towards these goods, as a strategy for dealing with the difficulties of more traditional fordist production.

- A second factor encouraged the shift toward more diversified and higher-quality production: the introduction of **new electronic technologies**.
- The use of computers in production had major effects. Machines could now be programmed to perform different tasks and produce various products. In other words, new technologies could be reprogrammed simply by changing their software.
- This made **flexible production** much cheaper. Firms could produce small batches of high-quality, non-standard goods at lower costs.
- Both large firms upgrading their mass production and smaller artisan firms expanding their quality production benefited from these new techniques.

- The first strategy, often called “**flexible mass production**,” aimed to increase product variety without changing the basic production model. It kept the separation between design and execution, as well as the rigid organization of work.

- **Product development** remained centralized, though firms tried to save time by using new technologies. **Subcontractors** remained highly dependent, and production units had little autonomy from headquarters.

- The main innovation was “**programmable automation**,” with the widespread use of robots and other automatic machines. This reduced labor needs but also limited retraining opportunities and worker involvement, leading some to describe it as “**computerized neo-Taylorism**.”

- In other cases, large mass-production firms invested directly abroad, especially in **developing countries**, through **multinational strategies**. This allowed them to recreate the favorable conditions once found in advanced economies — expanding markets and lower labor costs.

5. Varieties of capitalism (Hall and Soskice 2001)

- This literature has produced **two ideal-typical** models of contemporary capitalism: on the one hand, the Anglo- Saxon model of **liberal market economies**; on the other, the Rhine model of **coordinated market economies**.

- H&S present a **relational view of firms** to solve **'problems of coordination'** and argue that the two models of capitalism create **specific institutional advantages** that guide **firms' innovation** in different directions.

- **Five spheres** are crucial for company competitiveness and show a high level of **institutional complementarity** — meaning that the logic of their different institutions fits together, strengthening overall performance and promoting specific types of behavior.

1. The **industrial relations,** to handle matters related to wages and labour productivity;
2. The **education and professional training**, to provide human capital equipped with the necessary professional skills;
3. The **corporate governance and financing**, to support innovation;
4. The **external relationships**, to deal with other firms, subcontractors and customers;
5. The **internal relationships**, to ensure the cooperation of employees in the achievement of corporate objectives.

- The **incentives** provided by the institutional framework steer companies to **produce** certain goods, to **specialise** in certain areas, and to **innovate** in a certain way.

- In particular, CMEs facilitate **incremental innovations** which lead to small improvements to existing products and production processes.

- This kind of innovation is typical of productive sectors where technological change is not too fast (**slow-tech**), such as mechanical engineering, transport and consumer durables (domestic appliances, etc.).

- The situation is different in LMEs, which are characterised by an ‘impatient capital’ (based on the stock market and venture capital) and market relationships that do not ensure long-term stability — both between firms and for employees.

- This model therefore shortens management time horizons, but also provides **flexibility**, **agility** and a greater willingness to **take risks**, which can be valuable for projects involving high uncertainty.

- As a result, this set of attitudes sustains a regime of **radical innovation** and specialisation in areas characterised by rapid technological change (**fast-tech**), such as biotechnology, semiconductors, computers and telecommunications, as well as in industries that require constant innovation, such as entertainment and advertising.

Convergence or Diversity

- During the **2000s**, the debate on varieties of capitalism was then enriched by new contributions.
- The Hall and Soskice model faced difficulties in explaining some **important national cases** that could not easily be classified as either CMEs or LMEs (**MMEs**). In this context, other types of capitalism were proposed — distinguishing among market, social-democratic, continental, Mediterranean, and Asian models (Amable 2003).
- **Theoretical questions** also emerged about the role of **institutional complementarity** in explaining national performance: do more integrated and coherent institutional systems achieve better economic growth, or are more heterogeneous systems more successful?
- Alongside the supply-side approach, which highlights how national institutions shape firms' behavior, a **demand-side approach** has gained importance, focusing on the **role of governments** and **households**.

- Furthermore, **globalization** has challenged the role of **national economies**:
- The rise of **international trade** and **global value chains** has strengthened the specialization of some countries, especially in sectors like smartphones and computers.
- The **integration of financial markets** — at least until the 2007–2008 financial crisis — and the growing **financialization** of economies have also played a major role.
- **Digital technologies** and, more broadly, the **knowledge economy** have become key drivers of change.

- These transformations have inspired two new lines of research: on one side, the **role of the state** in promoting innovation has been explored; on the other, attention has shifted from the supply side to the demand side, focusing on **growth models**.

6. The (new?) role of the state

- The **role of the state** in **promoting innovation** has returned to the center of attention, including in public debate, thanks to economist Mariana Mazzucato's book (2013). She argues for moving away from **market-centered views** of development and innovation and for recognizing the **entrepreneurial role of the state**.
- To support her argument, the Italian-British economist refers to the well-known distinction between **risk** and **uncertainty,** introduced by American economist Frank Knight (1921).
- **Risk** refers to situations where outcomes are unknown but still predictable to some extent, based on a known probability distribution. In such cases, decision-makers can use rules based on expected utility maximization.
- **Uncertainty**, on the other hand, describes situations where both the outcomes and their probabilities are unknown.

- **Private entrepreneurs** usually avoid situations of uncertainty, such as projects at the frontiers of scientific research.

