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Exploratory research study on key performance systems used to improve efficiency of brick artisans' within the brick construction industry in South Africa

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Abstract

The construction industry plays a crucial role in improving the socio-economic development of rural and urban communities. The sector is also responsible for providing employment and business opportunities for members of the society. Thus, reducing the level of poverty. The masonry brick construction SMEs contribute towards South Africa's GDP and economic growth. However, there are organisational challenges that confront the masonry brick construction SMEs and adversely affecting their productivity growth. The study was exploratory in nature and reviewed literature covering research constructs involving investment in human capital, just-in-time and workplace layout. Furthermore, how these productivity systems can be incorporated within operational process in order to grow productivity. Thus, achieving market and financial feasibility.

Keywords

Brick Construction SMEs, Human Capital Investment, Just-in-time, Workplace Layout, Productivity

1. Introduction (12 font)

The brick production industry, which is closely connected to the construction sector, plays a significant role in growing the economy of South Africa. The industry provides communities with employment opportunities (Matsiketa 2018; Windapo, Omopariola, Olugboyega and Moghayedi 2021). Thus, improving the socio-economic development of both rural and urban communities. Furthermore, contributing towards the Gross Domestic Product (henceforth-abbreviated GDP) of the country (Makhubedu, Nwobodo-Anyadiegwu and Mbohwa 2017). This is critical, as South Africa has the highest unemployment rate in the world. According to the recent statistics, the country's unemployment was recorded at 32.6 percent in the 3rd quarter of 2023 (Statistics SA 2023).

South Africa's GDP is perceived to be the strongest across the continent of Africa. According to Galal (2021), the construction industry contributed roughly 83 billion rand towards South Africa's GDP in 2020. An economic expansion of 1,2 percent occurred in the second quarter of 2021 (April-June) as the GDP reached R1 131 billion, marking the fourth consecutive quarter of growth for the economy (trading economics 2021).

According to Statistics SA (2023), South Africa's GDP expanded by 0,6 percent in the second quarter (April–June) of 2023. This follows a 0,4 percent rise in the first quarter. However, the report further suggest that despite the construction industry holding its head above water over the past few months, in the 2nd quarter of 2023, the industry lost some significant ground. According to trading economics (2023), GDP from construction in South Africa decreased to 111473.68 ZAR Million in the second quarter of 2023 from 111869.68 ZAR Million in the first quarter of 2023.

Literature read reveal that the masonry brick construction industry is confronted by other challenges that seem to negate the significant impact that these productivity improvement systems and drivers have on aggregate productivity growth. Thus, having an adverse impact on the market and financial feasibility of these brick companies. Further adding trauma towards a sector that is already ailing. Challenges involving poor performance, brick artisans' earning less than the prescribed minimum wage, poor quality of the end-product and numerous carbon emissions that cause climate change undermine the significant impact that identified systems and drivers have on productivity growth of the masonry brick construction SMEs (Arevalo-Barrera et al., 2019, Das and Landani 2021; Justino, Tengeh and Twum-Darko 2022).

1.1 Problem Statement

In light of the above-discussed reports, the masonry brick industry is connected to South Africa's Construction sector. The Construction industry has been trying to keep afloat without a proper life jacket. The economy of the country has also been struggling. The aggregate production output has been on a downward trajectory. As highlighted above, South Africa's construction GDP decreased to 111 473.68 million rand in the second quarter of 2023 from R111 869.68 million rand in the first quarter of 2023. Furthermore, there are various challenges involving below average performance of employees, climate change, poor remuneration, poor quality of masonry bricks, carbon emissions that undermine the significant impact that identified systems and drivers have on productivity growth.

1.2 Research Objectives

The research study aims to explore literature on perennial causes of considerable deviation from expected masonry brick productivity output. In addition, highlighting some of the challenges and advantages of productivity systems within the masonry brick industry SMEs in South Africa.

1.3 The Scope of the study

The research study is not only limited to South Africa, but also focusses on the masonry brick companies from Africa and across the globe. However, it is imperative to note that more emphasis is placed on the masonry brick companies that operate within the province of Gauteng, in South Africa.

1.4 Significance of the study

The research study seeks to highlight some operational challenges and advantages of the application of productivity systems involving human capital investment, just-in-time and workplace layout that the masonry brick industry SMEs can use to enhance productivity in South Africa. Thus, ensuring that these enterprises SMEs reach profit optimization

over a long-term period. From a South African perspective, to the researchers' knowledge based on the literature explored, there are not a lot of studies that focus on identifying barriers that seem to impede efficiency of brick construction SMEs and how to overcome these challenges. Thus, this approach renders the study unique.

