Executive Summary

This report examines digitalisation's effects on science, technology and innovation and the associated consequences for policy. Digitalisation today is the most significant vector of innovation in firms, science and governments. If properly harnessed, digital technologies could advance science, raise living standards, help protect the natural environment and improve policymaking itself.

Digitalisation and science

Digitalisation is bringing change to all parts of science, from agenda setting, to experimentation, knowledge sharing and public engagement. To achieve the promise of open science research budgets need to account for the increasing costs of managing data. Greater policy coherence and trust between research data communities are needed to increase sharing of public research data across borders. Co-operation is required to build and provide access to cyber-infrastructure internationally. And open access (OA) publication requires incentives for OA that match mandates coming from research funders.

Governments should also support platform technologies for science, such as distributed research and development networks, and storage for digital/genetic data. Room exists to better exploit advanced digital technologies in science. Artificial intelligence (AI) can increase productivity in science, at a time when research productivity may be falling. But policies are needed on high-performance computing, skills, and access to data (such as standardisation for machine readability of scientific datasets). AI in science also raises novel policy issues: for instance, will intellectual property systems need adjustment as invention by machines expands?

Realising the untapped potential of digital technology in policy

Digital technology could support policymaking for science and innovation in novel ways. Few governments have experimented with the opportunities available. Examples include: self-organised funding allocation; using collective intelligence through digitally enabled prediction markets and machine-crowd combinations; developing blockchain applications in science; and, using social media to help spread innovation.

Digitalisation and innovation in firms

As businesses innovate with data, new policy issues are likely to arise. For instance, restricting cross-border data flows can raise firms' costs of doing business, especially for small and medium-sized enterprises (SMEs). Decisions may soon be required on as yet unanswered policy questions: for example, should data transmitted in value chains be protected from sale to third parties?

AI is finding applications in most industrial activities. But firms with large volumes of data may not have the in-house skills to analyse it fully. Governments can work with stakeholders to develop voluntary model agreements and programmes for trusted data sharing. For more general AI applications, governments can also promote open data initiatives and data trusts and ensure that public data exist in machine-readable formats.

Effective sectoral support is also needed, for instance through roadmaps or sectoral plans, prepared with industry and social partners. Policy should also facilitate collaboration for innovation, for instance, by digitally enabled crowdsourcing and open challenges.

Even in the most advanced economies, the diffusion of advanced digital technologies needs to accelerate. Institutions for technology diffusion – such as applied technology centres – can be effective, and should be empowered to take longer-term perspectives, rather than prioritising short-term revenue generation. To help diffuse digital technology to SMEs governments can: systematise key information for SMEs; develop information on the expected return on investments in new technologies, and on complementary process changes; provide signposts to reliable sources of SME-specific expertise, along with facilities where SMEs can test varieties and novel combinations of equipment.

Developing digital skills

Occupational titles like “industrial data scientist” and “bioinformatics scientist” are recent and reflect a pace of technological change that is contributing to shortages of digital skills. Entirely new fields of tuition are needed, such as dedicated programmes for the autonomous vehicle industry. Existing curricula may also need to change. Too few students learn the fundamental role of logic in AI. Many schools barely teach data analysis, and more multidisciplinary education is needed.

Measures are required to address the fact that in many countries, in some subjects, such as AI, male students far outnumber female students. Digital technologies such as virtual reality could also facilitate skills development, as is happening in industry.

Committing to public sector research

Publically financed basic research has often been critical to advances in digital technology. A recent levelling off – and in certain cases decline – in government support for research in some major economies is a concern. The complexity of some emerging digitally based technologies exceeds the research capacities of even the largest individual firms. This necessitates a spectrum of public-private research partnerships. Interdisciplinary research is also essential. Policies on hiring, promotion and tenure, and funding systems that privilege traditional disciplines, may impede interdisciplinary research. Scientists working at the interface between disciplines need to know that opportunities for tenure are not jeopardised by doing so.

Building expertise in government

Without governments fully understanding technologies and sectors, opportunities to benefit from digital technologies might be lost. Calls to regulate AI highlight the need for expertise in government, such that any regulation of this fast-evolving technology does more good than harm. Technical expertise in government will also help to avoid unrealistic expectations about new technologies. As a wide array of critical systems become more complex, mediated and interlinked by code, governments also need improved understanding of complex systems. And as innovation agendas quickly evolve, governments also need to be flexible and alert to change. They must likewise ensure the availability of key infrastructures. For instance, broadband networks – especially fibre-optic connectivity – are essential to Industry 4.0.

To use digital science and innovation policy (DSIP) systems to help formulate and deliver science and innovation policy, governments must: ensure the interoperability of the data sets involved; prevent misuses of DSIP systems in research assessments; and, manage the roles of non-government actors, particularly the private sector, in DSIP systems.