- However, these projects (which are **capital-intensive** and involve **immeasurable risks)** are essential for **long-term development**.

- They form the foundation of almost all major **general purpose** technologies discovered in the second half of the twentieth century, including: internet, biotechnology, nanotechnology, and today’s renewable energy.

- This is where the entrepreneurial role of the state becomes important: **funding forward-looking** and **uncertain research projects**, from their **early stages** to the **marketing** of results.
- Economic theory justifies government intervention only in specific cases, mainly to correct so-called "**market failures**."
- According to Mazzucato, however, this view overlooks the state's **visionary** and **proactive role** in technological change, where it plays two key roles:

1. Providing innovators with **patient capital**, which is often lacking in market economies;
2. **Promoting partnerships** among researchers, universities, public laboratories, and firms, and **guiding them** toward innovations that serve the public good.

The entrepreneurial state

- In other words, the entrepreneurial state explores the "**risk landscape,**" creates new markets (especially where large capital investments are needed under conditions of great uncertainty) and takes the lead as both a **risk taker** and a **market shaper**.

- According to this line of research, the economic success of **Asian countries** is linked to the presence of a **developmental state** that both **protects young industries** from foreign competition and promotes the competitiveness and exports of **strategic firms**, while setting strict performance standards for those receiving **public support**.

- In other words, East Asian developmental states were able not only to **promote** economic growth but also to **guide** and **coordinate** the industrialization process.

- However, these early studies present a **reductive** and **simplified view** of the relationship between the public and private sectors, in which "***the state dominates civil society and social groups are pacified agents of economics***".

- This perspective can help explain the **Chinese case**, while in other economies — both within and beyond Asia — the situation appears more complex and nuanced.

- Following this approach, researchers have also examined **other emerging** countries such as Ireland, Israel, and Taiwan, which have taken leading positions in **high-tech sectors**.
- These “success stories” should be understood in the context of “**global production networks**” (cfr. GVCs): increasingly fragmented and geographically dispersed production systems, that allow emerging countries to specialize in specific stages of production and compete internationally.
- However, these new development strategies are not linked to a **single type of state**.

- **New role?**

7. Growth regimes

- A **growth regime** is a **mode of governance** of the economy.

- It includes the institutional, policy, and organizational frameworks that shape the specialization of firms, the consumption and saving patterns of the population, the use of technology and work organization.

- A growth regime can depend on a specific type of innovation, the evolution of a high–value-added industry, fiscal and monetary policies, and **welfare reforms**, that influence employment and human capital.

- **Three** key aspects of growth regimes:

1) The **engine of growth:**the sectors that drive wealth creation, job creation, and productivity. These include agriculture, manufacturing, services (high or low-value-added), finance, housing, knowledge-based activities, and ICT.

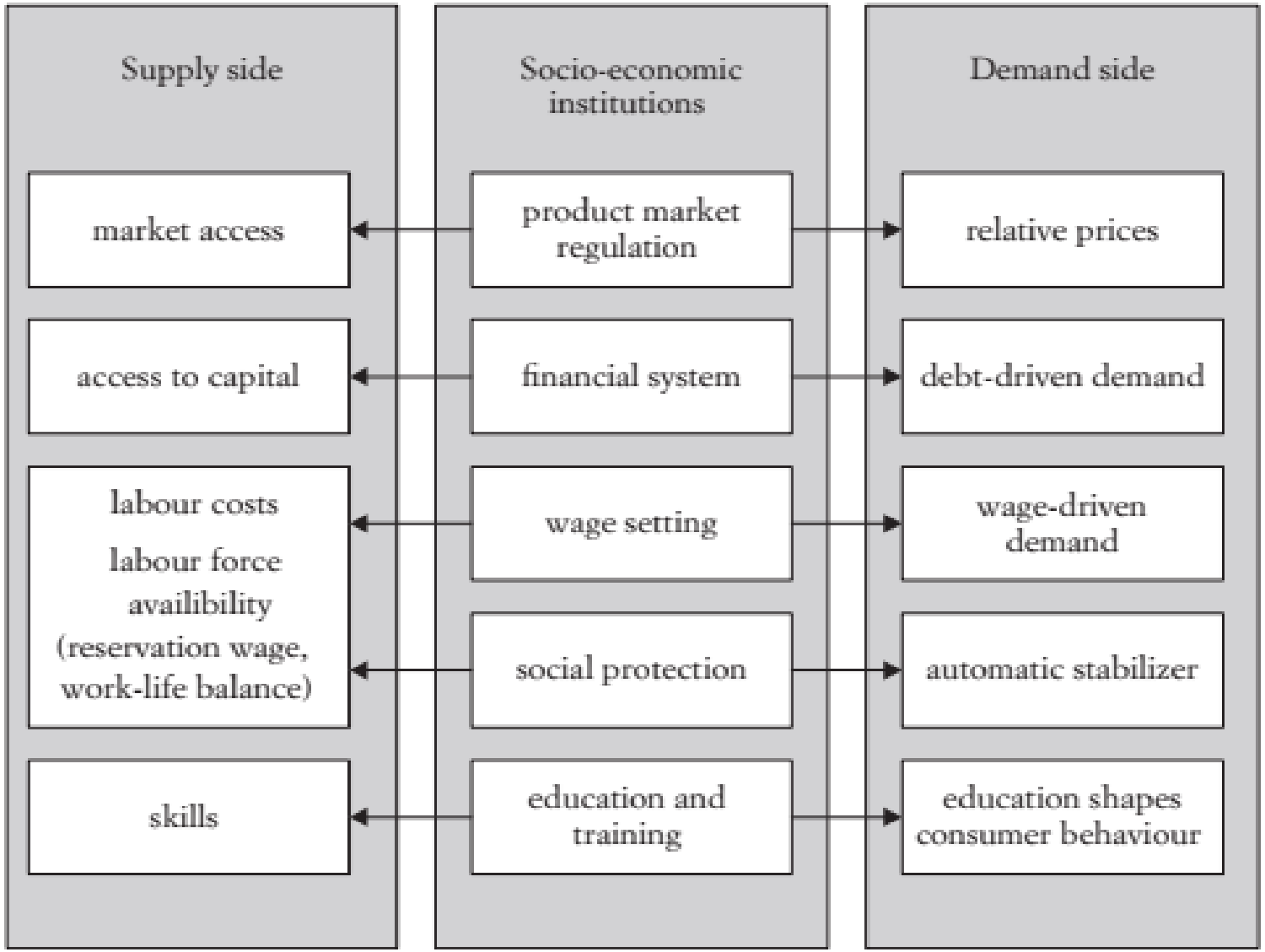
2) The **institutions organizing the economy**:

