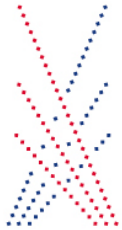

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SUSTAINABLE MANUFACTURING PRACTICES AND SUSTAINABLE PERFORMANCE OF SMALL AND MEDIUM ENTERPRISES IN SOUTH AFRICA

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Abstract

The study investigated the effect of sustainable manufacturing practices (SMP) on the sustainable performance (SP) of SMEs in South Africa. The study adopted the quantitative research approach. The cross-sectional survey method (self-administered questionnaire) was used for data collection. The participants in the study were conveniently sampled. Descriptive statistics, factor analysis, correlation and regression analysis were used for data analysis. The Cronbach's alpha was used as a measure of reliability. Factor analysis of SMP revealed four factors namely sustainable product design, sustainable manufacturing process, sustainable end of life management and sustainable supply chain management. The results of this study indicate significant positive relationships between the four sub-constructs of SMP and the three sub-constructs of SP. Limitations and recommendations to improve the SMP of SMEs are suggested.

Keywords: sustainable manufacturing practices, sustainable performance, manufacturing, small and medium enterprises, South Africa.

1. Introduction

The Organisation for Economic Cooperation and Development (2017) remarks that in many countries, governments face the challenges of low economic growth, high unemployment rates, rising income inequality and poverty. Small and medium enterprises (SMEs) play a significant role in the economies of countries around the world. SMEs contribute to innovation, generate employment and are key to the achievement of inclusive growth and long-term sustainability of economies (Ayyagari et al., 2007). In developed countries such as the United States of America (USA) and Japan, more than 99% of the country's businesses are SMEs. The contribution of the SME sector is one of the reasons for the low rates of unemployment and high rate of economic growth in many developed countries (Pandya, 2012). Formal SMEs contribute up to 40% of the gross domestic product (GDP) and 60% of total employment in developing economies. (World Bank, 2018). In South Africa, SMEs account for about 34% of GDP and 60% of all employment and make up 91% of all formalised businesses (Abor and Quartey, 2010). There is positive correlation between the size of the SME sector and a country's economic growth (Ayyagari et al., 2007).

South Africa has a diversified manufacturing base that contributes significantly to employment and economic growth. The manufacruring sector is one of the biggest sectors in the South African economy accounting for 13% of the country's GDP in 2017 (Wentzel and de Hart 2015; Bhorat and Rooney, 2017). Despite the contributions of the manufacturing sector, its activities and operations have impacted negatively on the environment especially in the process of transforming input into output. Manufacturing activities lead to the exploitation of natural resources, overconsumption of energy and enormous amount of waste and destruction to the green-house gas. Manufacturing of goods contributes over 20 percent of global emissions of carbon dioxide, (Adebambo, Abdulkadir, Mat, Abdulkadir and Kanaan, 2013; AbdulRashid, Sakundarini, Ariffin and Ramayah, 2017). South Africa contributes about 1.2% of global emissions and as a signatory to the Kyoto Protocol on Climate change, has promised to reduce emissions by 34% by 2020 and 42% by 2025 (Vosper and Mercure, 2016). There is the need for the implementation of environmental initiatives in the manufacturing industry. Sustainable manufacturing (SM) is a key environmental initiative that can help to reduce the negative environmental impact of manufacturing. SM is the foundation of new clean, carbon-neutral global economy that will help businesses achieve competitive advantage.in the current dynamic business environment. The need for SM is driven by stricter regulations relating to the environment and occupational safety/health, diminishing non-renewable resources and increasing consumer preference for environmentally-friendly products. The manufacturing sector has a high potential to become the driving force behind the use of sustainable manufacturing practices (SMP) (Jyalf, Badurdeen, Dillion and Jawahir, 2010; Abdul-Rasheed et al. 2016; Thanki, Govindan and Thakkar, 2016; Jabar, Muhamad and Murad, 2017).

The activities of SMEs with respect to SM are important area of study for many reasons. SMP can help SMEs to reduce waste and pollutions as they are responsible for about 64% of industrial environmental impact. While many studies have examined the adoption of SMP by large firms, little is known about the SMP of SMEs. Also, the effectiveness of the implementation of sustainability activities by a firm needs to be evaluated. One of the ways to

measure the impact of sustainability activities is to examine its effect on firm performance. One of the approaches for evaluating firm performance is the Triple Bottom Line (TBL) or sustainable performance (SP). The TBL adds both environmental and social dimensions to the traditional economic (financial) results to measure a firm's performance (Schaltegger and Wagner, 2011; Qorri, Mujkić and Kraslawski, 2018).

