

## Impacts of ICTs

The recent developments in information and communication technologies (ICTs), such as the rise of high-speed affordable broadband, the geographic expansion of broadband access networks, the development of “big data” and the rise of cloud computing) significantly shape today’s innovation landscape. They facilitate innovation by improving information exchange, collaboration, and knowledge diffusion incurred in the production of innovations, reducing production costs and increasing productivity. They also extend the geographic reach of markets and provide opportunities to develop new products and services, new processes and new business models.

### What characterises ICTs today?

Information and communication technologies (ICTs) are technologies that are either intended to fulfil the function of information processing and communication by electronic means, including transmission and display, or that use electronic processing to detect, measure and/or record physical phenomena, or to control a physical process. ICTs include, for instance, technologies used for servers, personal computers, work-stations, and data communications equipment.

Several developments modified conditions for innovation as follows.

- **Improved access.** The recent rise of high-speed broadband, the geographic expansion of broadband access networks and affordable devices and connectivity options in most OECD countries improve access to ICT substantially.
- **Widespread use of mobiles.** The number of mobile phone subscriptions worldwide has more than doubled since 2005 and tripled in non-OECD countries.
- **New more mobile technologies.** Over the past few years, tablet PCs and smart phones have made computers ubiquitous, while cloud computing and mobile Internet are enabling “everything/everywhere” data access, thus paving the way for new services and applications.
- **Rise of “big data.”** The recent improvement of data collection, storage and processing, leading to the generation and use of huge volumes of data (commonly referred to as “big data”) is opening new opportunities for innovation in all industries.

### How do ICTs affect innovation today?

The following have been major innovations that have had a great impact on ICTs.

**ICTs foster innovation by improving information exchange and knowledge diffusion incurred in the production of innovations.** This includes improved information management and sharing within the company (e.g. electronic data interchange [EDI], enterprise resource planning [ERP]), as well as outside the company, with ICTs facilitating collaboration with third parties, including suppliers, consumers, and research organizations (e.g. through networking sites and collaborative tools, such as electronic conferencing tools). The use of participative networks can also allow firms to reach out to customers and partners in order to orient their innovation efforts and improve their products. ICTs and broadband networks allow firms to participate in larger networks, which may encourage them to increase their R&D activities.

**ICTs are a key factor in why cooperation in research and innovation is increasing, at the**

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**expense of the single-inventor (individual or entity) model** (Jones 2010). In addition, connectedness, together with the bigger size of networks, contributes to the increased division of labour in S&I activities: it can enhance the specialization of scientists because they can function above their usual competency level just by engaging other researchers and can acquire relevant search and absorptive capacities.

However, although ICTs can facilitate global collaboration and knowledge diffusion, geographical proximity still matters, in particular for acquiring tacit knowledge that cannot be codified and cannot be shared without interactive face-to-face relations.

### **ICTs can help reduce costs incurred in innovation activities in the following ways.**

- **Providing less expensive access to information.** ICT access and broadband-enabled trade in services allow businesses to get access to less expensive inputs and services by reaching global markets. These services create new opportunities for business efficiency.
- **Providing less expensive and more flexible ICT systems.** Cloud computing is one example where firms can adopt a pay-as-you-go model for computing resources instead of making significant, up-front investments in ICT infrastructure or software. Cloud computing services can provide innovative businesses with computing resources rapidly and flexibly in response to changing needs, and it will also allow greater scalability, which refers to the ability to handle a growing amount of activities and accept increased volume without impacting the contribution margin. Cloud computing services also offer the opportunities to access computing resources at a lower cost than companies' own ICT infrastructure (OECD, 2011). It allows immediate, on-demand access to information technology resources without the need for capital expenses in hardware and software and thus significantly decreases entry barriers. Similar examples of cost saving can be found for legal, accounting, and advertising services. Cost reductions may also occur thanks to broadband-enabled global sourcing.

### **ICTs can also expand market access and improve access to international markets in the following ways.**

- **Web-based transactions.** The Internet can extend the geographic reach of the market and enables transactions that could not have occurred without its existence. In turn, increased market access can facilitate opportunities to expand markets for innovative products. This is true in great part because ICTs can lower search cost substantially, including the time and effort required for firms to identify suitable markets for their innovations.
- **E-commerce has grown steadily over nearly 15 years.** The value of e-commerce transactions has risen on average by approximately 7% per year over the previous decade in the United States and European Union. But growth has been uneven across OECD countries (OECD, 2012b). The market remains highly polarized geographically, with a "digital divide" clearly evident. Smartphones and mobile apps provide a powerful new platform for e-commerce growth, particularly for B2C transactions.

### **ICTs can change competition for markets, a critical factor for innovation.**

- **Web-based electronic transactions.** Electronic commerce platforms on the Internet can create opportunities for transactions that would not occur or that would not be profitable otherwise in the marketplace by aggregating demand and by allowing a more efficient

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matching between supply and demand.

- **ICTs aid market entry.** ICTs might have different impacts across large and small businesses and shape conditions for market entry. The potential gains from better ICT access are likely to depend on multiple firm characteristics, such as the availability of adequate internal skills and complementary assets. Businesses with a stronger skills base and access to finance might have greater potential to maximize the benefits from ICTs (e.g. as they would have the opportunity to implement organisational changes to maximise impacts). At the same time, firms of smaller size and in more remote locations can potentially gain more from ICTs than other businesses, because ICTs may allow them to access markets, products, services and knowledge they previously were excluded from.

### **The Internet itself is a source of innovation.**

- **Internet-based businesses.** The Internet provides opportunities to develop new products and services, new processes (e.g.: new ways of delivering products and services, new advertisement possibilities) and enables new business models (e.g.: online advertising or pay-per-click advertising). The Internet is at the origin of numerous new industries and services that rely solely on this technology. This includes the emergence of the Internet-based software industry and cloud computing.
- **Provision of “big data.”** The confluence of several trends, including the increasing migration of socioeconomic activities to the Internet and the decline in the cost of data collection, storage and processing, are leading to the generation and use of huge volumes of data—commonly referred to as “big data”. These large data sets are becoming a core asset in the economy, fostering new industries, processes and products and creating significant competitive advantages. For instance, in business, data exploitation promises to create value in a variety of operations, from the optimisation of value chains in global manufacturing and services to more efficient use of labour and tailored customer relationships. The adoption of “smart-grid” technologies is also generating large volumes of data on energy and resource consumption patterns that can be exploited to improve energy and resource efficiency. The public sector is not only an important data user but also a key source of data.

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