

Understanding innovation

SUMMARY

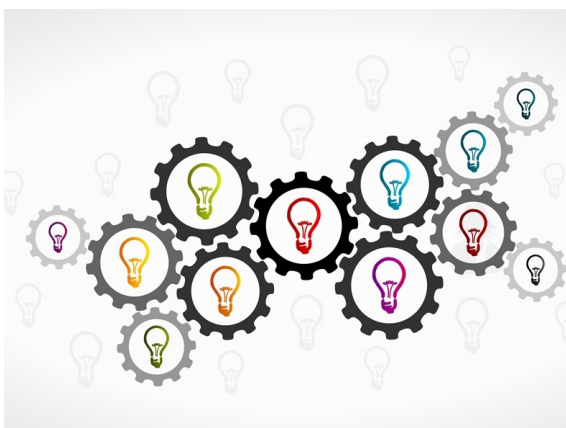
Innovation can be defined as the adoption of new products, processes, marketing or organisational approaches that create a valuable outcome in terms of financial benefit, wellbeing or efficiency, to name a few. Given its impact on smart, inclusive and sustainable growth, innovation is at the heart of European policies and one of the priorities of the Dutch Presidency of the Council of the European Union for the first six months of 2016.

The innovation process occurs in an ecosystem in which companies, public research institutions, financial institutions and government bodies interact through the exchange of skills, knowledge and ideas. The model of open innovation is used to describe the flows between these actors.

New insights on the innovation process and the organisation of the innovation ecosystem lead to the requirement to design a new policy mix that includes, above all, policies in support of research and development to foster innovation; policies for education and training to provide the workforce with the relevant skills; and policies to promote a sound business environment and to encourage engagement in innovation and entrepreneurship.

In addition to supporting the more technical aspects of the innovation process and ecosystem, these policies also need to spur the development of a culture of innovation which involves creative thinking, collaboration, initiative, openness, a positive approach to failure, and high trust within organisations and society as a whole.

Despite its positive aspects, innovation is capable of inducing potential long-term negative social, environmental or economic outcomes. Approaches involving responsible ways of undertaking research and innovation, as well applying the precautionary principle, aim to address these shortcomings.



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A multidimensional concept

The key characteristics of innovation

'Innovation' is a concept that includes each of the three following features:

- **novelty**: an element of change from the current situation;
- **adoption**: a change that is embraced by its potential users; and
- **outcome**: value, for example profits for a company, increased efficiency of a process or improvement of the wellbeing of users.

An additional aspect of innovation is that unlike an invention, which is usually considered an individual accomplishment, it results from a process involving the cooperation of numerous actors.

Different levels of impact

An innovation that is a game-changer for a whole sector or market will be referred to as a **disruptive innovation**, classical examples of which are the car, ready-to-assemble furniture and video-on-demand. An innovation that produces fundamental changes in a sector, for example, the smartphone, is known as a **radical** or breakthrough innovation. Innovations – usually – occurring inside a given organisation and with lower impact, as in the case of a new model of the same smartphone, are defined as **incremental** or sustaining innovations.

Different types of innovation

The Organisation for Economic Co-operation and Development (OECD) recognises four types of innovation, described in detail in its [Oslo Manual](#) for measuring innovation (Table 1). Product and process innovations, often based on new knowledge and/or new technologies, are strongly linked with research and development (R&D) activities. Organisational and marketing innovations are usually the result of the adoption of new methods, concepts and/or strategies.

Table 1 - The four types of innovation as defined in the Oslo Manual

Type of innovation	Characteristics
Product innovation	A good or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, software in the product, user-friendliness or other functional characteristics.
Process innovation	A new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.
Marketing innovation	A new marketing method involving significant changes in product design and packaging, product placement and promotion, and/or in the pricing of goods and services.
Organisational innovation	A new organisational method involving changes in business practices, workplace organisation or external relations.

Source: OECD, [Oslo Manual](#), 2005.

Innovation and growth

In 1942, US-based economist and political analyst Joseph Schumpeter laid out his theory on 'creative destruction', considered the foundation of innovation economics. According to this theory, innovation opens up new opportunities and markets that lead to the replacement of existing activities and actors, inducing dynamic evolution of the economic fabric. An innovation gives its proponents competitive advantages when commercialising new products, services or processes on the market. However, the more diffuse the innovation becomes, the fewer advantages its proponents receive, which thus implies the need for a continuous process of innovation. Today, this dynamic process is considered one of the key engines for economic growth.