The aim of this study is to investigate the effect of SMP on the SP of SMEs in the manufacturing sector in South Africa. . This study will make a contribution to the literature on SMP and firm performance in the following ways. First, the findings of empirical studies on the effect of SMP on SP is not conclusive. Some researcher find a significant positive relationship while other researcher find insignificant or negative relationship (Ameer and Othman; 2012; Adebambo, Ashari and Nordin, 2014; Alshehhi, Hami, Muhamad and Ebrahim, 2015; Nobanee and Khare, 2018). Second, this study focuses on SMEs in a developing country where empirical studies on SMP and performance are relatively few. Although SM is being practiced and commonly studied in developed countries, its application and research are at its infancy in developing nations (Abdul Rashid et al., 2017). Third, empirical studies on SMP have focused mainly on financial performance (Islam, Hamid and Karim, 2007). This study adopted a sustainable measure of performance as social and environmental measures are added to financial performance. The findings of this study can help manufacturing SMEs in South Africa in their decision-making processes and policies for the implementation of SM. The study is organised as follows: The definition of SMEs, sustainability and measures of performance as well as the literature on the effect of SMP on SP will be presented in the next section. Then, the research methodology, results and discussion, conclusion and limitations are discussed.

2. Literature review

2.1 Definition and role of SMEs in South Africa

A small business is defined in South Africa, as "*a separate distinct entity including cooperative enterprises and non-governmental organisations managed by one owner or more, including branches or subsidiaries if any is predominately carried out in any sector or subsector of the economy mentioned in the schedule of size standards*". The quantitative definition focuses on the turnover, the number of workers and the gross asset value of the business (Government Gazette, 2003). Table 1 shows the quantitative description of small businesses in the manufacturing sector in South Africa.

Table 1. Quantitative definition of the small businesses in the manufacturing sector in South Africa.

Enterprise size	Number of employees	Turnover Rand (Million)	Gross assets excluding fixed property Rand (Million)
Micro	5	0.20	0.10
Very small	20	5	2

Small	50	13	5
Medium	200	51	19

Adapted from (Government Gazette. 2003).

Table 1 shows the definition of small businesses in the manufacturing sector in South Africa. Although, the small business space in South Africa includes micro, very small, small and medium enterprises, the term small and medium enterprises (SMEs) is generally used (Government Gazette, 2003). This study used the number of employees as the method of enterprises size classification. A micro enterprise has between one and five employees, a very small enterprise has between six and twenty employees, a small has between twenty one and fifty employees and a medium enterprise between fifty one and two hundred employees. In South Africa, SMEs including those in the manufacturing sector account for about 34% of GDP and 60% of all employment and make up 91% of all formalised businesses (Abor and Quartey, 2010). South Africa has a diversified manufacturing base that contributes significantly to employment and economic growth. However, manufacturing activities also represent a significant burden on the environment. Manufacturing of goods contributes over 20 percent of global emissions of carbon dioxide. It is important for manufacturing firms to adopt practices that can reduce or eliminate the negative environmental, social and economic impacts of theur activities. One of the initiatives to improve sustainability is SM (Adebambo et al., 2013; Vosper and Mercure, 2016).

2.2 Sustainable manufacturing (SM)

Manufacturing can be described as the process of adding value to raw materials and transforming them into semi-finished or finished goods that satisty customers' expectations (Hurreeram, Toolsy and Callychurn, 2014). There is no single universally acceptable definition for the term sustainable manufacturing (SM). Some researchers define SM as a strategy or approach and others define it as a paradigm or system (Moldavska and Welo, 2017). The United States of America. Department of Commerce (2016) defines sustainable manufacturing as: "*the creation of manufactured products that use processes that minimize negative environmental impacts, conserve energy and natural resources, are safe for employees, communities, and consumers and are economically sound"*. Garetti and Taisch (2012 p 1) define SM as "*the ability to use natural resources in manufacturing intelligently in order to fulfil economic, environment and social aspects and thus, preserves the environment and improve the quality of life"*. These definition focuses not only on the conservation of resources, but also on the preservation of the environment and the promotion of the safety of workers and the community. SM takes into consideration financial profitability, social equity and environmental protection in the manufacturing process. The goal of SM is the reduction of environmental impacts during the production process through the implementation of strategies that lead to pollution prevention, waste and energy minimisation and end of life management. SM involves an all-inclusive view that involves not just the product and the manufacturing processes but also the entire supply chain, including the manufacturing systems across multiple product life cycles. At the product level, SM has moved beyond the traditional 3R concept of promoting green technologies (reduce, reuse, recycle) to the 6R concept (reduce, reuse, recover, redesign, remanufacture, recycle*).* At the process level, SM involves process planning and technological for the reduction of toxic wastes, occupational hazards and resource and energy consumptions, At the system level, SM takes into consideration all areas of the entire supply chain and focuses on all the major life-cycle stages (pre-manufacturing, manufacturing, use and post-use, over multiple life-cycles (Jyalf, Badurdeen, Dillion and Jawahir, 2010; Abdul-Rashid et al, 2017).

