



# Digital Technology Adoption and Performance in South African Manufacturing Firms: Early Evidence for Policy

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## Introduction: Digitalisation – The missing link for structural transformation?

The 4<sup>th</sup> Industrial Revolution (4IR) is fast becoming a catalyst for structural transformation in many economies. From a developing economy and manufacturing standpoint, the 4IR offers new and exciting prospects for industrial development encapsulated in increases in productivity, value creation,

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efficiency gains, and employment creation avenues. Within this revolution, many technologies and methods are also bringing new momentum for structural change and technological transformation.<sup>3</sup>

These technologies and methods are also increasingly becoming organised under digitalisation. Digitalisation influences innovation, production, trade, consumption, and a host of business processes. The perceived benefits from digital technologies are particularly important for African economies, many of whom are technological followers.<sup>4</sup>

In addition, digitalisation and the disruptive and incremental technological changes and upgrades accompany alterations in global, domestic, and regional value chains by transforming where, how, and what is manufactured.<sup>5</sup> However, these changes and upgrades, disruptive or incremental, are not always the same across time, geographies, firms, and industries. These differing impacts are due to several inherent complexities and characteristics (observed and unobserved), which provides a smorgasbord of considerations prior to implementing or adopting advanced digital technologies and a digital industrial policy.

Nevertheless, the rapid pace of technological advancement necessitates an acceleration of digital technologies' uptake across all facets of society, government, and business to avoid being left behind.<sup>6</sup> Moreover, the impact of the Covid-19 pandemic on industrial production, exports, and innovation across developing economies like South Africa, a well-documented technological follower, emphasises the prospects of a manufacturing recovery driven by the adoption of digital technologies.<sup>7</sup>

However, a crucial hurdle to a disruptive technology-induced manufacturing recovery in South Africa is the lack of understanding of the current state of disruptive technologies' adoption and the essential digital skills and capabilities needed to foster a digital technological transformation. Considering this caveat of our understanding,

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3 Davis, J. et al., 2012. Smart manufacturing, manufacturing intelligence and demand-dynamic performance. *Computers & Chemical Engineering*, Band 47, pp. 145-156.

4 Ayentimi, D. & Burgess, J., 2019. Is the fourth industrial revolution relevant to sub-Saharan Africa?. *Technology analysis & strategic management*, 31(6), pp. 641-652.

5 Bristow, G. & Healy, A., 2020. Introduction to the Handbook on Regional Economic Resilience. In: *Handbook on Regional Economic Resilience*. s.l.:Edward Elgar Publishing.

6 Schuelke-Leech, B., 2018. A model for understanding the orders of magnitude of disruptive technologies. *Technological Forecasting and Social Change*, Band 129, pp. 261-274.

7 Bell, J.F., Goga, S. & Robb, N., 2021. Emerging issues for industrial policy in South Africa. *CCRED Working Paper Series*

this policy brief explores the relationship between digital technologies and firm manufacturing performance in several levers of adoption to provide an early evidence from which evidence-based policy can emerge. This policy brief utilises data from the first iteration of the South African digital skills survey covering 516 South African manufacturing firms and based on our previous empirical work.<sup>8</sup>

### **Main findings: Digital technologies can drive manufacturing firm's performance to new frontiers and heights**

The primary goal of adopting digital technologies is the improvement of business processes, productivity, and innovation. To better understand the behaviour and attitudes of South African manufacturing firms towards the adoption of digital technologies, be they disruptive or incremental, we undertook an empirical investigation of the effect of digital technologies on two primary firm performance variables (exports and innovation) across two essential business functions – supplier relations and production management. We explore and unpack the two prominent findings from this work with the view of offering some early insights into the adoption behaviours and strategies of manufacturing firms in South Africa.

#### ***Finding 1: The adoption of digital technologies is crucial for firms engaging in export activities***

South African manufacturing firms engaged in exporting activities were more likely to possess advanced digital technologies within their current technological infrastructure. This finding echoes those of the literature in finding a performance bonus among export-oriented and digitally-sophisticated manufacturing firms in developing economies.<sup>9</sup> Additional findings suggest that several other factors such as access to broadband, capital ownership, age and size of the firm are all determinants of South African manufacturing firms' abilities to export.

Offering affordable and wide-reaching broadband and internet services are necessary building blocks for South African firms to operate competitively in the digital manufacturing space. For example, firms with access to broadband internet services

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8 The digital skills survey was part of an ongoing joint project for the Department of Trade, Industry, and Competition between the Centre for Competition, Regulation, and Economic Development (CCRED) together with the South African Research Chair in Industrial Development at the University of Johannesburg and in collaboration with the Sector Education and Training Authorities (SETAs) that govern skills training in manufacturing and engineering services (MerSETA), chemicals (CHIETA), and textiles and fibre processing (FP&M SETA).

9 Delera, M., Pietrobelli, C., Calza, E. & Lavopa, A.. 2022. Does value chain participation facilitate the adoption of industry 4.0 technologies in developing countries?. *World Development*, 152: 105788

are more likely to engage in export activities as this may improve their reach and strengthen their interactions with external partners. A lack of sufficient broadband access and infrastructure will only work to create further doubts in the decision-making of South African manufacturing firms regarding adopting advanced digital technologies.