2. Literature Review

The concept of productivity is articulated differently within industries including the masonry brick small and medium enterprises (abbreviated SMEs) in correlation with performance, productivity output and unit person hour rate (Lawaju, Parajuli and Shrestha 2021). Moswane, Aigbavboa and Mewomo (2018); Zhan and Pan (2020), productivity is an operational concept that is measured as "the ratio of output to input".

In this section below, the study explored the definition of small and medium scale enterprises SMEs from and international and local perspective. From a European perspective, The European Commission (abbreviated EC), with a recommendation from May 2003, define companies that operate within the category of medium size as those SMEs that employs less than 250 workers and whose annual turnover total is not more than 50 million euros. Those companies that operate within the category of small size as those SMEs that normally hire less than 50 employees with profit margins that are not more than 10 million euros. Micro-scale enterprise SME have less than 10 personnel with an estimated profit that does not go above 2 million euros as cross-tabulated in **table 1**. below.

Table 1. Quantitative interpretation of small and medium scale enterprises SMEs by European Commission

Company category	Employee headcount	Turnover Less than
Medium	Less than 250	Approximately 50 million euros
Small	Less than 50	Approximately 10 million euros
Micro	Less than 10	Approximately 2 million euros

Source: European Commission (2022:14)

In South African, various small and medium scale enterprises SMEs make up the construction industry and have extensive various range of tasks to perform involving building (residency, commercial and industrial building), civil works construction buildings, construction repairs and maintenance. The National Small Enterprise Act, 1996 (Act No. 102 of 1996) articulate SME enterprise that is Small and Medium Scale as a category that involve a separate and distinct business entity and any of its subsidiaries or branches, as well as cooperative enterprises managed by one owner or carried on in any sector or subsector of the national economy.

Table 2: South Africa, Republic (RSA) Construction SMEs quantitative articulations

Construction size/class of enterprise	**Total full time equivalent of paid employees**	**Turnover Less than**
Medium	51-250	Approximately R170.00 million
Small	11-50	Approximately R75.00 million
Micro	0-10	Approximately R10.00 million

Source: National Small Enterprise Act (2019:2).

Table 2 above, enterprises that employ roughly 51 to 250 producers of bricks are categorized as medium scale and have a profit margin that is equivalent to approximately 170 million rand. The enterprises that hire generally 11 to 50 workers are categorised as Small-scale construction enterprises that generate about 75 million rand. The Act further mention that businesses that provide employment opportunities to workers between 0 to 10 and their profit optimization is roughly 10 million rand are categorised as Micro-scale enterprises (National Small Enterprise Act 2019).

2.1 The Brick Production Process

Material selection plays a significant role in the overall cost of most structures (Danso, 2018). Historically, clay was used for producing bricks and the constant demand for clay for brick production has led to the material becoming increasingly expensive and the source of clay becoming scarcer with each passing year (Odimegwu et al. 2018). Almssad, Almusaed and Homod (2022), the term "Masonry" is explained as the art or ability to construct or build a wall or house utilizing bricks. According to Cultrone and Rosua (2020), the process of construction masonry bricks comprise of grinding, mixing (water and sand), drying (moulding) and baking (firing/burning). The final product is then ready for delivery to potential customers.

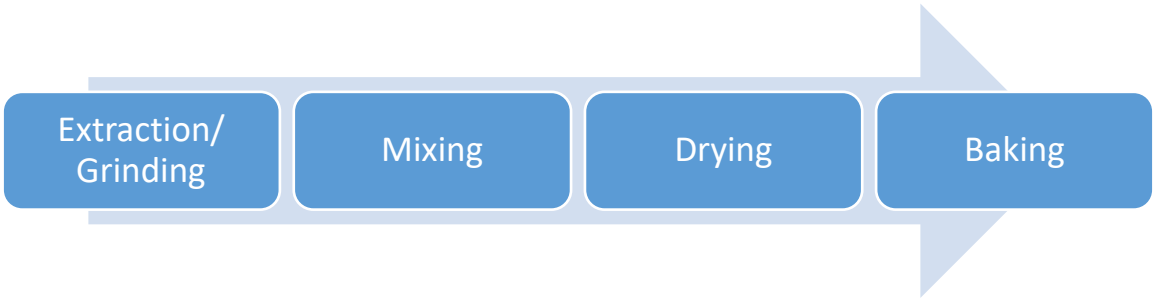

Figure 1. The Masonry Brick Production Process

The standard brick size that is used in South Africa is 222mm long x 106mm wide x 73mm with a mass of between 3kg and 3.5kg (Nithiya et al. 2016). Aniyikaiye et al. (2021) in South Africa, the type of combustion Kilns used is clamp and scove, the type of fuel used for firing/baking bricks is fly ash or coal, wood and farm waste (macadamia husks), the fired brick dimension is 220mm long × 150mm wide × 75mm high. The bricks in South Africa are mostly produced in this format. Arevalo-Barrera et al. (2019) how relatively strong (compressive strength) a masonry brick manufacturing is, depends upon SMEs considering the following factors, namely:

