POLICY BRIEF

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Productive skills in the 4th industrial revolution -

The South African airline industry: Surviving through smart innovation?

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4IR and new technology adoption in the airline industry

The global aviation industry and, by extension, the airline industry, are arguably among the most technology-intensive sectors, operating with some of the most technologically sophisticated assets, often at the forefront of industrial innovation. From the technologies needed to ensure the highest security levels, up to the applications aimed at facilitating ground operations, the airline industry is characterised by many activities in which the deployment of sophisticated technologies provides opportunities for improving efficiency and transforming the travelling experience. Before being hard hit by the COVID-19 pandemic, the industry had already been in the

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This study of the airline industry is part of a broader project promoted by the DSI/NRF South African Research Chair in Industrial Development, University of Johannesburg examining the dynamics, requirements and implications of the adoption of 4IR technologies in South African manufacturing. The current study is based on interviews conducted with a sample of 11 international and domestic airline industry players as well as the public infrastructure provider.

spotlight because of the need to embrace greener production models in response to the global climate emergency.

The nascent socio-technological paradigm of the 4th industrial revolution (4IR), characterised by interconnected production and mobility systems as well as networked social interactions, suggests that the recovery of the industry will have to lean on the more intensive use of smart technologies, with increasing digitalisation and the application of artificial intelligence. The adoption of such technologies is expected not only to shape recovery, but also to put the airline industry in a pioneer position as a testing ground for expanding the technological frontiers of automation, augmented reality, robotics and artificial intelligence (AI).

Today, the global airline industry is expanding its technological reach in several directions with the aim to be ready for the digital world of the future. However, despite their evident benefits, these technological innovations also entail important ethical and political considerations, in addition to requiring significant infrastructural leaps and potentially displacing some jobs.

In this regard, one of the main questions we have tried to address is – what are the effects of such technological transformations on employment and skills requirements, infrastructural adaptation and the privacy protection-security trade-off?

In South Africa, the impact of the pandemic significantly shook an industry that was already dealing with many challenges. Therefore, the post-COVID-19 recovery of this industry represents a considerable economic challenge that poses wider economic ramifications. One of the issues of immediate relevance therefore relates to how the South African airline industry can harness the advantages of emerging technologies not only to survive and recover from the pandemic downturn, but ultimately to trigger new virtuous cycles of growth and expansion. The questions therefore are, what will be the growth and competitiveness implications of adopting 4IR technologies, and which factors could undermine their promised potential for the industry? What are the risks and the challenges involved in such a transition and how can they be overcome? Questions regarding the subsequent implications for carbon footprint and environment sustainability are equally pertinent, and were addressed in our study.

After depicting the current configuration of the airline industry in South Africa, this policy brief summarises the main findings of our study, and also offers some policy recommendations for a meaningful and inclusive transition of the industry to the new socio-technological paradigm.

The SA airline industry: current state and latest developments

Before the COVID-19 pandemic, the airline industry in South Africa was characterised by a sizeable number of domestic and international operators, with regular, scheduled services to three main international hubs (Johannesburg, Cape Town and Durban), in addition to six main domestic airports (Port Elizabeth, East London, George, Bloemfontein, Kimberley and Upington). Lanseria Airport is a privately owned airport that also offers frequent scheduled domestic flight services. The air transport infrastructure comprises other public and private airports with international standards, but they currently offer less frequent services. The grounding and subsequent liquidation of Comair in June 2022 (which accounted for 40% of the country's domestic seat capacity before its financial distress), as well as the financial restructuring of South African Airways (SAA), meant a considerable reshuffle of the domestic air transport industry. In the wake of the crippling COVID-19 restrictions, the industry comprises four main domestic operators and 36 international operators. Domestic airline companies coordinate their operations

through the Airlines Association of Southern Africa (AASA), while international operators cooperate though the Board of Airline Representatives of South Africa (BARSA). The most important hub for domestic and international flight services remains O.R. Tambo International Airport (JNB), with a total of 40 operators, while Cape Town International Airport (CPT) accommodates all four main domestic operators and 13 international operators. King Shaka International Airport (DUR) currently offers services for only three of the four domestic carriers, and for four international operators.

