

# INDUSTRIAL DEVELOPMENT REPORT 2020

## BRIEF NO 4

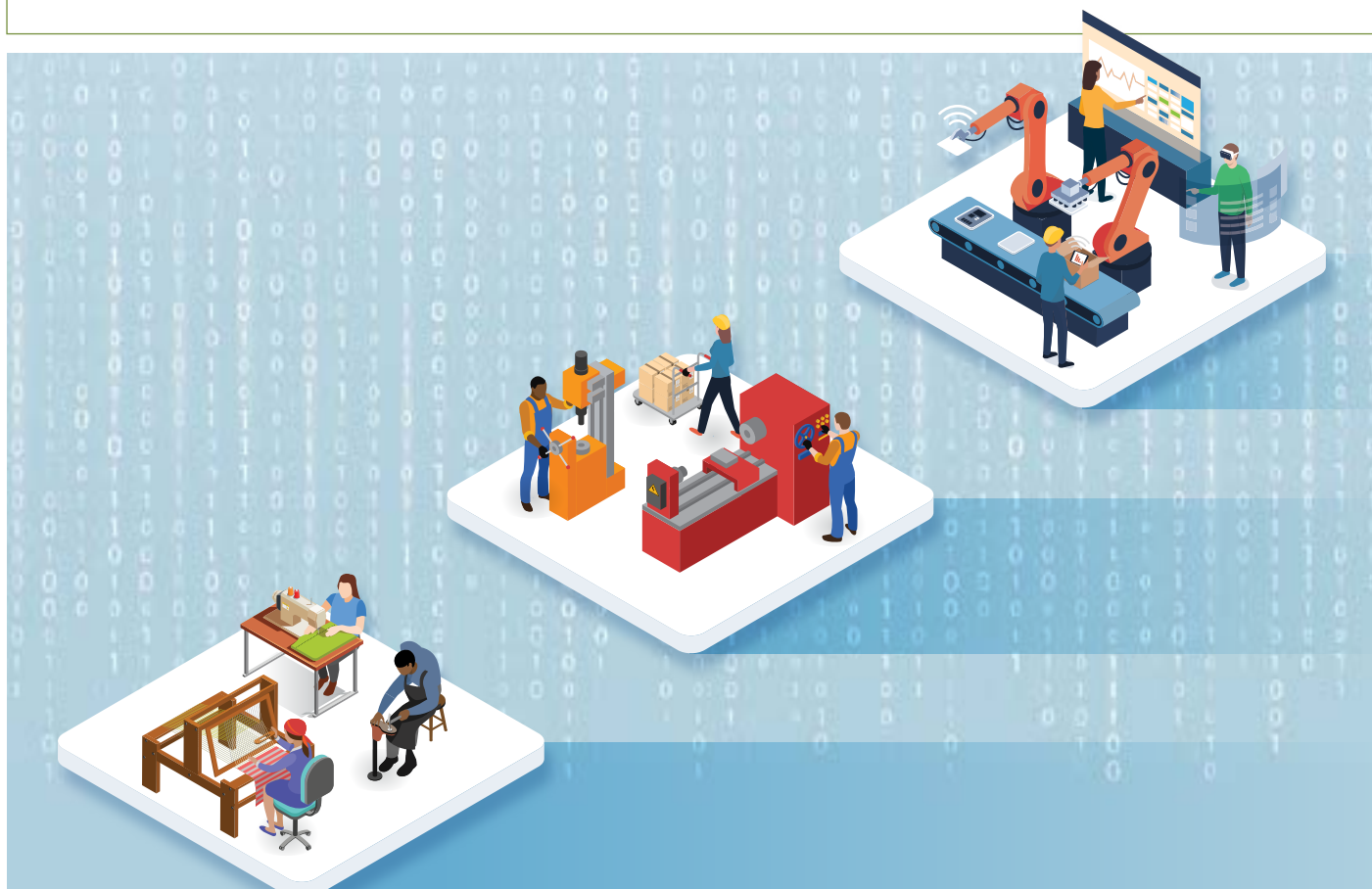
### The contribution of advanced digital production (ADP) technologies to inclusive and sustainable industrial development (ISID)

#### Executive summary

ADP technologies accelerate the achievement of ISID. The diffusion of ADP technologies contributes to boosting industrial competitiveness, employment creation and environmental sustainability through two main channels. First, ADP technologies improve the efficiency of production, with important knock-on effects on the environmental sustainability of manufacturing production. Secondly, new technologies unlock product innovations, leading to the emergence of new business models and entirely new industries. Under the appropriate conditions, new products can also help address the needs of marginalized communities and the environment.