- water and cement should weigh the same during the mixing process;
- bricks should be aged appropriately;
- proper material usage and brick density should be maintained; and
- it should be ensured that the density of the cement and water is as dense as possible during the mixing process.

Premkumar et al. (2020) suggest that the market offers a variety of brick manufacturing machines, but only large scale brick manufacturers can access and afford them. The brick producing machines available for small-scale companies are generally focused on a single aspect, such as algorithm, brick type, cost, production rate, weight, etc. The complexity of the algorithm and the cost of a particular machine increase as the production rate of the machine increases. Premkumar et al. (2020) further discuss that the speed of brick production can reach 25 000 bricks per hour using modern extrusion machinery. Fly ash brick making machines can produce 500 bricks per day at a low cost for small-scale brick manufacturers SMEs.

The use of hydraform technology, developed in South Africa but now spread throughout many parts of Africa, is also used for manufacturing bricks. A wall made of hydraform blocks is usually solid and can be built without cement.The term "HYDRA" refers to hydraulic action in making blocks, and "FORM" refers to forming interlocking blocks (Sholanke, 2015). According to Chuchra and Seth (2014) it is imperative to acknowledge that, mechanization does not completely substitute personnel, but rather, mechanisation serves as the interface amid employees and machines (Gumede, 2018).

2.2 Brief Background of Key Efficiency Systems

The masonry brick production process of transforming raw material (inputs – water/ sand/ cement) into outputs (masonry bricks) require the use of key efficiency systems or functions in order for the masonry brick SMEs to attain market and financial feasibility (Gavrila and Lucas Ancillo 2021). Thus, for the masonry brick SMEs to radically

enhance production processes, it is required that they adopt performance systems involving human capital investment, Just in time (JIT) and workplace layout (good housekeeping) (Kyakulumbye and Pather 2022; Vrontis, Chaudhuri and Chatterjee 2022). The idenfified performance systems that are significant to productivity growth are explored below.

2.3 Defining Key Efficiency Improvement Systems - Human Capital Investment, Just in Time (JIT) and Workplace Layout

Kucharˇcíková, et al. (2018:2) suggest that investment through human capital, provision of education (knowledge), training (skill development) and health care, which is a part of human resource management/ development, involve developing innate abilities such as skills, knowledge, experiences etc., employed to drive efficiency aligned with organisational strategies. Just in time (JIT) system, can be communicated as lean production/ construction, which is used by SMEs to ensure that not only customers receive their products on time but also machine are integrated into the business to improve cycle time for the generation of products to achieve zero inventory control (Othman, Sundram, Sayuti and Bahrin 2016). Koumas, Dossou, and Didier, (2021) propose that SMEs use business layout as means to integrate machinery, brick employees' with the working environment to create a conducive and sustainable efficient environment.

2.4 Key Efficiency Improvement Systems Challenges - Human Capital Investment, Just in Time (JIT) and Workplace Layout

Table 3. Key Efficiency Improvement Systems Challenges

Human Capital Investment Challenges	**Author(s)**
Lack of concentration, emotional and physical stress	Evans & Lindsay (2017)
Lack of education (knowledge)	Windapo (2020)
Lack of training (skill development), incompetent management, inadequate supervision and lack of experience	Kolodziejek & Tey (2016); Singh et al. (2019); Pham et al. (2020)
Just in Time (JIT) Challenges	**Author(s)**
High costs of transporting material from the extraction location to the production site	Das (2017); Adu et al. (2019)
Poor quality material, shortage of resources and poor customer service.	Yadav, Jain, Mittal, Panwar & Sharma (2018)
Late delivery of final products to customers	Krishnasamy (2021)
Workplace Layout Challenges	**Author(s)**
Non-existence of essential infrastructure - social (healthcare) and economic (water supply and sanitation)	Adu et al. (2019)
Lack of capacity for workplace layout system to handle brick productivity	Valdes, Vilches, Felmer, Hurtado, & Figueroa (2020)
Dirty working environment	Karmaoui, Albalkhy, Danel, Jullien, Lafhaj, & Chapiseau (2022)

2.5 Application of Key Efficiency Systems - Human Capital Investment, Just in Time (JIT) and Workplace Layout

2.5.1 Human Capital Investment on efficiency of the masonry brick SMEs

It is imperative that brick artisans working within the brick construction industry are equipped with the necessary resources to successfully produce masonry bricks (Adu et al. 2019). Adu et al. (2019) further adds that this success can only be achieved through accumulation of knowledge and skill development provided by training and education institutions over a prolonged period of time. In addition, brick construction SMEs must invest in excellent quality of skill development (Heo, Han, Shin and Na 2021).