In a [document](#) describing the strategy that needs to be in place to encourage innovation, the OECD recognises that 'there is widespread agreement that innovation is an important driver of growth, especially in the long run'. However, the OECD admits that 'the conceptual and empirical links between innovation and growth are complex', despite the clear correlation between them.

Innovation influences three production factors which have an impact on economic growth:

- **tangible capital value**, which is improved by technological progress embodied in physical capital;
- **knowledge-based capital (KBC)**: R&D activities, skills or organisational capital; and
- **multi-factor productivity growth**, which is boosted by non-technological innovation and spill-over effects of investments in technology or KBC.

The OECD estimates that 'the different components of innovation together often account for at least 50% of economic growth.' Nevertheless, it also draws attention to 'other important goals for public policy, such as the environment or well-being, that are also affected by innovation.' These findings reflect evolution in the work of the OECD, involving the preparation of a more global approach to the relationship between innovation and growth, which takes into account the effects of innovation on sustainable and inclusive growth.

Models used for describing the innovation process

In the past four decades, six models¹ have been proposed to help understand how innovation occurs and to give insight into the relationship between innovation and growth. The first two models, known as the **linear models**, describe innovation as a simple succession of discrete steps. In the first, called the **technology push** model, the process starts with the production of new knowledge through basic research. It continues with the design of new products based on this knowledge, then with their manufacturing, marketing and commercialisation. In the second, known as the **market pull** model, the linear process starts with the users' need that drives the development of new products in the same sequence. The linear models have since been widely criticised as too simplistic to describe the complexity and diversity of the innovation process.

The third generation of innovation models, known as the **coupling models**, introduced interactions and feedback loops between the different steps outlined in the linear models. While these models advocate better integration of R&D and marketing activities, they still describe innovation as a process fully internal to an organisation, as did the linear models. This limitation is addressed in the fourth generation of **interactive**

models that integrate external interactions with key suppliers of knowledge, products and processes (upstream) and with active customers (downstream).

External interactions are given a central role in the fifth generation of models, the **network models**. In them, the innovation process requires continuous exchange between different actors. Companies are not just connected with their suppliers and customers, but also, for example, with some of their competitors through strategic alliances. They accumulate knowledge from various sources and integrate the different steps which the linear models considered as successive, both internally and in parallel to each other.

In the past two decades, these networking aspects have been extended further, as a result of which the **open innovation** model has emerged. In this model, the boundaries of organisations are fully porous. New ideas and paths to markets can be generated and exploited internally or externally in various combinations. Companies rely not only on their own R&D divisions but also on external sources of knowledge, and develop ideas either internally or externally through spin-offs or joint ventures. This attitude allows increased flexibility and lowers the risks associated with innovation.

The study of the innovation process has shown that innovation is a complex and uncertain phenomenon. It does not simply consist of turning ideas into products, as is often believed by the adherents of the outdated linear models. In the context of the latest innovation models, networking activities are considered essential, as innovation is no longer seen only as an internal process but as one that needs to remain open to, and seize opportunities from, external interactions.