1. modes of financing the economy and corporate governance;
2. product market regulation (including industrial policies, subsidies, state ownership);
3. industrial relations, modes and rules of wage-setting, labor market rules and organizations;
4. skill-formation systems (education and vocational training);
5. social protection policies (social insurance, social investment and social assistance).

3) The **main components of aggregate demand:** private consumption (households and firms), private investment, public spending (both consumption and investment), and net exports.

- Socio-economic institutions, as identified in the CPE literature, shape the main dynamics of growth, influencing the **interaction** between **supply** and **demand** sides.

- These institutions also encourage economic actors to specialize in certain types of activities and lead political actors to support and strengthen these specializations through their **economic policies**.


Supply side
Socio-economic institutions
Demand side
market access
product market regulation
relative prices
access to capital
financial system
debt-driven demand
labour costs
labour force availibility (reservation wage, work-life balance)
wage setting
wage-driven demand
social protection
automatic stabilizer
skills
education and training
education shapes consumer behaviour

- The **welfare state** is central to national **growth regimes** because **social policies** influence both the demand and the supply sides of the economy.

- Key features of the welfare state are thus closely linked to the economy in ways that create **positive complementarities**.

- The design of the welfare state therefore plays an important role in shaping a **country's growth trajectory**.

- The policy areas and reforms (in the labor market, education, training, and social policies) are not the same across countries. They differ in both **content** and **timing**.

- These differences show that each country follows its own **internal logic**, with a certain level of consistency and coherence, that can be understood as a national “strategy”.

- However, much of this coherence comes from the specific growth and welfare regimes that exist in each country.

Five growth regimes in Europe

- If we look closely at the main components of growth regimes (the engines of growth, the institutions that organize the economy, and the main elements of aggregate demand) we can identify five different configurations:

Three types of **export-led** growth regimes:
1. Dynamic services export-led growth regimes
2. High-quality manufacturing export-led growth regimes
3. FDI-financed export-led growth regimes

Two types of **domestic demand-led** ones:
4. Finance-based domestic demand-led growth regimes
5. Publicly financed domestic demand-led growth regimes

TAB. 2. *Characteristics of the five growth regimes*

	Dynamic services export-led growth regime	High-quality manufacturing export-led growth regime	FDI-financed export-led growth regime	Finance-based domestic demand-led growth regimes	Publicly financed domestic demand-led growth regime
Demand drivers of growth	Export	Export	Export	Domestic consumption	Domestic consumption
Current account	Surplus	Surplus	Mixed	Deficit	Deficit
Financialization	High	Low	Low	High	Low
Knowledge economy (ICT)	High	Medium	Low	High	Low
Education system	Inclusive high-level	Inclusive mid-level	Inclusive mid-level	Elitist	Elitist
Social protection	Social investment	Social insurance	Social insurance	Private insurance and investment	Social insurance
Wage-setting	Coordinated	Coordinated	Deregulated	Deregulated	Regulated

Source: Table 2 is based on empirical observations, Hassel and Palier (2020) Figure 1.2 and Table 1.1; Chevalier (2020) on education; Palier and Hay (2017) on social protection and Visser (2019) ICTWSS database on wage-setting.

8. Networks and innovation: the structural approach

1. **Granovetter: The Strength of Weak Ties**
2. **Burt: structural holes and brokerage**

Granovetter: The Strength of Weak Ties

- Weak ties (for example, acquaintances made in the workplace) give people access to new information that they could not obtain through strong ties.

- Friends and relatives usually belong to the same 'information area' as the individual, so they are less likely to provide new or useful information.

- On the contrary, weak ties are more important for obtaining useful information when looking for a new job.

Thomas Edison

- Edison's approach prevailed not necessarily because it was technologically superior (efficiency) to other possible solutions at the time (such as maintaining gas lighting or building local generators), since this was a difficult parameter to assess, especially in relation to its long-term effect.

- But because it was supported by his strong network of social and professional connections.

