

# **Sustainability Analysis of food Manufacturing SMEs – A critical review**

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## **Abstract**

The rapidly increasing advancements in manufacturing sector has created pressure for manufacturers to rethink and redesign their existing systems in order to cope with the challenges that emerged with globalization and environmental concerns. This trend brought about the introduction of the sustainable manufacturing concept; this concept of sustainable manufacturing is generally referred to as “green business” which emerged towards the end of the 20th century. An increase in customer awareness and pressures from stakeholders shifted manufacturers' focus; no longer were financial benefits the primary concern in the contemporary business environment. As a result, many innovative strategies were brought into the realm of manufacturing systems, such as lean, green, agile, and sustainable manufacturing practices. Sustainable manufacturing has been acclaimed in recent years for its significant benefits directed at triple bottom line factors (social, environmental, and financial) also known as the sustainable development pillars. Even though many studies have been conducted on sustainable manufacturing, the critical assessment conducted in this study posits that there is much gap to be covered as far as research in this field is concerned. Considering this gap, this study aimed at theoretically assessing sustainability in food manufacturing SMEs. The results of the critical appraisal of the current literature, clearly illustrate that there is a gap in the current body of knowledge particularly with SMEs. These can feed in future endeavours of crafting a framework for sustainable manufacturing for food manufacturing SMEs.

## **Keywords**

Sustainability, Food Manufacturing, SMEs

## **1.0 INTRODUCTION**

The manufacturing sector is one of the strongest economy players throughout the globe [J Odour et al, 2017]; however the fast growing concern regarding sustainability of economic development has tremendously inflated throughout the global community as well, especially with the increasing awareness of environmental issues; the drastic change in global climate, depletion of natural resources, increased waste generation and pollution [Y Koren et al, 1999]. These are a great threat to the manufacturing sector because of the risk of raw materials; hence the concept of “sustainable manufacturing” has been adopted and embraced by the global manufacturing community at large, with the dream of preserving the world and all its rich resources for many generations to come or manufacture [K Wynen and P Goel, 2017].

Sustainable manufacturing, derived from the globally buzzing term “sustainable development”, is defined as the development of technologies, techniques, and practices to help in the transformation of materials with zero or with minimum emission of greenhouse gases, minimal use of either non-renewable or toxic materials, and reduction of waste generation and disposing [K Wynen and P Goel, 2017; H Jim, 2015]. In sustainable manufacturing the similar processing method of utilising materials and the processes that transforms the materials to being the desired product, should minimise the negative environmental effects, conserve energy, and natural resources, should be safe for people, be it employees, communities, and consumers, while maintaining an ecological sound stance. Sustainability, according to the US National Research Council is defined as “the level of human consumption and activity, which can continue into the foreseeable future, so that the systems that provides goods and services to the mankind, persists indefinitely” [Rachuri S, 2009].

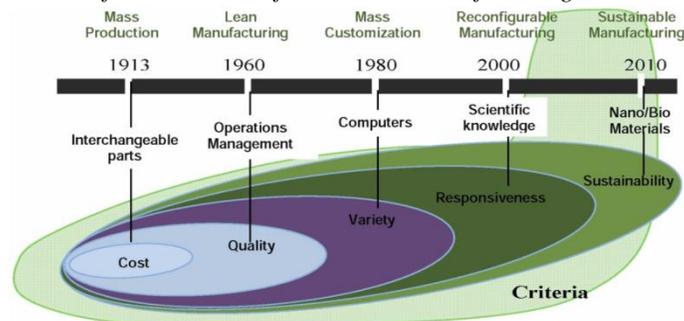
### 1.1 Evolution of Sustainable Manufacturing

Manufacturing systems have been evolving and it is significant for them to evolve for businesses to remain relevant to the current trends, arising operational needs, change or introduction of new products, raw materials, more efficient technology [Y Koren et al, 1999], and most importantly because they need to constantly meet emerging needs either from the customers or from the manufacturing environment. A summary of the history of the manufacturing sector is illustrated in **figure 1**.

Customers have always been a vital voice of input towards the designing and development of a product; throughout the years we observe how the diverse and ever changing scope of consumers and/or customers' expectations and product or service requirements on has been gradually expanded [R Sousa, 2003]. The earlier markets, around the years of 1913, had the objective of meeting the need in this case it was meeting the demands of market running short of products, and customers were primarily concerned with the functionality of the product and meeting the present basic need. The sole objective of companies was aimed at reducing cost with the goal to make better profits. Later around the year 1960, capabilities of global manufacturing became efficient in meeting just the basic need in terms of customers demand, and further introduced competition amongst suppliers. This enabled customers to lay greater demands than the basic product functions. From all this agitation of good competition between various suppliers, quality became the new key strategy of success from the 1960s to the 1970s from the service to product quality [6]. With an abrupt advancement of information technology (IT) from 1980, global manufacturing markets were gradually saturated; companies then had much greater pressure to produce new at a faster pace to absorb earlier marketing opportunities.