The metrics of SM include environmental impact, energy consumption, economic cost, worker safety and health and waste management (Haapala, Zhao, Camelio, Sutherland, Skerlos, Dornfeld, Jawahir , Clarens and Rickli, 2013). According to Abdul-Rashid et al. (2017), based on the product life cycle concept, SM practices can be divided into four categories depending on the stage that the practices are implemented. (1) Sustainable product design and development: All the aspects of sustainability should be included early during the product design stage. (2) Sustainable manufacturing process: The design and operation of manufacturing process should reduce wastes, eliminate hazardous and toxic substances, conserve materials and energy and minimise physical hazards. (3) Sustainable supply chain management: This includes sustainable warehousing, sustainable packaging and environmental purchasing. (4) Sustainable end-of-life management: This involves recovery of materials or components at the end of a product's life by means of reuse, recycling and remanufacturing. Hashidah, Syukor and Razali (2017) establish that SM has eight pratices. These are cleaner production, eco-efficiency, employee relation, supplier relation, customer relation, community relation, closedloop production and industrial ecology.

The theoretical foundation of SM can be linked to the Natural-Resource Based View (NRBV), an extension of the Resource Based View (RBV) of the firm. RBV by Barney (1991) contends that valuable, costly-to-copy firm resources and capabilities are the key sources of sustainable competitive advantage for a firm. The NRBV by Hart (1995) proposes that the competitive advantage of a firm is based on its relationship with the natural environment. This comprises of three interconnected strategies: product stewardship (minimisation of life cycle cost of products), pollution prevention (minimisation of emission and waste) and sustainable development (minimisation of the environmental burden of firm growth). In addition, the Stakeholders Theory by Freeman (1984) defines stakeholders as an organisation or individual whose activities are either affected by the firm or affects the way the firm operates. Stakeholders include employees, investors, and customers, suppliers and the environment. Issues that are relevant to stakeholders should be included in the decisions to achieve the strategic goals of the organisation goals and strategic direction of the firm. The implementation of proactive environmental initiatives helps to incorporate and manage the concerns of stakeholders and ensures competitive advantage and success for the firm (Hart, 1995; Freeman, Martin, & Parmar, 2007). In addition, the Institutional Theory by Hirsch (1975) maintains that the operations of a firm are influenced by external pressures. Firm behaviour and operation are influenced by social networks which include the pressure to adopt environmental initiatives such as the SMP. There are three forms of isomorphic drivers that can influence the decision to adopt SMP. These are mimetic, coercive and normative. Coercive isomorphic pressure comes from formal and in formal pressures exerted on an organisation by other organisations and by cultural expectations in the society within which the organisation operates. Such pressures may be through force or persuasion. Environmental regulations by government can force manufacturers to install new pollution control technologies in the form of SMP. Mimetic pressure derives from uncertainty that encourages imitation. When an organisation faces a problem with unclear causes or unclear solutions, problematic search may yield a viable solution. Normative pressures stems from professionalisation which refers to the collective struggle of members of an occupation to define the conditions and methods of their work. Trade associations that a firm belongs to may have rules that govern interaction with the environment and this can lead to the adoption of SMP (DiMaggio and Powell, 1983).

2.3 Sustainable performance

Sustainability is a concept that has its origin in the Brundtland Report of 1987.The report focuses on the reconciliation of two concerns: development and the environment. This can be construed as needs versus resources, or the short versus the long term (Kuhlman and Farrington, 2010). Sustainability has three dimensions: economic, environmental and social. Sustainable development is about economic development, social development and environmental protection. The World's first Earth Summit in Rio in 1992 defines sustainability as *"development that meets sustainability is multidimensional and is based on social, economic and environmental aspects*". Sustainability is the way an organisation creates value for its owners and society by maximising the positive and minimising the negative effects of social, environmental and economic issues (Little, 2014). There is no single universally definition or measurement of performance. Performance can be described as a firm's ability to create acceptable outcomes and actions. The measure of performance can be financial or non-financial. Financial indicators include profitability, sales and market share. Non-financial measures focus on customer satisfaction, quality, innovation, employee satisfaction and reputation (Chong, 2008). One of the approaches for evaluating firm performance is the Triple Bottom Line (TBL). The TBL adds both environmental and social dimensions to the traditional economic (financial) results to measure performance from a sustainable perspective (Hourneaux et al., 2017; Qorri et al., 2018). Environmental performance depends on the use of efficient and cleaner sustainable energy resources by an organisation. Social performance focuses on the organisation's accomplishment with respect to the satisfaction of customers and employees in (Habidin et al., 2016; Abdul-Rashid et al, 2017).

