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The Application of Productivity Improvement Systems for Enhancing the Productivity of the Small-Scale Masonry Brick Manufacturing Enterprises

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Abstract

The small-scale masonry brick manufacturing sector is pivotal in the industry as it plays an important role in the socio-economic development of the members of the surrounding communities. The industry is perceived to be the source of income in that it creates employment and entrepreneurial opportunities, particularly at the ground level. However, there are perennial causes of deviation from expected productivity that impede growth in productivity within the small-scale masonry brick-making sector. A qualitative (deductive/subjective) research strategy using interviews and aided by an interview guide was used to gather data of a qualitative nature. Thematic analysis through using themes developed from the transcribed interviews was employed to identify similarities, differences and potential gaps between identified research constructs. The findings revealed that productivity improvement systems involving human resource management, ergonomics, just in time and quality management supported productive growth except for business process reengineering within the small-scale masonry brick manufacturing industry in Gauteng, South Africa.

Keywords
Productivity, Manufacturing, Productivity Improvement Systems, South Africa.

1. Introduction
Productivity is often used in conjunction with performance factor, production rate, and unit per person hour (Lawaju, Parajuli & Shrestha, 2021). Productivity in the brick manufacturing sector pertains to the measurable relationship between the output, namely the bricks produced, and the input materials such as coal, clay or sand, water, and pipes (Islam, Nazifa, Yuniarto, Uddin, Salmiati & Shahid, 2019). Furthermore, productivity is measured in monetary terms whereby the value generated is determined considering costs expended (Islam et al., 2019; Seth, Chadha & Sharma, 2020).

The generation of a product divided by the resources used within the masonry brick manufacturing industry is regarded as productivity (Del Rio & Sovacool, 2023). These resources include labour, capital, raw materials, and plant. One or

all of these resources can be used as a denominator in the productivity ratio (Ebikeseye & Puyate, 2022; Del Rio & Sovacool, 2023).

The small-scale masonry brick manufacturing business contributes to a country's infrastructure growth and, in turn, the economy, which produces jobs and entrepreneurial prospects (Hilson, Bartels & Hu, 2022; Khanh, Kim, Khoa & Tu, 2023). Making cement and bricks are primary input resources used in most infrastructure projects. Brick manufacturers, including small-scale building construction enterprises, benefit from construction materials, aiming at expanding their output and operational capacity for an increase in job opportunities (Department of Public Works and Infrastructure, 2024:41).

The sector is pivotal in supplying construction material such as masonry bricks to the building and construction industry. These small-scale brick manufacturing enterprises assist in the development of the construction sector, skills development, sources of income and creation of employment opportunities, thus, contributing towards the social and economic development of surrounding communities (Sampea & Pakidingb, 2015; Matsiketa, 2018; Windapo, Omopariola, Olugboyega & Moghayedi, 2021), ultimately, contributing towards the gross domestic product (GDP) and economy of South Africa.

The research examines the application of established productivity enhancement systems designed to boost productivity growth in the small-scale masonry brick manufacturing sector in Gauteng province, South Africa.

1.1 Problem statement

The size of the industry, in relation to its turnover in Table 1 below dropped from R555 880 in 2016 to R524 771 in 2022 for manufacturing and dropped from R155 996 in 2016 to R108 906 in 2022 for construction (Gaan et al., 2023; Algoa Clay brick Association, 2024). Production output within the masonry brick manufacturing industry declined from approximately 7.5 million tonnes in 2015 to roughly 5.6 million tonnes of saleable bricks in 2023 (Algoa Clay brick Association, 2024).

Table 1. Turnover contributing to the GDP by industry in South Africa

Year	Manufacturing	Construction
2016	555 880	155 996
2017	554 883	147 076
2018	563 250	144 861
2019	559 322	139 986
2020	493 681	115 076
2021	526 711	112 718
2022	524 771	108 906

The research problem is that small-scale masonry brick manufacturing is faced with a decrease in clay brick production output, which is attributed to a lack of training, poor working environment, a lack of health and safety compliance, poor handling of machinery and a lack of technology (Algoa Clay brick Association, 2024).

1.2 Objectives

The purpose of the research was to investigate how productivity improvement systems are applied to enhance the productivity growth of small-scale masonry brick manufacturing in the Gauteng region, influenced by human, physical, and technological capital.

1.3 Research scope

The study primarily focused on small-scale masonry brick-making enterprises to assess the application of productivity improvement systems for productivity growth in Gauteng, South Africa. This limitation affects the study's ability to apply its findings to other medium-sized enterprises and various sectors.

1.4 Importance of the study

This paper seeks to examine how brick artisans perceive the application of the identified systems for productivity enhancement within the small-scale masonry brick manufacturing industry. Furthermore, highlight challenges that seem to impede small-scale masonry brick manufacturing enterprises from attaining expected productivity growth. Thus, not achieving profit optimisation and long term market-related competitiveness.