Today, customers are well aware and conscious of the deterioration of the global environment and the predictable shortage of natural resources for generations to come. Manufacturing companies are forced to change the paradigms of their systems and culture, so to accommodate the new needs of sustainability. As shown in Figure 1, the evolution of manufacturing system paradigms has been divided into six phases. [Koren Y, 2010]

*Figure 1: A paradigm illustration of the evolution of sustainable manufacturing*



*Picture taken from Koren .Y, 2010*

## 1.2 Sustainable manufacturing

In supply chain management, it's important to ensure that the quality of the product be kept at its optimal level, whilst the performance of the operational process be ran efficiently to its full capacity – catering to the demand-supply needs [N Hami et al, 2015]. This then raises an issue of building partnerships with suppliers for new product introductions, so the complete supply chain from raw materials to final products which are pleasing to customers; have to be a well-integrated process.

Achieving sustainability in manufacturing requires a holistic view spanning not just the product, and the manufacturing processes involved in its fabrication, but also the entire supply chain, including the manufacturing systems across multiple product life-cycles [N Hami et al, 2015]. This requires improved models, metrics for sustainability evaluation, and optimization techniques at the product, process, and system levels. Eco-efficiency describes the ecological efficiency of goods and services [Suering .S, 2008]. This is done by measuring their economic price, including their consumer demand and monetary cost, along with checking it against its production or manufacturing successes in:

- Minimising environmental impact
- Improving quality of life and
- Reducing overall negative environmental impact on the earth.

An improvement eco-efficiency ratio of the goods and services means there is less negative environmental impact and minimal use and abuse of natural resources. Manufacturers must be encouraged to improve eco-efficiency by using Life Cycle Assessment and other environmental evaluation tools such as:

- environmental auditing
- environmental impact assessment and
- Sustainable design theory.

### 1.2.1 Sustainable resources

Environmental degradation, competition for resources, conflict between environmental management and economic growth, and loss of biodiversity are caused by: increasing demands for, and conflict over, land and natural resources [G Ingarao, 2017], the failure to internalise environmental costs, insensitive and fragmented land-use planning, unsustainable consumption and production patterns, and the failure to integrate environmental concerns into planning and resources use and management.

Increasing demands for land and natural resources create competition and conflict. Unsustainable patterns of consumption and production combined with a growing population are major causes of continued environmental deterioration. Excessive demands for resources and unsustainable lifestyles place immense stress on the environment [Suering .S, 2013]. Manufacturing companies depend on these resources [natural & non-natural], thus lay a greater demand for supply in a shorter space of time, this then introduces a threat to their future operational goal if such resources like water and energy, are becoming scare and more costly[Suering .S, 2013]. Now since this sector is a great contributor to the country's economy, such challenges then need the governance of the State to assist in order to ensure flawless and sustainable run of things through laws, regulations, and policies [B Kramer, 2010].

## 2. **Significance and Aim of The Study**

The food processing industry is one of the most vital in every country; it forms the basic and most vital foundation to the three industrial pillars of sustainable development: Social, Economic, and Environmental. It has been identified that even though these pillars have been realised and discussed over the years, many companies are still struggling to find the balance between the pillars during implementation process. The current and expected exponential growth of the world's population, bring questions to the global food industry in terms of meeting the; challenges in volumes and quality, and complication of consumer preferences and demands (Andrei Jean-Vasile, 2016). The recent global developments of globalisation and liberalisation has not only characterised the food sector, but had also greatly

influenced the structural development of the food industry globally, this was reported by the Food and Agriculture Organisations (FAO, 2012). Considering that SMEs are major contributors (large number) in this sector of food manufacturing, the aim of this study is to theoretically assess sustainability in food manufacturing SMEs.

### 3. GAP ANALYSIS OF CURRENT LITERATURE

This section presents the gap analysis of the currently available literature on sustainability in the manufacturing industry according to global research site (ISI Web of Science). The search focused primarily on peer reviewed articles, published in English in relation to manufacturing sustainability, the results of the search was of studies more than 300, which were further analysed according to research title, source, and countries within the past two decades (1997-2007). These were further critically analysed to 15 best study, which were the most cited articles under the keywords sustainable manufacturing, these studies were mined out with the aim to eliminate unrelated interference in highlighting the gap, thereafter emphasize the significance of this study. It is therefore important to mention that studies that did not meet all these criteria requirements were excluded.

