POLICY BRIEF

PB 2023-10

August 2023

Inertia or Progress? Digital Technology Adoption Within a Group of South African Manufacturing SMEs

Justin Barnes and Warren Sachs

Introduction

Small and medium enterprises (SMEs) play a crucial employment role globally. Similarly, SMEs contribute significantly to the South African economy, having provided 11.8 million jobs in the last quarter of 2019 (Small Enterprise Development Agency [SEDA] 2020). Manufacturing SMEs, led by entrepreneurial owner/managers, are particularly important contributors to economic growth (Hulbert et al. 2013), although the manufacturing sector more broadly has declined significantly in South Africa over the last decade.

To maintain their competitiveness, manufacturers need to increasingly adopt digital technologies (DTs). Traditional digital operations technologies (OTs) have evolved into the internet of things (IoT), enabling interconnected devices and data-driven decision-making (Seetharaman et al. 2019). Key digital economy-based technologies include IoT, cloud computing, big data analytics (BDA), and artificial intelligence (AI) (Sturgeon 2021). These technologies streamline manufacturing processes, improve asset efficiencies, and enhance customer interactions (Navas 2020; Rejikumar et al. 2019). Globally, SMEs appear to face major challenges in adopting DTs. This includes factors such as limited long-term strategic thinking, a reactive approach to disruptions, and a lack of managerial competence (Ates and Bititci 2011; Bessant and Tidd 2011). Consequently, despite its proven benefits, only a small percentage of manufacturers have fully implemented DTs (Goodness et al. 2020).

There is a clear research gap regarding DT adoption by SMEs, particularly in the South African context. By exploring the drivers of and barriers to adoption, as well as the role of owner/manager mindsets and platform

About the authors

Justin Barnes, Manufacturing Ambassador of the Toyota Wessels Institute for Manufacturing Studies, Associate Professor at the Gordon Institute of Business Science, University of Pretoria, and Chairperson of B&M Analysts. E-mail: justin.barnes@twimsafrica.com.

Warren Sachs, Chief Operating Officer of the Beier Group. This Policy Brief is based on Warren's Master's dissertation, submitted in partial fulfilment of his MBA degree. E-mail: wsachs@beier.co.za.

openness to doing so, this research attempts to contribute to a deeper understanding of how manufacturing SMEs can leverage DTs to enhance their competitiveness.

Contextualising DTs in the South African SME manufacturing space

The adoption of digital technologies (DTs) is deemed crucial for the competitiveness and growth of manufacturing SMEs. DTs, including the internet of things (IoT), cloud computing, big data analytics (BDA) and artificial intelligence (AI), offer opportunities for agility, resource efficiency, and improved decision-making in manufacturing processes. These technologies can enhance asset efficiencies at SME manufacturers, reduce operational risks, and improve customer interactions and experiences (Popovič et al. 2018; Tortorella et al. 2019; World Economic Forum 2021).

However, the adoption of DTs in manufacturing SMEs is often hindered by various factors. One key factor is the mindset of owner/managers, who may lack long-term strategic thinking, managerial competence, and the ability to cope with firm growth (Ates and Bititci 2011; Bessant and Tidd, 2011). These characteristics impede the successful adoption of DTs, leading SMEs to rely on personal expertise and being reactive to external disruptions (Eggers 2020; Hulbert et al. 2013). SMEs also face resource constraints and may perceive DT adoption as costly and technically complex (Müller et al. 2018). The lack of DT awareness and understanding further hinders adoption. As such, many SMEs use only basic DTs, such as production monitoring (Moeuf et al. 2018; Stentoft et al. 2020).

Platform openness is another critical factor in DT adoption decisions. The choice of platform affects data interoperability and security. Open standards are necessary for interoperability, but they may increase security concerns (Zdravković et al. 2018). DT adoption is therefore influenced by factors such as perceived security risks, cost, resource scarcity and the absence of external motivators (Müller et al. 2018; Stentoft et al. 2020).

Research questions and methodology

The research questions (RQs) guiding the study were:

1. Do South African manufacturing SMEs implement DTs, and for what reasons? (RQ1)
2. What digital transformation strategies are employed by manufacturing SMEs in South Africa? (RQ2)
3. How do platform openness and owner/manager mindsets influence SME intentions to adopt DTs? (RQ3)

A qualitative research design was adopted to explore these questions. Due to the large number of small-scale SMEs in the South African manufacturing sector, non-probability purposive sampling was used. A total of 12 SME manufacturing owner/managers were interviewed in KwaZulu-Natal, Gauteng and the Western Cape, representing ten manufacturing sub-sectors. In addition, four interviews were conducted with DT vendor managers/owners. Semi-structured interviews constituted the primary data collection method. The interview guide included questions about the SMEs' DT strategy decision-making processes, enablers and inhibitors of DT implementation, and other relevant factors.