2.4 Relationship between SMP and sustainable performance

2.4.1 SMP and financial performance

The literature is inconclusive about the effect of SMP on financial performance. While some studies find a positive relationship, the findings of some studies reveal a negative or insignificant relationship. This can be attributed to different research methodologies and different indicators used to measure financial performance and differences in firm size and industry (Alshehhi et al., 2018). Hami, Muhamad and Ebrahim, (2015) find that SMP is a competence-based view that allows a firm to develop products and processes for long-term sustainability. This is a source of competitive advantage and leads to improved financial performance for the firm. The study used survey data from 150 manufacturers in Malaysia and found a significant positive relationship between SMP and firm performance. Causal evidence of the study by Ameer and Othman (2012) find that firms that engage in SMP have a higher level of financial performance as measured by sales growth, return on assets, profit before taxation compared to firms that do not engage in SMP. The findings are consistent with the results of Islam, Hamid, Karim (2007) that SMP helps to optimise three critical performance factors: product development, less customer return rate and on-time delivery (OTD). These factors help to improve firm reputation and increase financial performance. The findings of the study by Abdul et al. (2016) indicate that sustainable manufacturing process and sustainable end-of-life management have significant positive effects on financial performance. However, sustainable product design and development and sustainable supply chain do not have significant positive effects on financial performance. Other empirical studies such as Chin & Shih (2007) and Schoenherr and Talluri (2012) establish that SMP helps to reduce green logistics, plant efficiency and reduce emission with positive effect on firm financial performance. Adebambo, Ashari & Nordin (2014) did not find a significant positive relationship between SMP and firm performance. A possible explanation for the insignificant relationship is that firms at times consider SMP as ethical and necessary things to be done to conform to environmental regulations. Nishitani et al. (2013) find that

firms that voluntarily implement SMP and not to conform with environmental regulations do experience better financial performance. However, firms that implement environmental practices because of mandatory pressures from environmental regulators do not experience better financial performance. SMP increase operational and administrative costs and do not enhance revenue generation (Hurreeram et al, 2014). The implementation of SMP should reduce operational costs in the long-run through improvement in operating efficiency. In addition, SMP leads to innovation in product development, reduce product recalls and customer return rate and improve competitive advantage and firm reputation. These factors will lead to increased sales, reduced costs and improved profitability. Consequently, it is hypothesised that there is a significant positive relationship between SMP and the financial performance of SMEs.

2.4.2 SMP and social performance

The findings of Abdul et al. (2016) indicate that sustainable manufacturing process and sustainable supply chain have significant positive relationships with social performance. However, sustainable product design and development as well as sustainable end-of-life management do not have significant positive relationships with social performance. Wu, Sabramanian and Abdulrahman (2015) find that SMP has a significant positive relationship with social performance. This is achieved through better relationship with employees, customers and suppliers which brings social returns in the long-run. SMP leads to knowledge sharing between firms and diverse internal and external stakeholders and improves social trust (Jararaman et al, 2011; Hami et al., 2015). SMP can help to achieve sustainable prevention in occupational health and safety. This can be done through the integration of health and safety during the design stage of buildings and equipment and the creation of health and safety culture through training (Hurreeram et al., 2014). Some of the principles of SMP are the safety of products and packaging through their life cycles, the elimination of physical and chemical agents that can cause hazard to human health, continuous evaluation and improvement of employees by management. In addition, the principles of SMP include the organisation of work to enhance creativity and efficiency of employees and the security and wellbeing of employees and the local community (Rosen and Kishawy, 2012; Boileau, 2016; Alayón, Säfsten, and Johansson, 2017). Based on these principles, it is hypothesised that there is a significant positive relationship between SMP and the social performance of SMEs.