**Table 1: Gap analysis of sustainability in manufacturing**

Article Author & Year	Firm size		Manu. Sectors		Pillars of SD			Country			Methodology	
	SME	Large	Food	Other	Eco	Socio	Environ	RSA	Nigeria	Other	Quantitative	Qualitative
Joyce Boye & Yves Arcand (2012)			✓				✓					✓
Zhuming Bi (2011)		✓			✓		✓					✓
Pipatprapa Anirut et al (2017)		✓	✓				✓			✓		✓
Marc A. Rosen (2012)				✓			✓			✓		✓
Ricardo J. Hernández (2012)	✓			✓						✓		✓
S.X. Zeng et al (2010)	✓				✓		✓			✓		✓
Denis Lagace & Mario Bourgault (2003)	✓									✓	✓	
Leigh Smith & Peter Ball (2012)							✓			✓	✓	
Kris M.Y.Law & Angappa Gunasekaran (2012)	✓	✓		✓						✓	✓	
Sissel A. Waage (2006)		✓		✓	✓	✓	✓			✓	✓	✓
Tobias Schoenherr (2011)		✓					✓			✓	✓	
Qinghua Zhu & Joseph Sarkis (2007)		✓			✓		✓			✓	✓	
A.D. Jayal et al (2010)		✓		✓	✓		✓					✓
J.S. Damtoft et al (2007)				✓			✓					✓
F. Birkin et al. (2006)	✓			✓		✓	✓			✓	✓	✓

The assessment of the studies in table 1 is outlined below:

Joyce I. Boye & Yves Arcand (2012):

Joyce and Yves (2012) mention an important statement regarding challenges that are to face human race in the next decade if the balance between food demand and supply is not addressed in a sustainable manner, through which long-term survival of human race can be guaranteed. They further emphasize on the demand laid by the fast growing global population as observed in the recent decades, this together with industrialisation has elevated the need and importance of the processing and production of food industry, especially with the anticipated further increase to about 9 billion earth occupants. Environmental issues concerning this food processing industry that should require attention include climate change, eco-toxicity, land use change, water shortages caused by irrigation, great reduction in biodiversity, aquatic and human bad effects caused by pesticides, amongst many. This study summarised key elements highlighted from the book titled Green Technologies in Food Production and Processing; this study offers an all-inclusive summary of the current status of agri-food and agriculture sectors with relation to environmental sustainability, energy and material stewardship, furthermore it offers strategies practically applicable to industries in enhancing the use of environmentally friendly technologies for the food processing and production sector.

However this study is based on a generic location with a narrow focus on the environmental aspect, even though it is embracing sustainability within the food processing sector, it is not explicitly addressing the SMEs, this too is affected by the fact that the study covered a general view of the study, and did not address specific firms within a certain area.

Jan van der Goot (2015):

This study gives an overview of current methods of production of food and food ingredients; it further presents options for producing healthier foods in a sustainable fashion. This is significant as it has been observed that the current methods of producing food products have major effects which then prove the methods to be not environmentally sustainable. The study suggests that there are three causes responsible for the food production inefficiencies, namely: (1) the inflated use of animal originated products, (2) the layout of food processes and processing chains, (3) and the inefficient use of food products after being produced, resultant of the generation of waste. This study summarised the recent development and drew future scenarios for food processes and process chains for the novel designs purposed at reducing environmental impact. The study proposes that processes in the future can be improved through minimising drying and avoiding dilution, whilst the focus of ingredients in production is rather on functionality than purity. Consequently the focus on functionality will allow the use of milder process conditions in fractionation leading to modern food products with a reduced amount of refined ingredients, which have the potential to provide a much healthier diet.

Atze Jan van der Goot (2015) presented an interesting study within the food production sector guided by the sustainability concept, it is however worth noting that the driving sustainability pillar of the study was the environmental pillar, and that the food manufacturing firm, was specifically a dry-product firm using the drying technology. This is not applicable to a significant portion of the firms within the food industry, furthermore it would have been good if the study had covered the fundamental blocks of the food sector, which are the SME food manufacturers.

James Scott Baldwin et al, 2004:

The increased number of available tools for industrial sustainability highlights that the challenge is not with the step of implementation. Amongst other identified barriers, the uncertainties of management undermine the progress towards industrial sustainable development. This paper was executed driven by its aim to model manufacturing evolution; integrating manufacturing cladistics, a classification scheme of evolution from the biological sciences, with systems of evolutionary modelling, from physical science. In this study, James Scott Baldwin et al, (2004), highlighted the challenges allied with the implementation of new practices and technologies. A new approach is introduced and further evaluated within the context of sustainable manufacturing. The aim was to guide transformations and explore the evolutionary differences between non-sustainable and sustainable organisations, and further identify new structures which can offer the industry novel solutions for sustainability.