#### Key findings

- » ADP technologies contribute to ISID by unlocking product innovations, which can address societal and environmental needs, and by improving manufacturing production's efficiency.
- » At the aggregate level, the diffusion of ADP technologies is associated with improvements in economic performance. Countries that actively engage in ADP technologies experience faster growth rates in manufacturing value added (MVA).
- » In developing and emerging industrial economies, the diffusion of ADP technologies is associated with positive employment trends at both the country and enterprise level.



## ADP technologies and ISID: from greater production efficiency...

ISID is a vision for an industrialization process that boosts countries' competitiveness, increases the living standards of all—producers and consumers alike—while harnessing technology to ensure that manufacturing production is environmentally sustainable. ADP technologies contribute to ISID through two main channels (Figure 1). First, they improve the efficiency of production processes. They may also help unlock product innovations.

By their very nature, ADP technologies lead to significant efficiency gains in production. The introduction of IoT, together with big data analytics, for instance, helps firms plan a range of activities—from the use of industrial machinery to the consumption of electricity—in ways that reduce idle times and ensure full use capacity. Combined with predictive maintenance, the analysis of these new sources of high-volume and high-quality data can help maximize the use of fixed assets by increasing the viability of real-time diagnoses and fault detection.

These efficiency gains have undisputable economic benefits for firms. By optimizing energy and material use, however, ADP technologies also boost manufacturing's environmental sustainability. New technologies also help save resources by directly replacing energy- and material-intensive technologies. One example is the application of 3D printers to the production of parts and prototypes. Rapid prototyping has the potential of reducing energy use by more flexibly enabling the production of parts and components and with less material than would have been possible with traditional production processes.

## ...to entirely new products

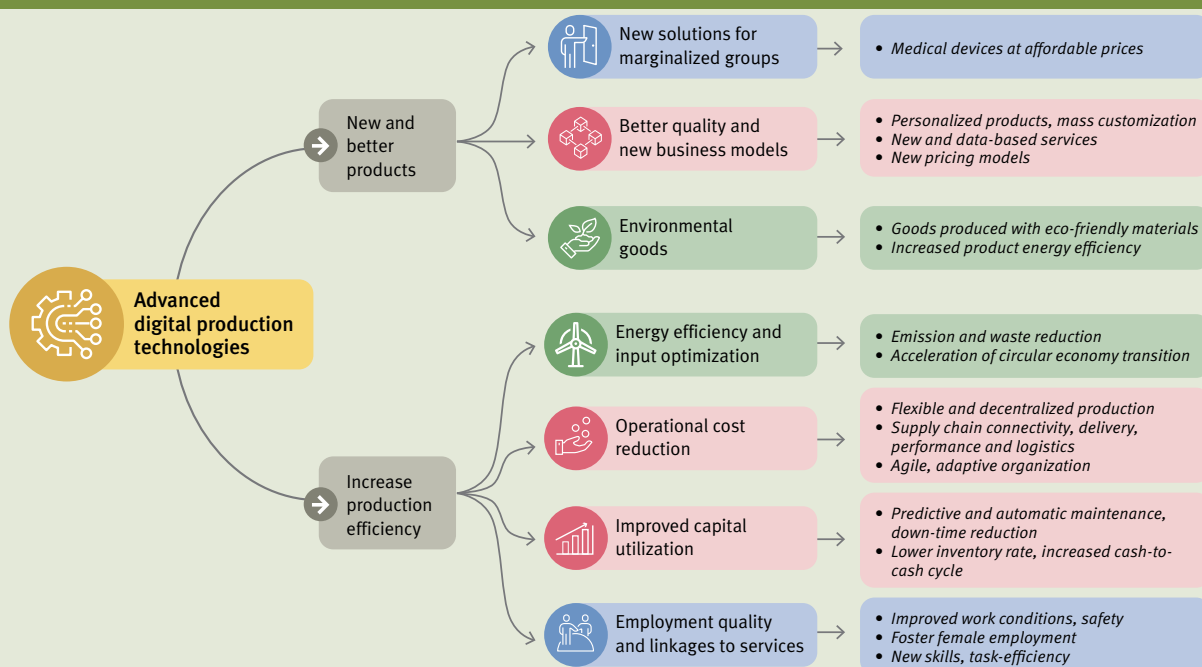
Efficiency gains are only one aspect of the story. ADP technologies also unlock product innovations in many areas of the economy. Consider once again the case of big data analytics. The insights firms gain from the collection and analysis of real-time data on consumer behaviour provides significant advantages for the design of new, highly customized products and services. The blending of manufacturing and service activities into new solutions and business models has the potential to revitalize countries' industrial structures, generate new employment, and boost overall industrial competitiveness.