2.4.3 SMP and environmenal performance

Wang et al. (2015) and Vihari and Rao (2018) find that lean manufacturing principles involve a systematic approach to detecting and removing waste through continuous improvement and leads to SM.) Lean and green practices are positively associated with environmental performance (Inman and Green, 2018). SMP has a significant positive relationship with environmental performance. SMP helps a firm reduce energy consumption, carbon emission and environmental degradation (Lai and Wong, 2012; Dieste and Panizzolo, 2018). Sustainable product design and development and sustainable manufacturing process are significantly associated with environmental performance. However, sustainable supply chain and sustainable end-of-life management do not have significant positive relationships with environmental performance ((Abdul et al., 2015). SMP reduces reduce energy consumption and carbon emission through improvement in the production process. Consequently, it is hypothesised that there is a significant positive relationship between SMP and the environmental performance of SMEs.

3. Research methodology

The study adopted the quantitative research approach and used the descriptive and causal research design. Data was collected through the use of self-administered questionnaire in a survey using the cross-sectional approach. Cross-sectional surveys are relational because they can scientifically investigate associations between two or more research constructs. The telephone directory was used to obtain the addresses of the respondents. The researcher visited the respondents' firms to physically deliver the questionnaire. The respondents were given two weeks to complete the questionnaire. The researcher then collected the questionnaire from the respondent after the period given. The survey was conducted between March and October, 2018 in the Gauteng and Limpopo Provinces of South Africa. Gauteng Province was selected as it is the heartland of entrepreneurship in South Africa. Gauteng Province has the largest number of SMEs in South Africa (Mafini and Muposhi, 2017). Limpopo Province also contains a sizeable number of SMEs. However, there exists no known single reliable sampling frame for SMEs in Gauteng and Limpopo Provinces, which made it difficult to adopt probability sampling method in selecting participating SMEs. Convenience and the snowball sampling methods were used to identify the survey participants. All the respondents in this study were in the manufacturing sector, and were owners or managers. Examining respondents from similar line of business helped to control the effect of industry on sustainability practices and performance. The manufacturing areas included food and beverage, textiles, rubber and plastics, building materials, machinery, furniture, paper and wood, pharmaceutical products and basic metal and chemicals. In addition, owners or managers were chosen because of their expected familiarity with performance indicators and sustainability practices. A pilot study was conducted on the survey instrument used in this research with 30 SME owners/managers in order to improve face and content validity. The questionnaire was divided into three parts: (1) biographical information; (2) SMP and (3) SP. Descriptive statistics, factor analysis, correlation and regression analysis were used for data analysis. The Cronbach's alpha was used as a measure of reliability. For ethical consideration, the participants were informed about the aim of the study, participation was voluntary and confidentiality and anonymity were assured.

3.1 Operationalisation of variables

SMP: The scale to measure SMP were developed by the researcher from previous empirical studies (Habidin et Al., 2013; Hami et al., 2015; Abdul-Rasheed et al., 2017). The scales used by these study had acceptable psychometric properties with Cronbach's alphas greater than 0.7 (Nunnally, 1978). The scale consisted of 33 questions. All the question items to measure SMP were anchored on the five-point Likert scale with "1 strongly disagree and 5 strongly agree".

SP: This study used financial, social and environmental performance to measure SP. Items to measure each indicator of sustainable performance were developed from previous studies (Hourneaux et al., 2017; Qorri et al, 2018). Perceptive measures for the last three years were used to measure SP. This period is broad enough to take into consideration seasonal and cyclical fluctuations in business practices and performance (Urban and George, 2018). Three question items were used to measure financial performance (increase in sales, increase in market share and increase in profit). Social performance was measured by seven question items (increased customer satisfaction with products, reduced rate of product return and recall, reduced staff turnover, increased employee satisfaction, reduced injury and work related fatalities, increased health and safety performance and increased contribution for social issues). Environmental performance was measured by three items (improved efficiency of raw materials, reduced resource consumption (energy, electricity, water) and increased recycling of materials). All the questions to measure SP were anchored on the five-point Likert scale with "1 strongly disagree and 5 strongly agree".

4. Results

4.1 Response rate

650 questionnaires with cover letters that explained the purpose of the study were distributed to owners and top managers of manufacturing SMEs. Out of the 280 questionnaires that were returned. 252 questionnaires were found usable as some respondents did not complete certain vital parts of the questionnaire. This yielded a response rate of 38.8%.Independent samples T-test and Anova results did not indicate any significant differences in the results on the basis of demographic variables. Harman's single factor test was used to identify the presence of common method bias. The result is not significant. This suggests that the interpretation of the findings of this study would not be disturbed by substantial method bias. Therefore, the full data set of 252 responses is valid and usable for testing the hypothesised relationships in this study

Table 2. Biographical information of the respondents.