The current recovery trajectory of the airline industry in South Africa reflects the post-pandemic trends of global air transport in the ramifications of the country's major international hubs. The envisaged recovery strategies include increased digitisation of airlines and airport service systems, increased interconnectivity and standardisation of digital platforms, resource optimisation through the expansion of self-service tools, green airports that adopt renewable energy sources and optimise energy consumption, more digitalised security systems, and the transformation of airports into social hubs by diversifying the array of services offered to passengers. The reduction of the operational capacity of South African Airlines remains a considerable challenge in the effort to restore international connectivity to its pre-pandemic levels, but the collaboration of ACSA (Airports Company South Africa) with international operators is betting on route expansion to achieve the kind of economies of scale that will make it possible to recoup the required investments in commensurate infrastructure.

Opportunities and challenges for 4IR technology adoption: main findings

Our study framed the adoption of 4IR technologies as a possible case of labour-augmenting technological change and analysed its labour market effects within the structural transformation framework in the context of a developing economy (see, for example, Schlogl and Sumner 2020; Andreoni et al. 2021).

We interviewed a number of executives and managers, representing various operators in the South African air transport industry, regarding the expected effects of adopting the newest technologies in their operations. All international and domestic airline operators indicated that they saw significant potential in the adoption of 4IR technologies, and singularly in increasing digitalisation to improve the travelling experience and increase the efficiency of ground-handling operations. While some of the most advanced technologies have already been tested in South Africa (for example, e-gates at Cape Town International Airport) or in the main hubs of foreign companies operating in South Africa (e.g. Schiphol in the Netherlands), the most sophisticated technologies still remain on a future agenda. Ultimately, interviewees consider such technology adoption as an essential move to gain international competitiveness.

Amongst the technologies estimated to have high transformative potential, indicate the following:

- The growing use of biometrics, e-gates and face-recognition systems to improve immigration procedures and speed incoming passenger flows;
- The increasing automation of check-in and bag-dropping via the sophistication of self-service kiosks and the integration of online booking and check-in operations;
- The use of big data to archive passengers' profiles and to improve the travelling experience;
- The adoption of driverless vehicles in airports, the demand for which has increased significantly during COVID-19;

- The digitalisation and increasing automation of cargo operations, with particular interest in the digitalisation of goods classification and the potential adoption of 3D scanners to optimise cargo loads;
- The deployment of AI for the predictive modelling of flight operations (AI to connect all available data and propose centralised solutions);
- The implementation of CUTE (common-use terminal equipment) systems as a centralised hardware infrastructure to better control passenger flows and flights in a given airport;
- Digitalisation and automation of the sanitary checks required since the COVID-19 pandemic started, which are expected to contribute to avoiding airport congestion;
- The use of drones for cargo handling;
- The use of DCS (departure control system) systems to provide real-time notifications and provide integrated solutions to all departure control operations (including check-in, ticket management and departure controls).

While most companies that participated in the study were aware of the potential offered by these technologies, and have seen them implemented in major hubs outside South Africa, they mostly considered them as an aspirational goal for their operations in the country. This is because the existing airport infrastructure constrains their ability to use them. However, ACSA, the main infrastructure provider, has indicated that considerable budget has already been reserved for infrastructure modernisation, including the deployment of digitalisation and biometrics systems to ensure better passenger- and cargo-flow efficiency, as well as enhanced security. The adoption of these technologies, however, is still confronted by significant constraints and challenges. Such constraints range from practical concerns such as the recent fuel and staff shortages (particularly aggravated by the layoffs caused by the COVID-19 crisis) to broader financial constraints (such as the financial distress that crippled SAA and led to the liquidation of Comair) and institutional fragmentation (for example, the lack of procedural harmonisation and data integration between airport authorities and Home Affairs on immigration procedures). Structural and ethical considerations are an equally important obstacle (e.g. data availability following the application of the POPI Act). Specific constraints also relate to the availability of skills. While there is good overall distribution of digital skills in the sector, highly skilled professionals, such as aviation engineers, supply chain managers and specialised data analysts, are particularly scarce.