The innovation ecosystem

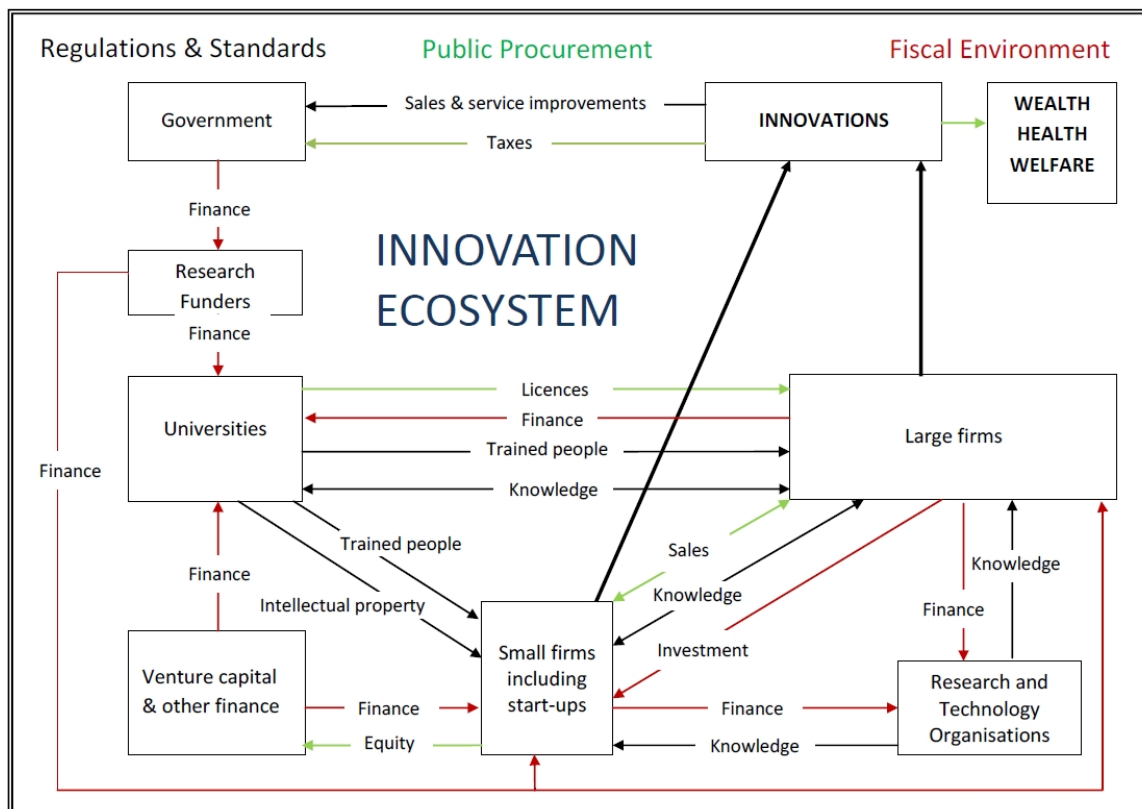
The open innovation model is based on the [assumption](#) that 'innovation is a distributed process across many actors, companies and other organisations, and is influenced by regulation, policy and social pressure.'

Innovation occurs in the context of an ecosystem, with different actors taking part in the process:

- large and small companies, including start-ups, that commercialise innovations;
- universities and research-performing organisations that train people and produce new knowledge;
- venture capital, research-funding organisations and other financial institutions that provide funding for R&D activities and business development;
- government actors influencing the innovation environment through policies, regulations and the adoption of standards.

The term 'innovation ecosystem' was coined to reflect the continuous interactions and flows of skills, knowledge and money needed between these actors for the innovation process to be sustained (Figure 1).

Figure 1 – The innovation ecosystem



Source: [Improving the Framework Conditions for R&D](#), Luke Georgiou, June 2015.

Innovation policies and regulations

Innovation policies aim to improve and facilitate interactions between the actors of the innovation ecosystem in order to enhance the performance of the system as a whole. Based on the latest models mentioned above and the description of the ecosystem, it is obvious that innovation is influenced by more factors than just R&D policies. When addressing innovation, policy-makers should consider a wide range of aspects, as suggested by the OECD:

- a skilled workforce to manage the different steps of the innovation process;
- a sound business environment that encourages investment in KBC;
- a strong and efficient system for knowledge creation and diffusion; and
- policies that encourage companies to engage in innovation and entrepreneurial activity.

As different levels of government (European, national, regional, local) have an impact on the policies supporting these different aspects, good coordination and a strong focus on governance, including effective monitoring, are required in the design and implementation of these policies.

When developing strategies for innovation, policy-makers need to consider a full set of policy measures addressing, for example, education and training, labour markets (including international mobility), product markets and financial markets, and regulatory reforms. These policy measures should also address the need to establish strong and well-governed universities and public research institutions, develop knowledge infrastructure including broadband and digital networks, and introduce tax incentives for investing in R&D. The overall policy mix needs to be tailored to the national or local context in order to be fully effective. The high number of parameters

that influence the innovation process implies that there is no one-size-fits-all solution. At European level, the [Innovation Union flagship initiative](#) is the key policy supporting innovation within the context of the Europe 2020 strategy.

Enhancing innovation policies requires making a careful assessment of interventions that have an impact on them. The [Innovation Growth Lab](#), an international project coordinated by [Nesta](#), a UK non-governmental organisation fostering innovation, addresses the links between innovation and growth. This project aims at enriching the body of evidence regarding the impact of different interventions on the innovation ecosystem, in order to provide better insight to policy-makers.