2. Literature Review

2.1 Masonry brick evolution

Masonry block crafting is viewed as one of many small and medium-scale artisanal industries that have existed for millennia. Brick creation plays an important role in fostering development and growth of the building and construction industry (Saediman, Noraduola & Nafiu, 2014; Sampe & Pakiding, 2015). Valdes et al. (2020) perceive the masonry brick-manufacturing sector to be the oldest industry in comparison to other sectors in the history of human civilisation. Valdes et al. (2020) echo Del Rio et al. (2022) in that, since a brick was invented approximately 5,000 years ago, people view a building brick as the only man-made conventional raw material that persists and continues to be used for building construction.

2.2 The Traditional Operational Process of Making Masonry Bricks

The manufacturing process for masonry bricks starts with the excavation of sand, which is then placed on a roller with a metal grid to remove any undesirable particles. Next, the sand is mixed with water, shaped into the required specifications, and then subjected to firing or burning, followed by drying, packaging, storage or warehousing, and finally delivery to the prospective customer (Cultrone and Rosua, 2020; Ridwan et al., 2021). Furthermore, Arevalo-Barrera et al., (2019) state that the masonry brick manufacturing process includes grinding, mixing, extrusion, drying and baking.

2.3 Human, Physical and Technological Capital Challenges

Mediators involving human, physical and technological capital factors are crucial in that they assist in the application of productivity improvement systems for the growth and sustainability of productivity of the small-scale masonry brick manufacturing enterprise (Cobîrzan et al., 2022). However, there are challenges that seem to negate a successful application of systems for growth in productivity within the small-scale block manufacturing enterprises. These capital challenges are discussed below in Table 2.

Table 2. Human, physical and technological capital challenges

Human Capital Challenges	**Author(s)**
Lack of skills development (training) and knowledge (education)	Adu *et al*., (2019); Van Nieuwenhove & De Wever (2022).
Inadequate personnel	Cobîrzan *et al*., (2022).
Poor remuneration	Delgado *et al*., (2019).
Lack of concentration, emotional and physical stress	Evans, J.R., and Lindsay, W.M., (2017).
Physical Capital Challenges	**Author(s)**
Poor quality of raw material for building and construction.	Vanderlinden (2021); Cobîrzan *et al*. (2022); Windapo *et al.,* (2022)
Water-cement ratio (complementary weight between water and cement not being the same), the durability of the masonry bricks (comprehensive strength) and brick density (weight).	Suhariyanto *et al.,* (2022).
Lack of proper equipment and not enough brick moulding machinery.	Kongkajun *et al.,* (2020)
Excessive drying of moulded bricks.	Aka *et al.,* (2020).
Technological Capital Challenges	**Author(s)**
Concerns that technology results in workforce reductions, is costly to implement within the organization, and is not readily accessible.	Koumas *et al.,* (2021)

Lack of acceptance and adjustment to technology.	Delgado (2019)
Lack of training in alignment with technological requirements.	Vrontis *et al.* (2022)
Lack of investment from the government	Bajrachary *et al.,* (2022)

2.4 The Implementation of Productivity Enhancement Systems Utilising Human, Physical and Technological Resources

Value-adding drivers are strategies that businesses use to enhance workforce performance and productivity in both international and national markets (Girdwichai & Sriviboon, 2020). Productivity enhancement systems or initiatives are mechanisms employed in the production process to convert inputs into value-added outputs within the masonry brick manufacturing small and medium-scale enterprise to achieve productivity growth, market-related competitiveness and profit optimisation (Gavrila & Lucas Ancillo, 2021; Amankwah-Amoah, 2021).

Ergonomic practices are generally associated with the study of human behaviour, skills, limitations and to create a safe and supportive working environment that allows employees to achieve their full potential (Banstola et al., 2019; Chakraborty, Mandal & Bhowmik, 2021). Ergonomics attempts to reduce the risk to the employees' well-being from various job-related injuries that artisanal brick makers might suffer over a period of years within the masonry brick manufacturing industry (Alzayed *et al*., 2018; Chakraborty *et al*., 2018; Manzoor *et al*., 2019).

Heizer *et al*., (2017:336), human resources management involves the processes of recruiting and selecting new employees, ensuring adherence to legal standards, and assessing employee performance.. Liu *et al*., (2021) describe the concept of human resources as the ability of management to design and implement systems and production processes, to stimulate innovation and ensure worker satisfaction within the masonry brick manufacturing small-scale enterprises workplace environment.

Just-in-time systems can be expressed as lean manufacturing which is used by small and medium-scale enterprises to ensure that not only customers receive their products on time but also that processes are incorporated into the organisation to enhance the turnaround time for generation of products to achieve zero inventory control (Othman *et al*., 2016; Lyu, Lin, Guo & Huang, 2020).