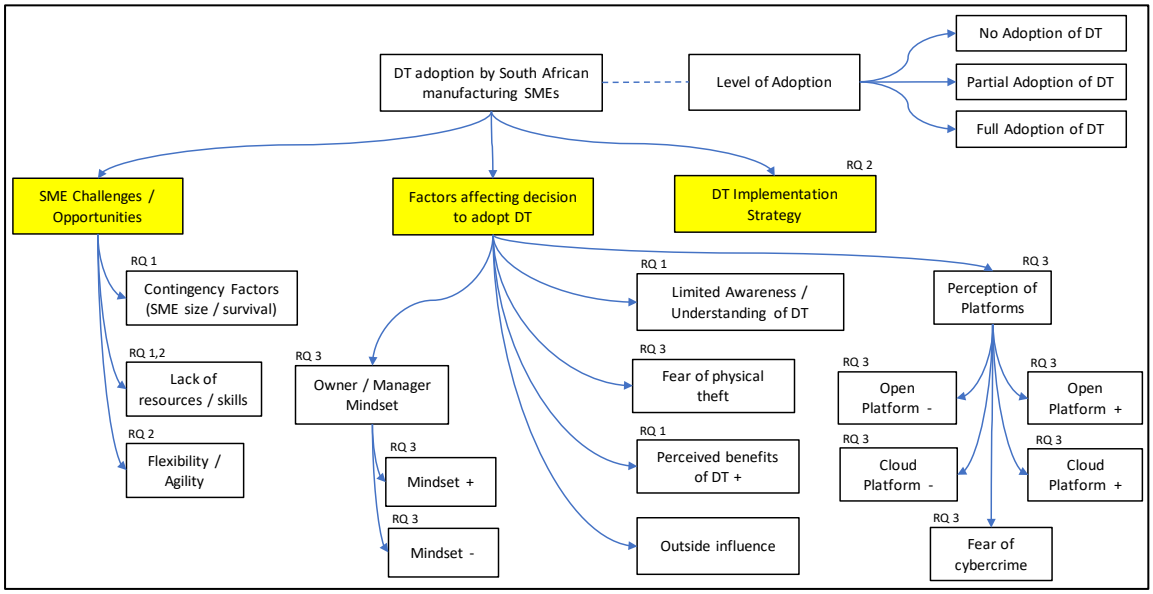
Interviews were recorded and transcribed using the Otter.ai online transcription service. Transcripts were then analysed and coded using thematic analysis. The process of data analysis involved breaking down the data into its constituent parts and interpreting these parts to derive meaning. Descriptive codes were assigned to significant segments of the interview transcripts. After the first round of coding, interview codes were reviewed and unnecessary/inappropriately linked codes

were corrected or unlinked from the text. This process included the merging of codes. After two rounds of revision, 16 code categories emerged. These categories were then analysed together with the document groups to identify primary themes.

Primary research findings

The themes that emerged from the primary research process are shown in Figure 1.

Figure 1: Code map



In respect of RQ 1, the findings indicate a low level of DT adoption among manufacturing SMEs in South Africa. Firms typically do not adopt advanced DTs due to their operational focus. However, the understanding and adoption of advanced production techniques and DTs appear to increase as businesses move further down the supply chain driven by customer requirements. Although sales are the primary focus for many manufacturing SMEs, they still utilise some form of mobile and cloud-based services. However, their use of these services is driven primarily by operational needs rather than strategic DT adoption. SMEs rely on technology such as cloud storage, mobile devices and enterprise resource planning (ERP) systems to make quick and agile decisions, thereby replacing manual systems. DT choice is based on its suitability for existing business needs. The use of cloud-based storage and ERP systems is further enhanced by the experiences of SMEs that have suffered data loss, leading them to perceive cloud-based storage as more reliable than traditional methods. Many manufacturing SMEs use online and social media platforms to support sales, emphasising their customer-centric approach and the positive effect of online sales platforms on their business processes and customer reach. However, SMEs have limited in-depth knowledge of DTs, with only one of the 12 firms exhibiting thorough knowledge. While this one firm understood technologies like 3D printing and remote machine access, there was little indication of AI knowledge or the use of advanced algorithms for process or product improvement.