2.5.2 Just in Time (JIT) on efficiency of the masonry brick SMEs

The masonry brick construction enterprises SMEs can utilise Just-in-Time (JIT) as one of many management tools to increase productivity by reducing production time and product delivery, while incorporating other manufacturing systems that reduce waste through lean and parallel production lines (Minunno et al. 2018). Literature read suggest that the masonry brick SMEs can utilise Just-in-Time (JIT) as management tool to reduce the time taken to produce masonry bricks while ensuring that efficiency, production and time to transport the end-product to customer are improved. Furthermore, the use of just-in-time (JIT) will reduce waste and excess of stock in inventory. In addition, market competitiveness and profit optimization are realised (Krishnasamy 2021; Kharub, Mor and Rana 2022). This system assist these companies to reduce and eliminate masonry brick excess waste in inventory through the process of simplifying operational and production process. Furthermore, this will reduce working time and increase efficiency of brick construction companies (Malik and Sharma, 2022).

2.5.3 Workplace Layout on efficiency of the masonry brick SMEs

The concept of workplace layout plays a significant role in how the brick production SMEs position their machinery in order to attain optimal operational process. Thus, improving the workflow and creating a conducive working environment for brick artisans. The masonry brick SMEs can also use heating systems to maintain thermal comfort as temperatures change throughout the year (Gassenfeit and Brüggemann 2014). The brick manufacturing SMEs use the workplace layout to develop a way to arrange space consuming physical resources inside their working environment that support productivity growth (Cowell et al. 2018). This will result in enhanced efficiency of brick construction SMEs

3. Research Methods

This study is part of the researcher's current doctoral study. As part of the thesis research methodology, the study is using a mixed-method design that incorporates an explanatory research approach (starting by collecting quantitative data, preceded by qualitative data and merging the results in order to identify similarities and difference). Between identified research constructs. The author is currently collecting data of a quantitative nature (using a semi-structured research questionnaire) and this will be preceded by gathering qualitative data (conducting individual interviews and case study observations) within the construction industry, targeting owners, supervisors and employees that work for brick construction SMEs. Thus, for this particular paper, an exploratory research methodology was used, focusing on secondary data using research journals, articles and books was extensively reviewed to get a comprehensive understanding of the identified productivity improvement systems and value-adding drivers, and how they are inextricably important in improving productivity of the masonry brick construction SMEs. In addition, aiding brick SMEs attain market and financial feasibility.

4. Research discussion and conclusion

The masonry brick construction SMEs play a pivotal role in growing the gross domestic product (GDP) of South Africa. Furthermore, these brick construction SMEs contribute towards the socio and economic development of communities that are within the rural and urban areas. They provide people from these communities with employment opportunities. Thus, reducing the adverse influences of poverty.

In order to answer the main research question "*The research study aims to explore literature on perennial causes of considerable deviation from expected masonry brick productivity output. In addition, highlighting some of the challenges and advantages of productivity systems within the masonry brick industry SMEs in South Africa*". The extensive literature reviewed highlighted perennial challenges involving lack training (education and skill development), high costs of transporting material to the brick production site, late delivery of the end-product to customers, the use of poor traditional raw-material (clay/sand) and an environment that not conducive to work in negate the efficiency of brick construction SMEs from attaining productivity growth. However, literature also revealed how these barriers can be mitigated by the application of investment of human capital through education and training, Just-in-Tine, that is, the delivery of raw material to the brick production site and that a customer receive their product on time. Lastly, creating an environment that is employees can work to their optimal. Thus, driving the efficiency of the brick construction SMEs.

5. Limitations and future research

This paper reviewed literature on identified research constructs, which limited the research study's overall generalizability, as it is part of a continuing research for my doctoral studies. In addition, the study does not take into account all productivity improvement systems. As a result, this opens up other research possibilities regarding productivity improvement systems. In the future, it is important to quantitatively, quantify the impact of productivity systems on the masonry brick construction SMEs' productivity growth.

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