- Edison's social networks, allowed him to mobilize personal contacts with international financiers, entrepreneurs in the electricity sector, and many other inventors and researchers whose opinions influenced decisions about lighting systems in major American cities.

The istitutionalisation of innovation: the financial derivatives

- A study by MacKenzie and Millo (2003) on the introduction and legitimization of financial derivatives on the Chicago Stock Exchange clearly shows the role of social networks in institutionalizing innovation.
- The Chicago financial community was highly structured through personal relationships that separated insiders from outsiders.
- The institutionalization of this financial innovation was possible only through the mobilization of cohesive insider groups, supported by actors from other institutional fields, such as economists and politicians.

Weak ties, social marginality and new ideas: the junk bonds

- Junk bonds soon became a symbol for medium-sized firms excluded from the traditional financial elite and a tool for launching hostile takeovers against established companies.
- However, insider firms within the financial élite mobilized political allies who introduced laws in several states to restrict the use of junk bonds.
- These measures eventually led to Milken's legal prosecution and his permanent disqualification from financial activities.

Burt: The structural holes and brokerage

- Social relationships tend to form **clusters** of individuals who interact frequently and intensely. These clusters become "**islands of opinion and behavior**" that can create barriers to information that challenges dominant beliefs and practices.

- Within the social structure, there may also be **gaps** (a lack of connections between clusters that remain isolated from one another).

- These gaps form "**structural holes**", an areas that block information flow but also create **entrepreneurial opportunities**.

- Their value lies in the fact that “they separate non-redundant sources of information”.

- Individuals who position themselves in these spaces act as bridges between different communication circuits. They benefit by gaining access to more **diverse** (non-redundant) and **timely** information and by **controlling** the flow of knowledge between clusters.

- These actors are the **entrepreneurs of networks**: real brokers who mediate between relational circuits and gain **competitive advantages**, especially in innovation and creativity.

Brokerage and creativity

- Burt explores this idea by studying the "**social origin of good ideas**".
- In his analysis, he shifts attention from how ideas are produced to the value they gain when transferred into new contexts. Their valorization depends on the exchange of information between distinct and separate groups.
- In other words, creativity works as a form of information brokerage: an import–export process where "**creativity by brokerage**" means moving an idea that is ordinary in one group to another, where it is new and valued.
- To support this argument, Burt analyzed suggestions from 673 managers in the supply network of a large U.S. electronics firm. The **ideas rated highest** by top management came from managers who accessed less redundant sources of information.

The diffusion of innovation

- These studies show that the adoption and spread of innovation depend on interpersonal relationships and the structure of the social network.
- One of the best-known findings from this research concerns the **speed of innovation adoption**.
- Many studies show that the rate of innovation adoption usually follows an **S-shaped curve**, although its exact shape may vary from case to case.
- This pattern is easy to explain: at first, only a few people adopt the innovation. Over time, as positive experiences spread through word of mouth, adoption grows rapidly (the curve rises), and then slows down as fewer individuals remain who have not yet adopted it.

9. The professionalisation of inventive activity

- There are only a few systematic studies on **inventive activity**. As a result, **inventors** and their inventions have often been overlooked.

- This underestimation is partly due to the **decline of independent inventors** that characterised the Fordist model of development, followed by the growing **socialization and formalization of innovation processes** (collective research teams, higher education levels, codified knowledge, standardized project evaluation procedures, and the routinization of research).

- In fact, although with national, sectoral, and territorial differences, the twentieth century saw the **rise of corporate research** (in the laboratories of large industrial firms), universities, and public funding, which reduced both the role of **individual inventors** and the **"market" for technological innovation**.

The social and professional figure of the inventor

- The **social and professional figure of the inventor** emerged in the nineteenth century, with the Industrial Revolution and the creation of a market for technological discoveries.
- Although intellectual curiosity and the creativity of talented individuals played a role, it is impossible to ignore the constellation of interests and collective commitment behind each stage of the discovery process.
- The **steam engine**, for example, was created to solve a practical problem that was limiting Britain's development: the need to pump water out of coal mines.

- The history of the steam engine clearly shows two things: its discovery was part of a **complex socio-economic process**, and James Watt's invention resulted from a **broader, collective development of knowledge**.
- Many technological advances that shaped our modern world came from from the work of men of great talent, who improved on **existing knowledge** and designs.
- In doing so, they often achieved innovations of great importance. As **Isaac Newton** said, the best discoveries are made "**on the shoulders of giants**": even when linked to one person (or a few individuals), most inventions are the result of collective effort.
- In other words, **invention does not take place everywhere**. It emerges in specific places and contexts, and it is not the work of an isolated individual.

9.1 The "golden age" of the independent inventor

- The period from the **first Industrial Revolution** to the **early twentieth century** is often described as the "**golden age**" of the independent inventor.
- The rise of inventors as an **independent social group** (which followed an entrepreneurial logic) was supported by the creation of a **real market for technological innovation** and, closely linked, to the development of **patent systems**. (institutional condition)
- However, it was only in the second half of the nineteenth century that reforms simplified procedures and reduced costs to make patents more accessible to working-class inventors and to strengthen the bargaining power of "ingenious workmen."
- This system made it easier for inventors to receive funding for their research and, more importantly, to **commercialise** their discoveries.

9.2 The "patent field" growth

- As technology transactions increased, the number of **specialised professionals** working in the "patent field" grew quickly.