Policy implications and recommendations

In the light of global trends in the aviation and air transport industries looking to the future, the South African airline industry will have to make strategic choices, including investments in the adoption of smart technology to not only overcome existing weaknesses and bottlenecks, but also to create a new impetus for the overall profitability and sustainability of the sector. In particular, five areas are identified as being of crucial importance, and these require careful consideration:

1) Modernisation of airport infrastructure as a platform for new technology adoption

The technological content and the amenities of airport infrastructure play a defining role in determining which technologies airline operators can adopt in their local operations. For the expected recovery to harness the benefits of the smartest technologies and be ready for the future of travelling, the infrastructure provider needs to strive to modernise existing airport facilities by adopting the best practices to enable

digitalisation and automation. Without adequate technological infrastructure, airline operators could remain constrained in their ability to deploy efficient technologies in South Africa, even if they have the means to apply them in the major international hubs that are setting the trends. As this transformation requires considerable investments, a careful analysis of the long-term benefits of this transition is necessary in order to ensure positive returns and spillover benefits.

2) Digitalisation and automation

Digitalisation and automation will have to cover multiple operations across the board, from self-service check-in and bag-drop to baggage handling at the airport, but also departures and transfer integration, as well as cargo services. Advance in these fields may allow seamless passenger flows, avoid congestion and improve the comfort and the security of the travel experience. However, the sustainability of all future innovations will have to be examined from all perspectives, including financial feasibility, the possibility of labour-displacing effects and the privacy implications of increasing data handling.

3) Pre-emptive intersectoral skills planning

While the potential benefits of the increased adoption of 4IR technologies are clear, intensification of digitalisation and automation may lead to labour displacement and to changes in skills requirements. In a country with extremely high rates of unemployment, industrial policy will have to anticipate the trajectory of technological change along with its employment effects, and provide the necessary support for strengthening labour absorption in sectors that are less prone to automation. While the successful adoption of 4IR technologies requires specific skills for which advanced training is needed, the reskilling of negatively affected employees is also essential to facilitate their absorption into the so-called automation-resistant sectors. A narrow collaboration between the industry, SETAs and the Department of Higher Education and Training (DHET) will be necessary to ensure both an adequate supply of skills required to adopt and operate these new technology systems, and a reorientation towards new growth sectors.

4) Environmental sustainability

The contribution of the industry to global emissions and its environmental sustainability will be an essential consideration for the sustainability of the sector. The level of competitiveness of individual companies and national industries will be determined largely by how green their future transformations will be. In this regard, smart technological development may help achieve important steps in terms of fuel efficiency, the reduction of current emissions, improvement of waste cycle management and the wider use of clean, green energies.

5) Policy and institutional coordination

Better institutional coordination and policy alignment will be necessary at several levels. For example, to improve immigration procedures, closer collaboration between airport authorities and the Department of Home Affairs will become very important. For matters related to additional sanitary measures, a closer partnership with the Department of Health is necessary to ensure that the protocols that are critical to the protection of our health do not become a drag on the competitiveness of the industry. In order to secure increasing sustainability and adopt smarter, greener technologies, a commitment of all stakeholders from all operations (airlines, ground handling and cargo) will be strictly necessary (including associations like AASA and BARSA). Matters related to infrastructure innovations will require more effective collaboration between all airlines, the Air Traffic Navigation Centre (ATNS), ACSA and the Department of Transport (DoT). For the growth of the industry, important competition matters will have to be solved, with special focus on the issue of

licences on new routes, moving beyond exclusive bilateral agreements and reinstating an efficient licensing department (DoT).

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About the South African Research Chair in Industrial Development (SARChI ID)

The South African Research Chair in Industrial Development conducts research, builds capacity and undertakes public and policy engagement in the field of industrial development. Activities focus on research projects; training and supervision of graduate students; hosting postdoctoral fellows and research visitors; and various projects, often with partners, such as conferences, workshops, seminars, training courses, and public and policy engagements. SARChI Industrial Development's research and capacity-building programme focusses on industrial development, with key pillars of interest in structural change, industrialisation and deindustrialisation, industrial policy, and technology and innovation. SARChI Industrial Development is hosted at the University of Johannesburg, where it operates as a centre located in the College of Business and Economics and is linked to the School of Economics.