New products can also generate significant social and environmental benefits. ADP technologies facilitate the design and manufacture of highly customized products at an affordable price, which can address the needs of marginalized groups. Such technologies also promote the introduction of environmental goods in the market or reduce the environmental impact of the products we currently use (Box 1). A recent study of the environmental impact in the U.S. aircraft industry highlights that 3D-printed components could replace 9–17 per cent of aircraft mass, thereby reducing fuel use.

### Box 1. ADP technologies and the circular economy

In circular economy processes, flows of resources—energy and materials, in particular—are narrowed down and, to the extent possible, closed. Products are designed to be durable, reusable and recyclable, so that materials for old products derive from new products. ADP technologies contribute to all of these processes. Greater mobile connectivity, for instance, contributes to the proliferation of sharing and product-as-service business models. Industrial IoT enables control and analysis of product performance. These new data sources provide a sound foundation for circular economy business models.

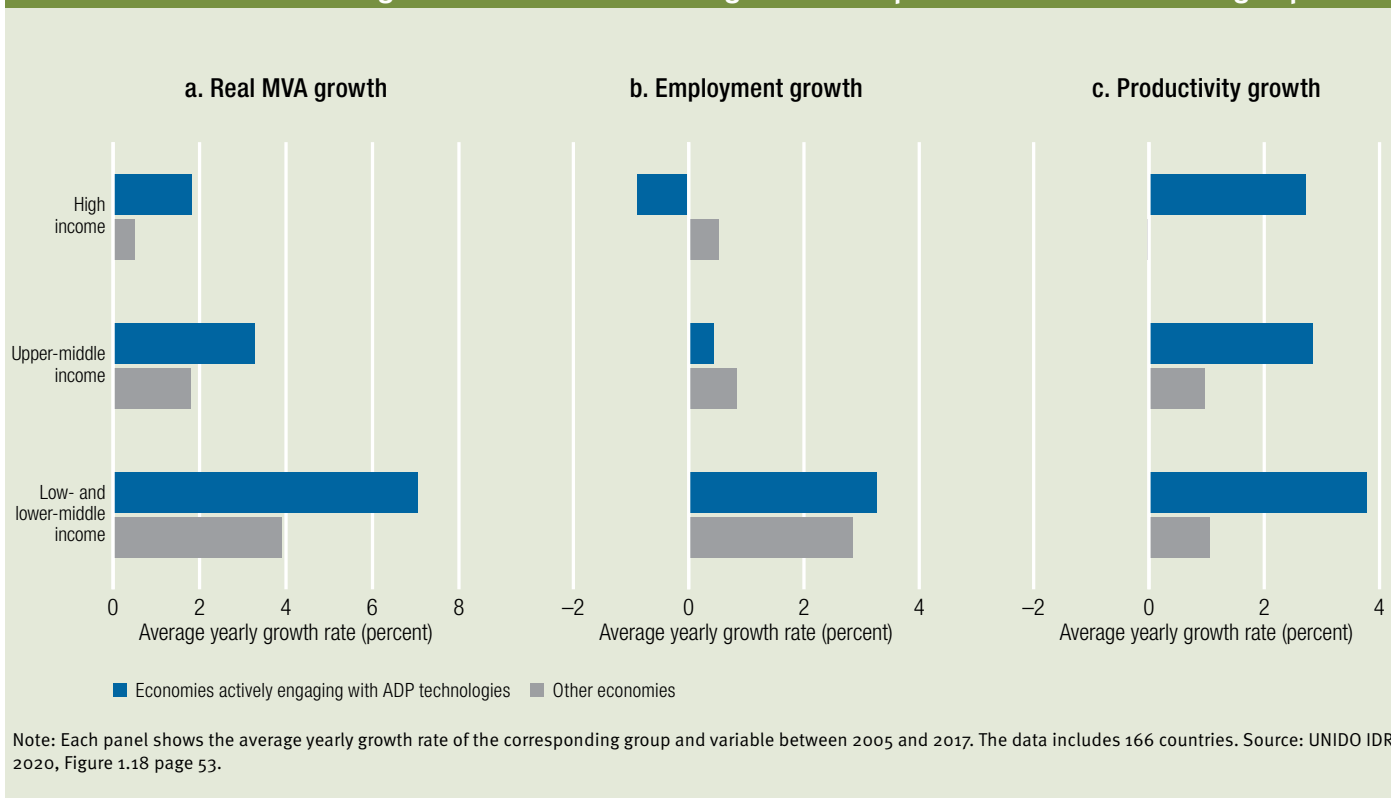
Figure 1  
From ADP technologies to ISID: the main channels