In respect of RQ 2, which explored what DT strategies manufacturing SMEs in South Africa have implemented, the key code categories demonstrated the limited scope of strategic planning adopted by the SMEs. The lack of resources and skills inhibits their adoption of DTs and the development of formal DT

strategies. SME implementation strategies are primarily informal, with SMEs prioritising flexibility and agility in their manufacturing and sales processes, often driven by customer requirements. Online collaboration tools and communication platforms are used to interact with customers. Cybercrime concerns were evident among the SMEs, with awareness of risks related to both cybercrime and physical theft. However, the participants believed that cloud-based data security was achievable, and that cloud platforms were a key future trend in manufacturing. In contrast, cost and complexity were noted as major barriers to DT adoption.

Finally, in respect of RQ 3, the study found varying responses among SME owner/ managers regarding their perceptions of proprietary platforms versus open platforms. Some participants seemed to lack an understanding of these platform types, but most owner/managers had growth mindsets, indicating a willingness to embrace new technologies and ideas.

Insights from vendor participants were used to validate the findings. All four vendors preferred to focus their energy on larger manufacturers due to the limited revenue potential and the additional effort required to work with SMEs. The vendors also noted that SMEs did not prioritise platform openness when deciding to implement DTs, despite its significance in selecting the most appropriate DT. The vendors emphasised the need for specific DT strategies tailored to SMEs. They recommended starting small with immediate value capture through the adoption of DTs such as the industrial internet of things (IIoT), and gradually scaling up to create incremental value. Successful DT adoption was considered more likely when SME owner/managers had an open mindset toward technology.

Analysis of key research findings

Most of the SMEs surveyed were in the early stages of digital strategy alignment, indicating a low level of DT adoption. They primarily used DTs for data storage, cloud-based enterprise resource planning (ERP), and sales and communication on mobile platforms. The findings suggest that manufacturing SMEs in South Africa have limited awareness of the available DTs, although they are familiar with mobile and cloud-based technologies.

The findings suggest that firm size does not have a significant effect on DT adoption, in contrast to previous research. Smaller SMEs, however, receive less attention from DT vendors due to their limited revenue potential. This information asymmetry hinders SMEs' access to DT-related information and capabilities compared to their larger competitors. A lack of resources, particularly skilled staff, and funding is a further significant challenge facing SMEs. Most SMEs have consequently not developed formal DT strategies, rather adopting DTs in an ad hoc manner based on immediate needs.

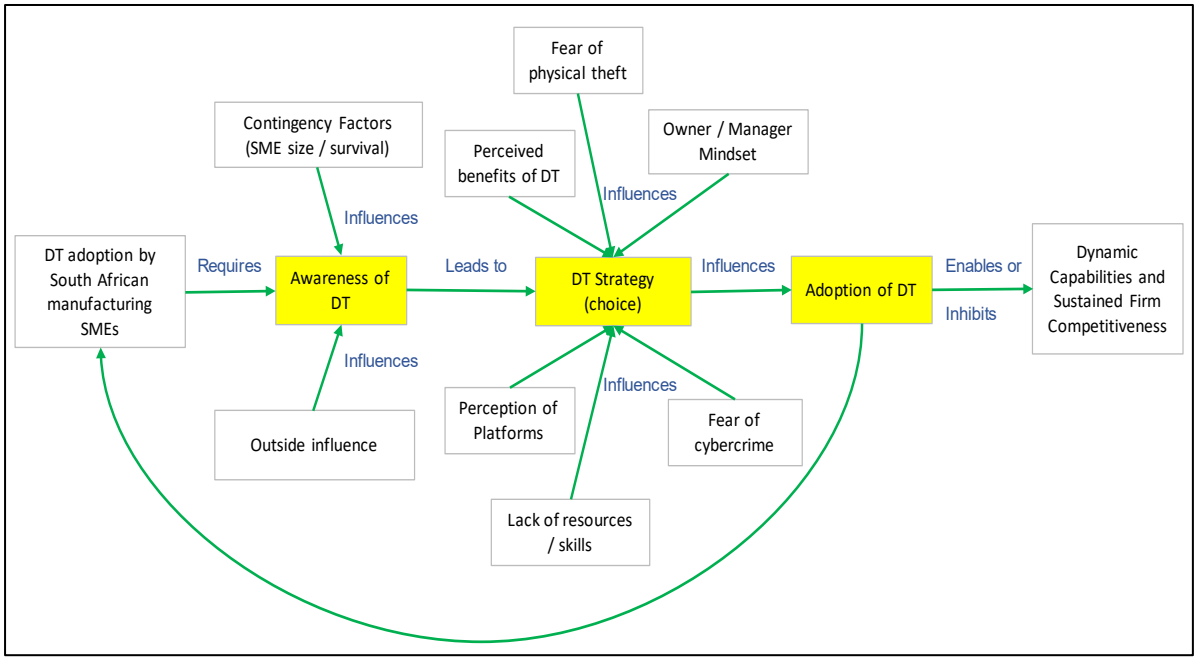
The lack of resources at South Africa-based manufacturing SMEs limits their time for strategic planning, creating a low level of digital maturity that hinders the development of comprehensive DT strategies. It therefore is proposed that the level of DT adoption by manufacturing SMEs either enables or inhibits the development of their dynamic capabilities, which in turn enables or inhibits their further adoption of DTs. This leads us to put forward three propositions.