- New roles emerged, including: journalists and publications focused on patents, lawyers in intellectual property, and consulting or brokerage agencies that helped with the submission of applications and the marketing of licences, etc (ecosystem).

- In the United States, the rise of mechanised production and a modern patent system, supported the creation of a **real market for technological innovation**.

- At the same time, it helped form a **new social group** of "**independent inventors**": research specialists who could earn an income from their patents and often achieve upward **social mobility**.

- The way in which inventions were used also changed. In the early nineteenth century, inventors often exploited their discoveries directly by **creating new firms**.

- In some cases (as a complementary activity), they also **sold** or **licensed** their **patents** on a limited scale, usually in regions where they did not run their own business (regional scale).

9.3 The growing socialization of innovation processes and the decline of independent inventors

- In the second half of the century, the role of the inventor became more **professional**. Not only did the number of **specialised inventors** increase, but the **commercial use** of patents also expanded.

- On the one hand, inventors became more skilled at mobilising **ex ante funding** for their research in exchange for future patent rights; on the other, they became more willing to sell their rights to companies with which they had **no long-term connection**.

- These inventors specialised in research and new ‘discoveries’, acted like **entrepreneurs** in the technology market, and enjoyed high **geographic and contractual mobility**, thanks to legal protection for their ideas.

- However, at the beginning of the **twentieth century**, the “golden age” of independent inventors began to decline, both in the United States and in other countries.
- Their **autonomy quickly decreased** as they started forming **long-term, exclusive relationships** with specific companies, to which they would “sell” their ideas.
- At the same time, the role of the “**employee inventor**” grew, as more research was carried out by highly educated staff working inside large private firms or public organisations.
- So, the first decades of the twentieth century marked a major change in the “**social organisation of invention**”.

9.4 The fordist era

- With fordism the production of new knowledge became then more closely linked to decisions made by actors that reacting to market pressures and stimuli.

- Companies, especially large ones, began to invest in research and created **big industrial laboratories**.

- The rise of large private and public research techno-structures changed both the **social role of the inventor** and the **generative mechanisms of invention**.

- Research began to focus on **big organisations** and on the **economic and organisational aspects of innovation**: funding, division of labour, specialised knowledge, and economies of scale of the research.

- In other words, attention shifted to the "**visible hand**", with a clear divide between public and private knowledge.

- The **scientific community** (mainly in universities, driven by reputation) promoted open knowledge and the free circulation of results, while the **technological community** (based in firms, driven by profit) promoted proprietary knowledge, using secrecy and patent protection.

The institutionalisation of the employee inventor

- The growing amount of resources needed, together with the uncertainty of projects at the technological frontier, changed the preferences of all **actors involved in innovation** (entrepreneurs, investors, and inventors).

- Technological innovation was becoming increasingly **capital-intensive**. This gave a **competitive advantage** to large firms that began to organise and diversify their own research and launch projects carried out by in-house technical staff.

- This led to a new socio-organisational structure in the private sector: the **institutionalisation of the employee inventor**.

10. The Post-Fordism and the rebirth of SMEs and independent entrepreneurs

- With the rise of **post-Fordism** and then the **knowledge economy**, SMEs regained importance: first in traditional industries (mainly through incremental innovation), and later also in high-tech sectors and areas of more radical innovation, such as telecommunications, IT, personal computers, and biotechnology.

- In this context, in recent years, the number of **venture capital** investors willing to finance highly innovative companies has increased.

- As a result, **independent inventors** and the **market for innovation** have attracted renewed academic interest.

- In many sectors, large research laboratories have been reduced in size, while small firms focused on cutting-edge research (especially technological start-ups) have multiplied. These companies often sell the **intellectual property rights** to their discoveries.

- **Patent activity** and the market transactions of new technologies have therefore started to grow again.

- This evolution has shifted the focus of innovation studies toward its **relational aspects**, with growing attention to **how information circulates** and **how innovative firms cluster** in **specific areas**.

- The creation and diffusion of new knowledge are now seen as **collective processes**, based on **interaction** between **firms** and **institutions** within certain **regions** — Silicon Valley is the best-known example but also industrial districts.

- **Theoretically**, researchers now place less emphasis on the idea that research results are difficult to appropriate.

- Instead, they highlight that even public **knowledge** requires the **ability to use it**.

- Knowledge, including public knowledge, requires a capability of use that encourages private actors to **invest in R&D**, to enhance the '**absorptive capacity**' of knowledge and of the information produced **outside** individual companies (**spillover**).

- In addition, changes in the knowledge base of some sectors — especially information technology, life sciences, and biotechnology — have led to stronger **integration** between different **types of knowledge** and closer collaboration between **companies** and **universities**.

- As a result, the traditional boundaries between the **scientific community** and the **technological community**, and between “academic inventors” and “company inventors”, have become less rigid.

- The **locus of innovation** has changed again: first it was the innovative entrepreneur, then large innovative firms, and **later** the focus is on social and territorial innovation systems;

- This shift highlights the importance of the relationship between economic actors (firms) and “non-economic” institutions.

- However, the role of **inventors** remains in the shadow. Inventors, who had already become almost invisible during the Fordist era, only partly reappear in post-Fordism, but mainly in studies on the **psychology of creativity**.

11. The "socio-cultural approach" to creativity

- Psychologists have increasingly analysed the **social and cultural contexts of creativity**, linking them not only to individual and motivational factors, but also to the **processual** and **relational** dimensions of creative activity.