Source: UNIDO IDR 2020 Figure 1.10, page 44

Figure 2

The diffusion of ADP technologies is associated with stronger economic performance across income groups



The dividends from ADP technologies: what does the evidence say?

The IDR 2020 finds that the diffusion of ADP technologies is associated with stronger manufacturing and economic performance at the country level. Average growth rates of manufacturing value added (MVA) are faster for economies that actively engage in ADP technologies relative to economies that are less proficient in the use of such technologies (panel a, Figure 2). The difference is particularly striking in developing and emerging industrial economies, where countries engaging in ADP technologies witness their MVA grow nearly 50 per cent faster compared with countries that have not adopted ADP technologies.

MVA growth is accounted for by trends in manufacturing employment and productivity: it can result from faster employment creation, a more dynamic trend in productivity growth, or from a combination of the two. In rich countries, faster MVA growth is primarily explained by productivity dynamics, which more than compensate for job losses. By contrast, developing and emerging industrial economies that engage in ADP technologies seem to experience both productivity and employment gains (panels b and c, Figure 2).

Countries' engagement in ADP technologies is not only linked to their economic and social performance. Their performance in terms of sustainability can also be associated with new technologies. Patents granted for the development of ADP technologies tend to be significantly greener than the average patent (Figure 3).

This is particularly the case for technologies related to robots, machine learning, and CAD/CAM systems and, to a lesser extent, additive manufacturing.

Figure 3

Judging from the content of patents, ADP technologies are greener than the average

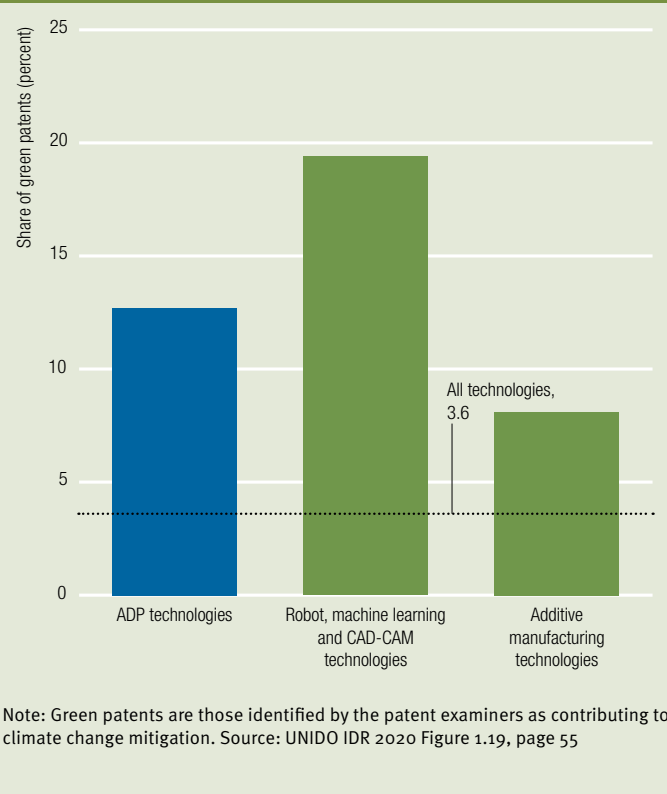
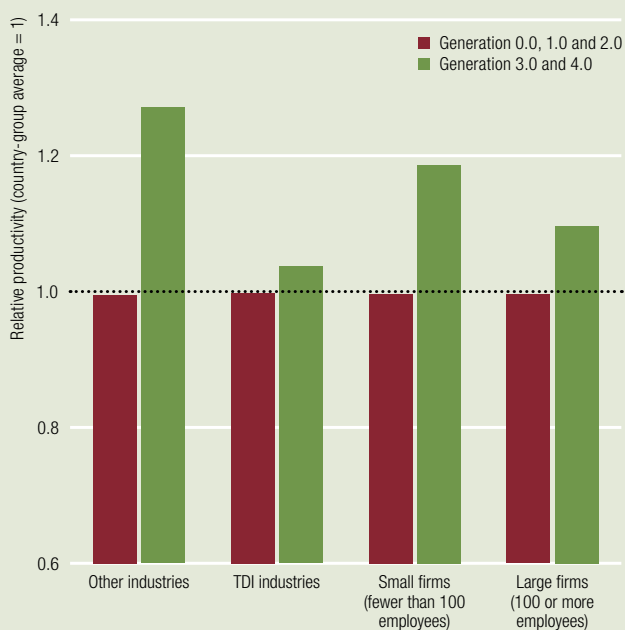