Biographical Characteristics	**Frequency (*N* = 252)**
Educational qualification of respondents	
Below Matric	28
Matric	84
Post–Matric qualifications	140
Gender of the respondents	
Female	105
Male	147
Age of the respondents (years)	
Less than 20	0
20–30	5
31–40	60
41–50	94
Above 50	98
Age of the firm (years)	
Less than one	0
1–5	52

6–10	145
Above ten years	55
Number of employees	
No employees	0
1–5 employees	6
6-20 employees	36
21–50 employees	109
51–200 employees	101

According to the Schedule of size standards, the SME sector can be separated into four groups. These are micro, very small, small and medium. This study used the number of employees as the method of enterprises size classification. A micro enterprise has between one and five employees, a very small enterprise has between six and twenty employees, a small enterprise has between twenty one and fifty employees and a medium enterprise between fifty one and two hundred employees. The results as depicted by Table 2 show that the majority of the respondents are male with Post-Matric qualification, six to ten years of operation and can be classified as small businesses with between 21 and 50 employees. However, many medium-sized manufacturing SMEs (101) also participated in the study

4.2 Principal component analysis of SMP

The Principal component analysis was used for data reduction and for detection of structure or underlying dimensions of SMP variables. .

Table 3: Factor analysis of SMP

Variables	Factor 1 SPD	Factor 2 SMP	Factor 3 SELM	Factor 4 SSPM
Design products that will decrease energy use	0.8210			
Design products that will enable the use of environmentally friendly products	0.7649			
Design products that will enable repairs and refurbishment	0.7126			
Design products that eradicate the use of hazardous materials	0.6528			
Design products that will permit reprocessing of materials	0.5882			
Design products that will extend the life of materials	0.5413			
Design products that will ease material use	0. 4788			
Process allows for use of waste in production		0.8248		
Reduce energy use		0.7617		
Reduce carbon emission		0.7126		
Allows us use environmentally friendly products		0.6568		
Set environments objectives		0.5741		

Use maintenance and support service to extend the life of products to customers			0.7225	
Provide facilities for recycling of products			0.6539	
Provide product warranty			0.6007	
Provide and manage product recalls			0.5351	
Use maintenance to extend the service life of equipment			0.4886	
Encourage suppliers to practice green initiatives				0.7188
Use energy efficient warehousing				0.6529
Use energy efficient transportation				0.6481
Use green suppliers				0.5926
Use reusable packaging				0.5493
Influence customers to accept green products				0.4977
Train staff and suppliers on green supply chain management				0.4146
Cronbach's alpha	0.741	0.809	0.726	0.729
Eigen value	10.088	7.240	4.374	2..962
% of variance explained	31.227	24.091	10.509	8.366

Items with factors loading less than 0.300 omitted

Table 3 depict the results of the principal component analysis using Varimax rotated factor method for SMP. To ensure the appropriateness of factor analysis, the Barlett Test of Sphericity (BTS) and Kaiser-Meyer-Olkin (KMO) were used. The results (BTS = 491.625; sig.=0.001)) and the KMO (0.736) support the use of factor analysis. Four factors accounted for 74.19 % of the total variance. Factor one is named "sustainable product design" (SPD) and consists of seven items. The Eigen value is 10.09 and the percentage of variance explained is 31.22 with a Cronbach's alpha of 0.74. Factor two is labelled "sustainable manufacturing process" (SMP) and consists of five items. The Eigen value is 7.24 and the percentage of variance explained is 24.09 with a Cronbach's alpha of 0.81. Factor three is labelled "sustainable end of life management" (SELM) and consists of five items. The Eigen value is 4.374 and the percentage of variance explained is 10.509. Factor four is named "sustainable supply chain management" (SSCM) and comprises of seven items. The Eigen value is 4.374 and the percentage of variance explained is 10.509 with a Cronbach's alpha of 0.73.

4.3 Reliability coefficients, Descriptive statistics and correlational analysis

Table 4: Reliability coefficients of factors

Factor	Cronbach's alpha coefficients
sustainable product design	0.74
sustainable manufacturing process	0.81
sustainable end of life management	0.73
Sustainable supply chain management	0.73
financial performance	0.73
environmental performance	0.79
social performance	0.72

Table 5: Descriptive statistics and Pearson's correlations for all the factors

Factor	Mean	SD	1	2	3	4	5	6	7
SPD	3.86	0.96	1						
SMP	3.75	1.01	.517**	1					
SELM	3.60	0.91	.545** .	.609**	1				
SSCM	3.40	0.95	.455*	.479***	.525*	1			
FP	4.05	1.01	.742**	.649**	.591*	.601***	1		
EP	3.92	0.99	.426**	.618**	.539***	.588*** .	.524** .	1	
EP	3.65	0.96	482**	.529**	.611**	.525*** .	484***	.611**	1

SPD=sustainable product design, SMP=sustainable manufacturing process, SELM= sustainable end of life management, SSCM=sustainable supply chain management, FP=financial performance, EP=environmental performance, SP=social performance, SD=standard deviation.