- It gradually became clear that earlier studies tended to **decontextualise and de-socialise creativity**, overlooking the fact that even the most solitary creative individuals are always **embedded** in networks of influence.

- In reality, social dynamics **shape the rules, motivations, knowledge, and skills** that condition creativity, both at the individual and at the group level.

- The “socio-cultural approach” moves in this direction: it studies creative individuals in relation to the different social contexts in which they operate.

- For an idea to be considered innovative, it must be not only **original** but also **appropriate** – meaning that it is recognised as valid by a relevant community of reference.

- The creativity of a new product therefore depends less on its **intrinsic qualities** and more on the **impact** it has on others.

- In other words it requires **public recognition**, based on interaction between producer and audience: ‘*Creativity is not the product of single individuals, but of social systems making judgments about individual’s products* (Csikszentmihalyi 1999, 313).

- To understand creativity, we need to look at the interaction of three elements:

1. The **person** (source of innovation), the individual who generates the innovative idea.

2. The **field**, composed of experts of a creative field (such as teachers, critics, editors of specialised journals, theatre or museum directors, and funding foundations, influencer) who select the ideas that are considered original and appropriate. They then act as the "**gatekeepers**" of a sector.

3. The **domain**, the area into which innovation, once it is recognised as such, enters and is diffused. It includes all the products created in the past and the rules and conventions accepted within a specific sector of activity.

- Innovation is therefore the transformation of **cultural practices** in a way that is considered appropriate according to the criteria of that field.
- Culture is made up of many domains (e.g. music, mathematics, religion, technology), each with its own rules, objects, symbols, and shared systems of notation.
- The level of connection or separation between domains changes across **societies** and **historical periods**.
- Innovation happens inside each domain, through the work of creative individuals who have specific abilities.

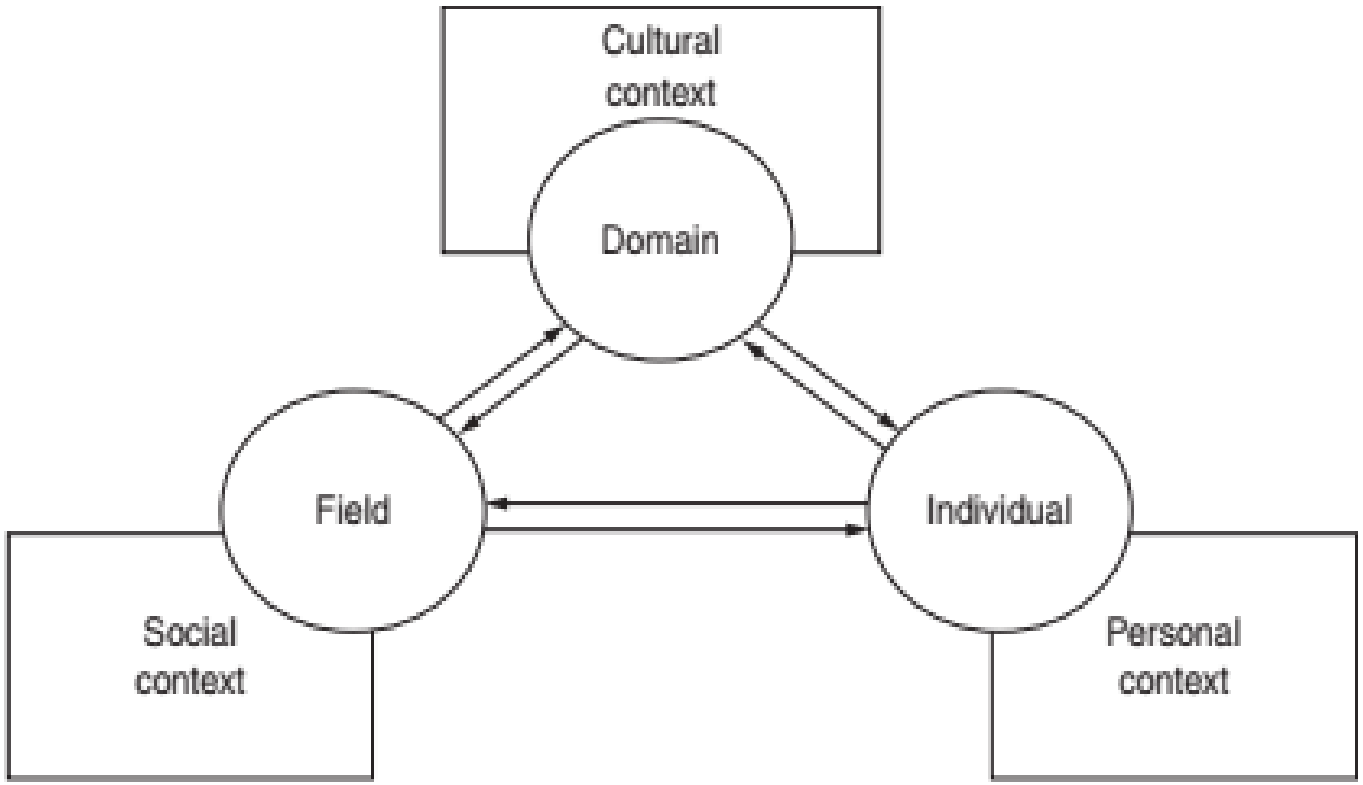


Figure 2.1 Systemic approach to creativity (source: adapted from Csikszentmihalyi (1999, 315)).