Innovation Union flagship initiative

The Innovation Union flagship initiative is aimed at strengthening research and innovation systems in Europe. The European Commission seeks to fully establish the European Research Area, develop strategic research agendas on key challenges, and enhance joint research programming between Member States. It aims to develop innovation in the private sector, with a particular interest in supporting SMEs. The Commission also strives to improve interactions between education, business, research and innovation. The flagship initiative invites Member States to reform their research and innovation systems to allow for better interoperability at European level and to foster EU cooperation. It also invites them to support education in science, maths and engineering, as well as to prioritise knowledge expenditure.

[Industrial Innovation in Transition](#) is an EU project funded under Horizon 2020, the EU framework programme for research and innovation, to 'create a holistic understanding of what are the current best practices in the most innovative companies in order to provide an evidence base for reviewing how well the current innovation policies support the adoption of new innovation processes.' Based on the conclusions of the project, recommendations will be made to policy-makers on drafting sound innovation policies.

Towards a culture of innovation

Developing a culture of innovation – a particular set of values, norms and patterns of behaviour that stimulate the innovation process – appears nowadays as important as managing the innovation process itself. In order to thrive, innovation needs a new global approach and a fresh mind-set on 'how to do things' that includes creative thinking, collaboration, initiative, openness, a positive approach to failure and high trust.

At company level, the culture of innovation is related to a trustful working environment that not only allows any employee to suggest new ideas, but also provides support for realising them. For this to happen, all employees need to share their company's global vision and objectives, but also to be afforded relative flexibility in how to achieve them so as to be encouraged to 'think outside the box'. Companies need to establish collaborative links both internally and externally, which can be done only if their workforce has good networking skills. Last but not least, the capacity of companies to stay open to external ideas is becoming increasingly important.

Policies aimed at supporting the innovation process and improving the innovation ecosystem need to take this cultural component into account. According to the OECD's [Science, Technology and Industry Outlook 2014](#), one key step in this direction consists of raising public awareness of, and interest in, science and technology. A second step is to foster entrepreneurship and improve the cultural perception of entrepreneurial activities. Here again, policies can help develop, for example, a positive attitude towards

risk-taking and failure. Finally, policies should address the capacity of public and private research and innovation institutions to better cooperate with each other and with other innovation ecosystem stakeholders on issues related to workers' mobility, flows of knowledge and intellectual property rights, and financial incentives.

Regarding all these aspects, education and training play a key role in the development of a culture of innovation, by providing the current and future workforce with the right skills for innovating.

Risks and limitations

Whether at the European, national or local level, citizens seem to generally have mixed feelings towards innovation.² Cautious and at times negative, their attitude originates partly from the fact that innovations that are designed to solve a problem in the short term may have unexpected consequences in the long term (perverse effects, hidden costs, negative social and/or environmental outcomes, etc.). A well-known example is the use of asbestos for insulating buildings, which was later established to be a source of health issues in the longer term. The use of fossil fuels that helped trigger the current climate change phenomenon is another such example.

To respond to these limitations, the concept of 'responsible research and innovation' (RRI) has been introduced in the context of the European framework programme for research. As [defined](#) by the Commission in 2012, RRI 'means that societal actors work together during the whole research and innovation process in order to better align both the process and its outcomes, with the values, needs and expectations of European society.' Linked with the concept of the [precautionary principle](#), RRI attempts to take into consideration various aspects of the consequences of the innovation process to prevent negative social, environmental or economic outcomes.

Another aspect of the cautious attitude towards innovation is linked to the negative outcome of the 'destructive creation' process. The introduction of innovations that replace existing products and companies can provoke negative effects on the socioeconomic fabric, such as unemployment of low-skilled workers. The rapid replacement of vacuum tubes by electronic transistors, leading to the decline or disappearance of large companies in the 1950s is a vivid example of this effect. Training and education policies are needed to address the adaptability and the employability of the workforce in order to avoid such effects.

Main references

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[Innovation Models](#), Joe Tidd, Imperial College London, 2006

[A framework for managing the innovation process](#), N. Du Preez and L. Louw, Conference: Management of Engineering & Technology, 2008

[Innovation Culture: The Big Elephant in the Room](#), Stefan Lindegaard, Innocentive, 2013

[The Innovation Union: a perfect means to confused ends?](#), S. van den Hove et al., Environmental Science & Policy, Volume 16, p. 73–80, February 2012

Endnotes

¹ Diagrams of the different models discussed here can be found on the [website](#) of IPASCO.

² A Commission [Eurobarometer](#) survey showed in 2005 that 49% of respondents from the EU-25 were either 'anti-innovation' or 'reluctant' to embrace innovation.

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