*Significant at 0.01; ** significant at the 0.05 level, *** Significant at 0.10

Tables 4 and 5 depict the reliability coefficients, descriptive statistics and Pearson's correlation coefficients. As shown by table 4, the reliability coefficients of all the factors are greater than 0.70. Nunnally (1978) points out that a Cronbach's alpha of 0.7 is viewed as the minimum acceptable level of reliability. The descriptive statistics for SMP show that the factor with the highest mean is SPD (mean 3.86, SD 0.96). This is followed by SMP (mean 3.75, SD 1.01), SEL (mean 3.60, SD 0.91) and SSCM (mean 3.40, SD, 0.95). The sunmated score for SMP is 3.65. The descriptive stastics for the three measures of SP are financial (mean 4.05, SD 1.01), EP (mean 3.92, SD0.99) and SP (mean 3.65, SD 0.96).The summated score for SP is 3.98. Using a Five-point Likert scale, a mean value below three is considered as low, three to four moderate and above four high (Alarape, 2013, Neneh and Van Zyl, 2017). The results indicate a moderate level of SPM and SP by SMEs. The results of the correlation shows significant positive associations between the four sub-constructs of SMP and the three sub-constructs of SP at 1%, 5% and 10% levels of significance.

4.5 Regression results

The assumptions of correlation and regression include normality, homoscedasticity and absence of multicollinearity. Normality was assessed by examining the normal probability–probability plot. The data forms a straight line along the diagonal, thus normality can be assumed. To assess homoscedasticity, the researcher created a scatterplot of standardised residuals verses and standardized predicted values. The plot shows random scatter, thus assumption is met. Multicollinearity was assessed by calculated variance inflation factors (VIFs). VIF value is 5.3. This indicates that multicollinearity can be assumed. Table 5 depicts the results of the multiple regression analysis of the effect of the effect of SPM variables on sustainable performance. The R^2 (0.388) and the F–test achieved a significance level ($p < 0.01$). This confirms the appropriateness of the regression model.

Table 5: Summary of the multiple regression results for SMP and SP

Variables	Financial	Environmental	Social
SPD	0.390*	0.024**	0.117*
SMP	0.269**	0.480***	0.315**
SEL	0.269**	0.405***	0.322***
SSCM	0.392**	0.266***	0.099***
R^2	0.388	0.265	0.176
R	0.346	0.239	0.168
F	31.169	28.255	30.088
P-value of model	0.000	0.000	0.000

*Significant at 0.01; ** significant at the 0.05 level, *** Significant at 0.10

The relationship between the sub-constructs of SPM and the sub-constructs of SP was investigated through regression analysis. The results of the indicate that SPD (β 0.390, p<0.01), SMP (β 0.296 p<.0.05), SEL (β 0.269, p<.05) and SSCM (β 0.392, p<.05) have significant positive relationships financial performance. The results also indicate that SPD (β 0.024, p<0.05), SMP (β 0.480 p<.0.10), SEL (β 0.405, p<.0.10) and SSCM (β 0.266, p<0.10) have significant positive relationships environmental performance. The results of the indicate that SPD (β 0.117, p<0.01), SMP (β 0.315 p<.0.05), SEL (β 0.322, p<.0.10) and SSCM (β 0.99, p<0.10) have significant positive relationships social performance. This study is premised on the hypotheses that there are significant positive relationships between SPM and financial, social, environmental performance. The summary results as presented in table 5 show that the four SPM variables have significant positive relationships with the three measures of performance at 1%, 5% and 10% levels of significance. Thus, all the hypotheses are accepted. The results of this study are consistent with similar empirical studies. Hami et al. (2015) find that SMP allows a firm to develop products and processes for long-term sustainability. This is a source of competitive advantage and leads to improved financial performance for the firm. Islam et al (2007) find that SMP helps to optimise three critical performance factors: product development, less customer return rate and on time delivery. These factors help to improve firm reputation and increase financial performance. Chin & Shih (2007) and Schoenherr and Talluri (2012) establish that SMP helps to reduce green logistics, plant efficiency and reduce emission with positive effect on firm financial performance. Liu et al, (2015) find that SMP has a significant positive relationship with social performance. This is achieved through better relationship with employees, customers and suppliers which brings social returns in the long-run. SMP leads to knowledge sharing between firms and diverse internal and external stakeholders and improves social trust (Hami et al., 2015). Nachiappan et al. (2015), Hami et al. (2015) and Inman and Green (2018) find that SMP is positively associated with environmental performance. SMP helps a firm reduce energy consumption, carbon emission and environmental degradation.