12. Complex network theory

1. Small-world effect and relational hub
2. Transaction costs
3. Actors agency

Small-world effect and relational hub

1. Saying that two people are separated by five intermediaries does not mean that they are socially close. The distance is not just “five people”, but five whole “**circles of acquaintances**” – and that still represents a very large **social gap**.

2. The **small-world** phenomenon must be understood in the **plural**. Society as a whole, scientific communities, and technological sectors all constitute a series of small worlds, highly internally integrated internally.

This **internal closure** of social networks has an important consequence: it limits access to new and non-redundant information, making it harder for actors to reach resources and ideas outside their own circle.

3. Close acquaintance cluster (family, close friends, colleagues, etc.) are internally well connected through direct links, but they are not isolated.

They are linked to the outside world through **indirect** or **weak ties**, and it is precisely these bridges that **connect different "small worlds"** and make the small-world phenomenon possible.

However, the experiments also show that even if people are theoretically connected by only a few intermediaries, **searcing**, **selecting** and **transmitting** reliable information across these links is not automatic.

The transaction costs in the use of networks

- These observations highlight the transaction problems and costs involved in using networks.

1. **Motivation**: even if connecting two acquaintances is easy, people will only do so if they have a good reason. Without motivation, the chain does not start or breaks quickly.
2. **Chain length**: the longer the chain, the greater the probability it will break or fail to deliver the expected benefits.
3. **Accreditation**: each intermediary also acts as a "filter" that validates both the information and the person who provides it.

- The longer the chain, the weaker the credibility effect becomes: "a friend of a friend of a friend" is less convincing than a direct contact. It is then evident that the more this function of accreditation is dependent on a long chain of 'acquaintances of acquaintances', the more it tends to lose power.

From non-human networks to actors' agency

- However, in **socio-institutional contexts**, the resources needed to build social ties are very different from those required to create or maintain web page links and, most importantly, they change depending on the **type of interaction**.

- In a logic of complex and **mutual interdependence**, networks both shape and are shaped by the socio-institutional environment in which interpersonal and inter-organisational relations develop.

- In the **social sciences**, there are then many more sources of variability and contingency, which limit the possibility of applying the same "**natural laws**" that govern the structure and evolution of non-human complex networks.

- Social networks are made up of **nodes**, and each node carries a **social identity**.
- The key point in this argument is that the **different identities** of actors shape both the **map** and the **compass** they use to act.
- These identities also structure networks through the **principle of homophily**, which leads people to connect mainly with others who share similar traits: "***similarity produces connection***", so networks tend to be homogeneous along many dimensions.
- This principle of homophily restricts the individual's social world, limiting interaction to a circle of "similar", and therefore reducing access to new information and diverse experiences.

- These small worlds of “similar” are also **layered** and **interconnected**, which opens windows onto different social worlds. Identities and interactions are indeed multi-dimensional, allowing individuals to move across various contexts and even bridge large distances.

- This **dual nature** of social identities shapes networks through two opposite principles:

1. **Homophily** makes local worlds small, because people cluster around similarity;
2. **Multi-dimensionality** makes the global world small, because it enables people to cross the boundaries of their local worlds.

- In conclusion, the distinctive feature of social networks is that they are composed of actors who **deliberately use** and **manipulate** their relationships (agency) and this feature conditions the properties that the social networks deploy.

13. The musicals industry

- **What is the relationship between small-world networks and innovative capacity?**
- Brian Uzzi and Jarrett Spiro (2005) explore this question in their study of the world of artistic creativity.
- They argue that creativity and innovation emerge from combining different ideas or mixing influences from several artistic fields.
- Creative tension does not come from the solitary efforts of isolated individuals, but from a system of social relations.

- The authors ask whether the dual nature of **small-world networks** (strong local clustering combined with wide global reach) influence creative performance.
- **Networks** shape the behaviour of actors by influencing the level of connection and cohesion in their relational world.
- **Cohesion** builds trust and reputation, so that material coming from a specific cluster acquires credibility and value in different environments.
- The strong **connectivity** of small-world networks allows a larger number of subjects to interact, helping information move across different clusters of relationships.

- Uzzi and Spiro tested these hypotheses by studying the Broadway musical industry.
- Box office revenue defines **commercial success**, while critics' reviews determine **artistic value**.
- Success depends largely on the **originality** of the product, which, in turn, rests on two factors:

1. The team's access to a wide and diverse set of artistic resources;
2. The belief that new experiments do not involve excessive risk.

- Creative work is based on **shared conventions**, which give artists common rules for effective collaboration and help them predict how audiences and critics will react (see Domain and Field).
- Original artists adapt and tailor these conventions to their own requirements, develop a personal style, and introduce innovations that, once accepted and copied, later become part of the conventions themselves.
- Innovation relies on access to “uncommon” creative material, which comes from working with other artists.

- A successful show is based on a combination of convention and innovative material. Without the first (shared standards) the product would be incomprehensible; while without the latter it would be boring and repetitive.
- Uzzi and Spiro showed with empirical data that changes in the balance between **local cohesion** and **global connectivity** also changed **creative performance**.
- When the small-world quotient (Q) was too low or too high, it produced opposite problems: too much variety made artistic products hard to share or use, while too much homogeneity reduced options and led to standardised conventions.
- The highest creative performance appeared at intermediate levels of the small-world quotient.