Evans and Lindsay (2017) explain that business process reengineering is accountable for redesigning disorganised manufacturing processes and modifying assembly lines (also known as production lines) to be more flexible to produce complete products. A company or part of its operational process can be restructured through business process reengineering (sometimes-called business process redesign).

The concept of total quality management suggests that the entire personnel involving management and employees continuously work towards enhancing their operations (Kumar & Raut, 2021). Thus, the masonry brick manufacturing small-scale enterprise can meet the quality expectations of customers, high levels of customer satisfaction and obtain a competitive edge over other enterprises (Carrero *et al*., 2021).

Technology in this instance is defined as the ability to scientifically transform production processes and integrate advances in computer systems, machines and humans to improve the efficiency of the masonry brick manufacturing small-scale enterprises (Chatterjee, Okazaki & Shaw., 2018; Singh *et al*., 2022).

3. Research Methods

The study was qualitative (deductive/subjective) in nature. To gather data using qualitative method, purposive, convenience and snowball sampling techniques were followed to provide the information required of the study. 4 small-scale masonry brick manufacturing enterprises were interviewed until data saturation with additional data gathered that provided little of the information, different from those of other participants, until data saturation was reached (Saunders et al., 2016). Thematic analysis through using themes developed from the transcribed interviews was employed to identify similarities, differences and potential gaps between identified research constructs.

4. Results and Discussion

The empirical findings deduced from the views of the participants, in alignment with the literature reviewed (as shown in the Table 3, highlighted prevalent constraints that impede productivity growth within the masonry brick building and construction enterprises. In regard to Theme 1 - productivity improvement, the findings revealed that the owners and managers confused productivity with production output. Their focus was mainly based on the number of bricks produced on a day-to-day basis. Productivity is not measured on a day-to-day basis but rather on a month-to-month, quarter-to-quarter or year-to-year basis. Pertaining to Theme 2 – capital resource factor challenges, the findings showed that participants lacked the will to progress in their career path (Human Capital), poor material and machine handling tools, absence of personal protective equipment (Physical Capital).

Table 3. The response rate, data collection site and the generated statistics

Response rate	**Data collection site and statistics**
Research targeted	The masonry block manufacturing small-scale enterprises
Location/area of study	South Africa, Gauteng – in the regions of Johannesburg and Tshwane (Pretoria)
Sum of the questionnaires distributed	322
Participants	252
The study's rate of response	78%
Failure to return rate	22%
Targeted respondents	Owners, supervisors and brick artisans

The information gathered from masonry brick manufacturing small-scale enterprises was summarised into a frequency distribution table focusing on the demographic variables as depicted in **Table 4** below. This section of the study assesses the demographic attributes of individuals involved in small-scale masonry brick production businesses in Gauteng, South Africa.

Table 4. Themes and Sub-Themes

NUMBER OF THEMES	THEMES	SUB-THEMES
THEME 1	PRODUCTIVITY IMPROVEMENT	1. Product over man hours
		2. Product over machine hours
		3. Product over material hours
		4. Product in Rand over labour cost
		5. Product in Rand over machine cost
		6. Product in Rand over material cost
		7. Product in Rand over energy cost
THEME 2	CAPITAL RESOURCE FACTOR CHALLENGES	1. Human capital (HC)
		2. Physical capital (PC)
		3. Technological capital (TC)
THEME 3	PRODUCTIVITY IMPROVEMENT SYSTEMS	1. Ergonomics (ERG)
		2. Human Resource Management (HRM)
		3. Just in Time (JIT)
		4. Business Process Reengineering (BPR)
		5. Total Quality Management (TQM)
		6. Technology (TEC)
THEME 4	VALUE-ADDING DRIVERS	1. Price
		2. Quality of material
		3. Quality of service
		4. Reliability
		5. Flexibility
		6. Delivery

As shown in Table 3 above, Themes 3 and 4 revealed that the findings attained from the interviews conducted and data transcribed, of all productivity improvement systems that were essential for the study, only ergonomics (ERG), Human Resource Management (HRM), Just-in-Time (JIT) and Total Quality Management (TQM) agreed with the literature except for Business Process Reengineering (BPR) and Technology (TEC) (Kharub, Mor & Rana ,2022). The findings from interviews conducted revealed that there was non-existence of emerging technologies with the masonry brick small-scale manufacturing enterprises. Thus, pointing out that these small-scale masonry brick enterprises are not technological inclined with industry 3.0 – 4.0.

5. Conclusion

The findings from interviews conducted revealed that there was non-existence of emerging technologies with**in** the masonry brick small-scale manufacturing enterprises. Thus, pointing out that these small-scale masonry brick enterprises are not technological inclined with industry 3.0 – 4.0.

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