Figure 4

The adoption of ADP technologies is associated with a productivity premium



Note: TDI stands for technology- and digital-intensive. ADP technologies in the figure are associated with generations 3.0 and 4.0 of digital technologies. Source: UNIDO IDR 2020 Figure 3.11, page 107

Firm-level evidence corroborates the positive association between ADP technologies and ISID

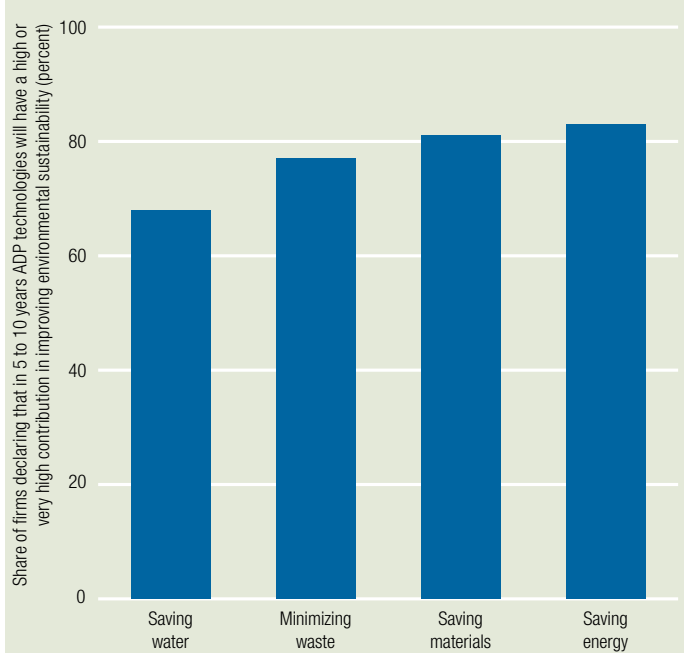
Results from a series of micro-level surveys among manufacturing firms run by UNIDO and partners in five developing and emerging industrial economies corroborate these findings. The results suggest that the adoption of ADP technologies is associated with a productivity premium: firms adopting ADP technologies are more productive than the average (Figure 4). This finding holds across countries, firm size and industrial sectors.

Findings from the UNIDO surveys also suggest that ADP technologies are surrounded by significant expectations in terms of their potential to improve firms’ environmental performance. The vast majority of firms adopting ADP technologies in Ghana, Thailand and Viet Nam—three of the countries investigated in the surveys—agree that ADP technologies can lead to efficiency gains in the use of energy, water and material, as well as to improvements in waste management practices (Figure 5).

Among the sample surveyed for the IDR 2020, two-thirds of the firms that actively integrate ADP technologies in their operations—independently of the industrial sector or country in which they operate, and of their size—expect these technologies to have a positive or neutral impact on their current employment levels. This is further confirmation that in developing and emerging industrial economies, the diffusion of ADP technologies can have positive effects on employment creation.

Figure 5

Firms adopting ADP technologies expect to see their environmental performance improve



Source: UNIDO IDR 2020 Figure 3.14, page 109

Conclusions

- » Efficiency in the use of fixed assets, energy and materials is a key channel through which ADP technologies contribute to ISID. The introduction of product innovation is another key channel.
- » Aggregate and firm-level evidence points to a positive effect of ADP technologies on productivity and employment growth, particularly in developing and emerging industrial economies.
- » ADP technologies can facilitate the diffusion of environmental standards and environmentally sound practices. They can also enable the design of new business models inspired by circular economy principles.

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