14. The Silicon Valley hub

- Michel Ferrary and Mark Granovetter study a well-known innovative cluster: Silicon Valley.
- They distinguish “innovative clusters” from “industrial clusters”, which are mainly based on incremental innovation within an existing specialisation.
- In contrast, innovative clusters stand out because they can radically **reconfigure** their **value chain** through **breakthrough innovation**, that creates new industrial sectors.

- The competitive advantage of these clusters lies in their constant ability to generate **cutting-edge start-ups**.
- Innovation is not created by single firms, but by the whole **local system**: it results from the interaction of many actors embedded in a complex network of social relations.
- A relevant key feature of complex networks is their **robustness**, meaning their ability to resist external shocks and reorganise itself to survival.
- This resistance comes from the **completeness of the network**, where many heterogeneous actors interact in a decentralised way.
- This structure makes it possible to integrate **different modes of learning**, stimulating the creativity of firms and innovation of the system.

- In fact, Silicon Valley was **formed historically** through several stages, each adding new actors who reinforced the systems of relations.
- The presence of a top university like Stanford, the creation of companies such as Hewlett-Packard, and the arrival of major external firms like General Electric, IBM and Lockheed in the 1930s were not enough on their own to make the area highly innovative.
- The area was given its initial boost through semiconductors (with companies such as Fairchild Semi-conductor, Intel etc.) but subsequently went on to specialise in personal computers (Apple), software (Oracle, Sun Microsystems, Symantec, etc.), telecommunication systems (Cisco System, Jupiter Networks, 3Com), and the internet (Netscape, Excite, eBay, Yahoo!, Google).

- As we have seen, certain actors in complex networks can act as **hubs**. In Silicon Valley, **venture capital** firms (VCs) play this role by investing risk capital in the most promising local start-ups.
- This strong VC presence distinguishes this area from many other technological districts.

VC function

1. The first, and most famous, is the **financing of technological start-ups**.
2. The second is **selecting** them.
3. The third function is **signalling** the most promising start-ups. When a VC – especially a well-known one – decides to invest, this creates a ripple effect of legitimacy among other actors in the system, which in turn facilitates the subsequent development of new businesses.
4. The fourth function is **embedding new companies** in the local system. VCs use their own networks to help start-ups enter the wider regional network. In this role, VCs act as key hubs that integrate and coordinate relationships in Silicon Valley.
5. The fifth function is **collective learning**. VCs help build a shared pool of entrepreneurial knowledge and experience that new firms can use.

15. National innovation 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.
- 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.

- The definitions of NIS 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**.

- 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.

16. Different types of skills and learning models

- 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.**
- 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.

17. Sectoral systems

- 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.
- Knowledge and technology are the central and distinctive element of this approach. The main idea is that each SIS is built on a different "**technological regime**".

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

18. 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***

Big data

- In the analog age, most of the data that were used for social research were created for the purpose of **doing research**.
- In the **digital age**, however, huge amounts of data are being created by companies and governments for purposes other than research, such as providing services, generating profit, and administering laws.
- While there are undoubtedly huge opportunities for repurposing, using data that were not created for the purposes of research also presents **new challenges**.

Ten common characteristics of big data

- Rather than taking a platform-by-platform approach (e.g., here's what you need to know about Twitter, here's what you need to know about Google search data, etc.), we describe **10 general characteristics** of big data sources, which can be grouped into two categories:

1. Generally **helpful** for research: big, always-on, and nonreactive

2. Generally **problematic** for research: incomplete, inaccessible, nonrepresentative, drifting, algorithmically confounded, dirty, and sensitive.

- Most big data sources are **incomplete**, in the sense that they don't have the information that you will want for your research. This is a common feature of data that were created for purposes other than research.
- Many sources of big data that would be useful are controlled and **restricted** by governments (e.g., tax data and educational data) or companies (e.g., queries to search engines and phone call meta-data).
- Social scientists are accustomed to working with data that comes from a **probabilistic random sample** from a well-defined population. This kind of data is called representative data because the sample "represents" the larger population. Using nonrepresentative big data sources to do out-of-sample generalizations can go very wrong**: lots of nonrepresentative data is still nonrepresentative**.

- Longitudinal data are very important for studying change. In order to reliably measure change, however, the measurement system itself must be stable: “if you want to measure change, don’t change the measure”. Unfortunately, many big data systems (especially business systems) are **changing** all the time: population drift (change in who is using them), behavioral drift (change in how people are using them), and system drift (change in the system itself).
- Although many big data sources are nonreactive, because people are not aware their data are being recorded, researchers should not consider behavior in these online systems to be “**naturally occurring**.” In reality, the digital systems that record behavior are highly **engineered to induce specific behaviors** such as clicking on ads or posting content.

- The ultimate source of this difficulty is that many of these big data sources are not collected, stored, and documented in a way that facilitates **data cleaning**. Moreover, while dirty data that is created unintentionally can be detected by a reasonably careful researcher, there are also some online systems that attract **intentional spammers**.
- Many other big data sources also have information that is **sensitive**, which is part of the reason why they are often inaccessible.

Thanks for the attention

mbetti@unite.it

(Fai clic sulla freccia in modalità Presentazione)