5. Discussion

This paper investigated the relationship between SMP and SP of manufacturing SMEs in South Africa. The manufacturing sector is one of the biggest sectors in the South African economy accounting for 13% of the country's GDP in 2017. Despite the contributions of the

manufacturing sector, its activities and operations have impacted negatively on the environment. South Africa contributes about 1.2% of global emissions and as a signatory to the Kyoto Protocol on Climate change has promised to reduce emissions by 34% by 2020 and 42% by 2025. There is the need for the implementation of environmental initiatives in the manufacturing industry. Sustainable manufacturing (SM) is a key environmental initiative that can help to reduce the negative environmental impact of manufacturing. Factor analysis of sustainable manufacturing practices (SMP) revealed four factors namely sustainable product design (SPD), sustainable manufacturing process (SMP), sustainable end of life management (SELM) and sustainable supply chain management (SSCM). Sustainable performance (SP) was measured using the Triple-Bottom–Line approach (financial, social and environmental). The results of this study, which is validated by a data set of 252 South African SMEs in the manufacturing sector show significant positive relationships between the four sub-constructs of SMP and the three sub-constructs of SP at 1%, 5% and 10% levels of significance. The findings of this study support the hypotheses that there are significant positive relationships between SPM practices and financial, social and environmental performance and thus sustainable performance. The findings of this study confirm that SMEs can achieve competitive advantage and sustainable performance by implementing SPM practices in line with the Natural-Resource Based View (NRBV) of the firm. The implementation of SPM can help to incorporate and manage the concerns of stakeholders and ensures competitive advantage and success for the firm in line with the Stakeholder theory. In addition, the findings of this study are consistent with the Institutional Theory by Hirsch (1975) that the operations of a firm are influenced by external pressures. Firm behaviour and operation are influenced by social networks which include the pressure to adopt environmental initiatives such as the SMP. The findings of this study show that the activities of suppliers and the influence of customers can affect the implementation of SMP by SMEs. The findings of this study are consistent with those of earlier empirical studies on the effect of SMP on SP (Schoenherr and Talluri, 2012; Hami et al., 2015; Liu, Lai and Pawar, 2015).

6. Conclusion

Manufacturing SMEs contribute significantly to employment and economic growth in South Africa. Despite the contributions of the manufacturing sector, its activities and operations have impacted negatively on the environment. There is the need for the implementation of environmental initiatives in the manufacturing industry. Sustainable manufacturing (SM) can help to reduce the negative environmental impact of manufacturing. The study investigated the effect of SPM on the SP of SMEs in the manufacturing sector in South Africa. The findings of this study showed that there is a significant positive relationship between SPM practices and SP. Empirically, the study contributes to the literature on SMP and performance from a developing country perspectives where empirical studies have been relatively few. The findings of the study can help small business owners to develop strategies to improve their performance by attending by attending training and seminars on SMP and SP. In addition, the findings of the study can help government bodies that support entrepreneurship in South Africa such as the Small Business Development Agency (SEDA) to understand the effect of SMP on SP. This can assist these organisations in designing training programmes to improve the sustainability of SMEs. The study has some limitations. First, the study focused on subjective and not objective measures of firm performance. This is because objective measures of the performance are often unavailable as SMEs are not obliged by law to publicly reveal their annual accounts. The validity of the findings could have been improved by objective measures. Second, the study used convenience sampling method because of the difficulty in obtaining the population and sampling frame of SMEs in the study area. Also, only 252 SMEs participated in the survey. Therefore, care should be exercised in generalising the

findings of the study. Third, the study used the cross-sectional approach and cannot be used to analyse behaviour over a period to time. This limits the ability of the study to determine cause and effect. Because of the cross-sectional nature, the timing of the survey is not guaranteed to be representative. Additional studies can investigate the effect of SMP on other measures of performance such as quality and innovation. A cross-country (developing and developed countries) study of SMP and SP of SMEs will help to generalise the findings of this study. In addition, a longitudinal study that will provide causal inferences into the relationship between SMP and SP can be explored.

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