The results also indicate that state-owned South African manufacturing firms were less likely to engage in exporting activities when compared to their foreign and privately-owned counterparts. This lack of exporting capabilities on the part of state-owned manufacturing firms may be due to several factors. One of these may be the individual mandates of these state-owned manufacturing firms to primarily serve the needs of the domestic markets with limited scale or scope for these firms to expand their production beyond domestic borders. Moreover, foreign-owned firms operating in South Africa already display an affinity towards exporting, given their establishment of subsidiaries in South Africa. It may be prudent to explore joint ventures with these foreign-owned firms as a means to boost both the domestic and export-orientated production capabilities of South African manufacturing firms operating in the same value chain

Our findings highlighted a dichotomy between older and newer firms in their respective degrees of technological adoption. From an exporting perspective, older firms may possess experience and knowledge of external markets and established supplier and production networks that newer firms do not, thus offering these older firms a relative advantage in terms of the ability and likelihood to engage in exporting activities. From the perspective of firm size, our results suggest that smaller firms are less engaged in export activities than larger firms. This result may be due to a distinct lack of financial resources that hinders the ability of smaller firms to purchase and adopt the necessary digital technologies essential to fulfilling their exporting ambitions.

***Finding 2: Adopting digital technologies is essential for firms looking to innovate***

For South African manufacturing firms who desire to become more innovative within their respective markets, our results note that firms with higher rates of digital technology adoption had a higher probability of engaging in innovative activities compared to firms that had adopted non-disruptive technologies (those not linked to 4IR and digitalisation). These findings indicate that being on the digital frontier is crucial for firms looking to break into new markets and industries by offering product and service innovations. Furthermore, other significant explanators of innovation included the total number of employees, human resources, size, and age of firms.

These findings offer some preliminary insights into the potential policy direction and support needed to stimulate innovation in South African manufacturing firms.

For instance, our empirical analysis found that younger firms were more likely to be involved in innovation, possibly through attempts to break into existing and long-established markets or carve out product and service niches. However, a lack of adequate human resources, viewed as the requisite level of skills needed to effectively implement and operate advanced and digital technological production and business systems, was a significant impediment to the ability of manufacturing firms to be innovative.<sup>10</sup> Moreover, our results further emphasised the importance of financial capital in driving innovation and digital technology adoption, with smaller firms less able to compete against larger firms, thereby weakening smaller firms' chances for success.

## Policy recommendations and discussion

The evidence unpacked and discussed in this brief highlights the positive effect of adopting advanced digital technologies on export and innovation performance for manufacturing firms in South Africa. In light of these findings, this section explores some existing high-level policy recommendations to foster a conducive environment for the increased adoption of digital technologies in the South African manufacturing sector.

- **Firstly, a digital industrial policy must recognise that the opportunities from digital industrialisation are about capturing value from incremental changes and disruptive technological innovations as part of an emerging and new digital industrial ecosystem.**

This recognition requires a more detailed, granular, and firm-level understanding of the extent of disruptions to industries and value chains caused by digital technologies both locally and abroad. Understanding these dynamics will assist in tailoring evidence-based policies depending on whether transitions to digitally-enabled business models are driven by disruptive or incremental technological adjustments and improvements to existing infrastructure.<sup>11</sup>

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10 The importance of possessing necessary skills associated with adopting digital technologies is discussed in Avenyo et al. (2022). The findings from this paper speak to the crucial need for the development of STEM skillsets drawing on science, technology, engineering, and mathematics. A deeper discussion on the implementation of the National Digital and Future Skills Strategy of South Africa can be found here: [https://www.gov.za/sites/default/files/gcis\\_document/202203/digital-and-future-skillsimplementation-programmefinal.pdf](https://www.gov.za/sites/default/files/gcis_document/202203/digital-and-future-skillsimplementation-programmefinal.pdf)

11 Andreoni, A., Barnes, J., Black, A. & Sturgeon, T., 2021a. Chapter 12 - Digitalization, industrialization, and skills development: opportunities and challenges for middle-income countries. In: A. Andreoni, P. Mondliwa, S. Roberts & F. Tregenna, Hrsg. Structural transformation in South Africa: the challenges of inclusive industrial development in a middle-income country. s.l.:Oxford University Press.

- **Secondly, policies designed to facilitate a digital industrial transformation must create the conditions for domestic value creation and distribution.**<sup>12</sup>

The evidence underscored the importance of firm size and age as strong determinants and drivers of adopting digital technologies across the export and innovation capabilities as they relate to financial capital and other intrinsic features like the existence of a well-established external network of suppliers. However, despite their relatively diminutive size, smaller firms displayed a higher affinity toward innovative activities, possibly due to their attempts to carve out niches within the markets they hope to compete. Therefore, policy should prioritise digital technology support to firms, large and small, to best navigate the digital transformation currently underway. Targeted and sectoral digital industrial policies must be designed and implemented to ensure that existing market shares are maintained and grown by making larger firms more competitive and assisting smaller firms in carving out new avenues for value creation through export and innovation support. Additionally, value creation could come through strategic partnerships and joint-ventures with foreign-owned manufacturing firms, given their existing and proven production and distribution capabilities and networks.

- **Thirdly, there is a need for strategic policy targeting, coordination, and alignment to extract the potential benefits of digital manufacturing transformation.**

The policies discussed in this brief are overarching, requiring the coordination and cooperation of stakeholders from different government departments to collectively coordinate their policy design, incentives, and implementation towards a common goal of a digitalised future. Achieving this would dictate that, for example, skills planning to be designed in unison with existing and new incentives programs to improve South African manufacturing firms' exporting and innovation capabilities and capacity and ensure a smooth transition to a digitalised industrial future.

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12 Barnes, J., Black, A. & Roberts, S., 2019. Towards a Digital Industrial Policy for South Africa: A Review of the Issues, Rosebank: Industrial Development Think Tank (IDTT).



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