1. The intention of manufacturing SMEs to adopt DTs is mediated by their lack of awareness of DTs and moderated by their perceptions of DT costs.
2. Manufacturing SMEs' DT awareness is inhibited by DT vendors, who fail to focus on SMEs.
3. The availability of support structures and sector/government programmes increases awareness and adoption of DTs by manufacturing SMEs.

Conclusion

The findings suggest that South African manufacturing SMEs have adopted DTs, but at an immature level (Canhoto et al. 2021; Frank et al. 2019). The mindsets of SME owner/ managers has played a significant role in influencing DT adoption, supporting the notion that owner/manager mindsets are influential factors (Jones et al. 2021). There is a lack of awareness and understanding of DTs among the management of manufacturing SMEs. Apart from one SME that had extensively adopted DTs based on the interconnectivity and cost benefits of an open platform, there is ambiguity regarding the intentions of other SMEs to adopt DTs. Based on the interview results and the DT literature review, a model of DT adoption by manufacturing SMEs was developed, as shown in Figure 2.

Figure 2: Proposed model of DT adoption by SMEs in the South African manufacturing sector



The model shown in Figure 2 represents a virtuous cycle, where DT adoption enables firm dynamic capabilities, leading to enhanced sensing and seizing of advanced DT opportunities, and ultimately transforming the firm's structures and business models. This virtuous cycle is proposed to contribute to the sustained competitiveness of manufacturing SMEs. SME owner/managers and managers are encouraged to explore the range of available DTs to improve their sensing abilities and assess their mindsets regarding technology, competence and perception of potential disruption caused by DTs. External agents such as government departments and larger customers can promote DT awareness among manufacturing SMEs, while DT vendors can develop new business models targeting these SMEs.

References

Ates, A. & Bititci, U. (2011). Change process: A key enabler for building resilient SMEs. *International Journal of Production Research*, 49(18): 5601-5618. https://doi.org/10.1080/00207543.2011.563825

Bessant, J. & Tidd, J. (2011). *Innovation and entrepreneurship* (2nd ed.). Chichester: John Wiley & Sons.

Canhoto, A. I., Quinton, S., Pera, R., Molinillo, S. & Simkin, L. (2021). Digital strategy aligning in SMEs: A dynamic capabilities perspective. *The*

Journal of Strategic Information Systems, 30(3): 101682. https://doi.org/10.1016/j.jsis.2021.101682

Eggers, F. (2020). Masters of disasters? Challenges and opportunities for SMEs in times of crisis. *Journal of Business Research*, 116: 199-208. https://doi.org/10.1016/j.jbusres.2020.05.025

Frank, A. G., Dalenogare, L. S. & Ayala, N. F. (2019). Industry 4.0 technologies: Implementation patterns in manufacturing companies. *International Journal of Production Economics*, 210: 15-26. https://doi.org/10.1016/j.ijpe.2019.01.004

Goodness, E., Velosa, A., Friedman, T., Berthelsen, E., Kim, S., Havart-Simkin, P. & Thielemann., K. (2020). *Magic quadrant for industrial IoT platforms*. Gartner, Inc. https://www.gartner.com/doc/reprints?id=1-24KDTTSL&ct=201109&st=sb

Hulbert, B., Gilmore, A. & Carson, D. (2013). Sources of opportunities used by growth minded owner managers of small and medium sized enterprises. *International Business Review*, 22(1): 293-303. https://doi.org/10.1016/j.ibusrev.2012.04.004

Jones, M. D., Hutcheson, S. & Camba, J. D. (2021). Past, present, and future barriers to digital transformation in manufacturing: A review. *Journal of Manufacturing Systems*, 60: 936-948. https://doi.org/10.1016/j.jmsy.2021.03.006

Moeuf, A., Pellerin, R., Lamouri, S., Tamayo-Giraldo, S., & Barbaray, R. (2018). The industrial management of SMEs in the era of Industry 4.0. *International Journal of Production Research*, 56(3): 1118-1136. https://doi.org/10.1080/00207543.2017.1372647

Müller, J. M., Buliga, O. & Voigt, K. I. (2018). Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0. *Technological Forecasting and Social Change*, 132: 2-17. https://doi.org/10.1016/j.techfore.2017.12.019

Navas, M. A., Sancho, C. & Carpio, J. (2020). Disruptive maintenance engineering 4.0. *International Journal of Quality & Reliability Management*, 37(6/7): 853-871. https://doi.org/10.1108/IJQRM-09-2019-0304

Popovič, A., Hackney, R., Tassabehji, R. & Castelli, M. (2018). The impact of big data analytics on firms' high value business performance. *Information Systems Frontiers*, 20(2): 209-222. https://doi.org/10.1007/s10796-016-9720-4

Rejikumar, G., Arunprasad, P., Persis, J. & Sreeraj, K. M. (2019). Industry 4.0: Key findings and analysis from the literature arena. *Benchmarking: An International Journal*, 26(8): 2514-2542. https://doi.org/10.1108/BIJ-09-2018-0281

Seetharaman, A., Patwa, N., Saravanan, A. S. & Sharma, A. (2019). Customer expectation from industrial internet of things (IIOT). *Journal of Manufacturing Technology Management*, 30(8): 1161-1178. https://doi.org/10.1108/JMTM-08-2018-0278

Small Enterprise Development Agency (SEDA). (2020). *SMME quarterly update: 1st quarter 2020*. http://www.seda.org.za/Publications/Publications/SMME%20Quarterly%202020%20Q1.pdf

Stentoft, J., Adsbøll Wickstrøm, K., Philipsen, K. & Haug, A. (2020). Drivers and barriers for Industry 4.0 readiness and practice: Empirical evidence from small and medium-sized manufacturers. *Production Planning & Control*, 32(10): 1-18. https://doi.org/10.1080/09537287.2020.1768318

Sturgeon, T. J. (2021). Upgrading strategies for the digital economy. *Global Strategy Journal*, 11: 34-57. https://doi.org/10.1002/gsj.1364

Tortorella, G. L., Giglio, R. & Van Dun, D. H. (2019). Industry 4.0 adoption as a moderator of the impact of lean production practices on operational performance improvement. *International Journal of Operations & Production Management*, 39(6/7/8): 860-886.

World Economic Forum. (2021). Global lighthouse network: Reimagining operations for growth [White Paper]. World Economic Forum. http://www3.weforum.org/docs/WEF_GLN_2021_Reimagining_Operations_for_Growth.pdf

Zdravković, M., Zdravković, J., Aubry, A., Moalla, N., Guedria, W. & Sarraipa, J. (2018). Domain framework for implementation of open IoT ecosystems. *International Journal of Production Research*, 56(7): 2552-2569. https://doi.org/10.1080/00207543.2017.1385870

Recommended citation

Barnes, J. and Sachs, W. (2023). Inertia or progress? Digital technology adoption within a group of South African Manufacturing SMEs. SARChI Industrial Development Policy Brief Series PB 2023-10. SARChI Industrial Development, University of Johannesburg.

Acknowledgement: The South African Research Chairs Initiative (SARChI) was established in 2006 by the Department of Science and Innovation (DSI) and the National Research Foundation (NRF). The funding support of the DSI and the NRF through Grant Number 98627 and Grant Number 110691 for the South African Research Chair in Industrial Development has made this policy brief series possible.

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.

SARChI SARChI Chair: Industrial Development
UNIVERSITY OF JOHANNESBURG
NRF National Research Foundation
science & innovation Department: Science and Innovation REPUBLIC OF SOUTH AFRICA