James Scott Baldwin et al, 2004 engaged in an exploratory study within the boundaries of manufacturing and sustainability, this kind of study is always good for the literature content, however it mostly becomes impractical to apply to specific conditions which might have not been considered by the author. The author's departure point is on an industrial novel solution, this might not be the best solution for SMEs particularly in economically developing states.

Q. Zhu et al (2014):

This study presented an investigation of the Model Predictive Controller application, with the application to energy management in the production environments, equipped with linear programming based optimizer. The focus of the study was on an automotive OEM assembly plant that consumes both the fossil fuel and electricity drawn from the grid. This study detailed the optimisation structure using two cost categories, namely; energy efficiency and cost-savings. The hypothesized results were in agreement with the current plant energy consumption which demonstrated the conflict of the two cost models suggested, hence highlighting the significance of using objective decision making

tools that are driven by specific performance criteria in managing energy consumption and the all-round sustainability of production environments. Furthermore the study discussed the role and the efficiency of the co-generation process on the overall plant energy consumption.

Q. Zhu et al (2014) conducted a study specifically in the automotive plant focusing on the energy element of the environmental aspect of sustainability, affecting cost which addresses the economic outcome. However failed to acknowledge that within the environmental pillar there are various key elements to focus on; which have the capability to affect the economic performance of a firm. The outcomes obtained from an automotive plant, might be retrieve reproducible results in a different environment such as the food processing sector, it is equally important to mention that a specific focus on SMEs is necessary for the challenges they encounter when implementing practices of sustainability will differ greatly from the large firms.

Pipatprapa A (2017) conducted a study on sustainable development in a food manufacturing sector in Thailand. The objective of the study was to improve the Thailand food industry in terms of attainment of optimal green management through the enhancement which comes with the proper understanding of quality management, market orientation, and innovativeness. The study was focused on managers from 178 companies within the food industry, data was collected through questionnaires, and it was concluded from this study that these three factors have a significant effect on green performance. Pipatprapa failed to differentiate the company sizes with the 178 food companies that were examined, thus the study only provides a generic view of the Thailand food sector. The study was furthermore limited to the three elements, namely Quality management, Market orientation, and innovativeness. Even though the study concluded on factors contributing to green performance, it failed to contextualize it outcomes from the basis of the three pillars of sustainable development; economic, social, and environmental.

Marc Rosen (2012) This study reported on an investigation highlighting the importance of the integration of sustainability with both manufacturing and design, including other important objectives such as competitiveness, functionality, productivity, and profitability. Marc also touches on the need for applying the use of tools such as life cycle assessment (LCA), design for environment, and other environmentally based practices that recognise the whole life cycle of a product including involved processes. This study further brings forth a prediction that environmental stewardship and sustainability will become vital factors in future decisions of manufacturing and design. To those that will adopt the culture of sustainability in their decision processes and way of working will be more likely to be successful in improving their designs and manufacturing. The study concluded that more in depth research and collaboration is needed; the research will enhance more understanding of sustainability in manufacturing and design, whilst the collaboration enhances technology transfer and broadening of applications of sustainability. Marc highlighted a significant relationship and relevance of the environmental pillar of sustainable development to manufacturing; however the analysis in this paper is not industry specific, and hence remains as a generic exploratory study which might not be necessarily applicable to the food processing sector, particularly small sized firms.

Ricardo J. Hernández (2012) this paper presented an approach that identifies opportunities in developing Product Service System (PSS) which involved Small and Medium Enterprises (SMEs). The goal of this study was to bring about an understanding on how the integration of product and service design coupled with the use of Information and Communication Technologies (ICT) can contribute to the identification of opportunities of developing sustainable PSS involving SMEs. In the process of developing the approach, a research sample of 16 manufacturing SMEs partook from Colombia. The data was analysed using a reference model and four generic types of PSS. Further research possibilities that came from this study were that of extending the approach into a generic framework to be applicable and functional with other industries too.

This study, even though its objective is about sustainability for the SMEs, it is not applying any of the sustainable development pillars, rather it is applying the traditional way of improving product, service, and system through ICT. Furthermore it is not industry specific leading to a generic conclusion.

Zeng (2010) A wide range of research has covered extensively the relationship between business performance and environmental management/performance, however the end results were found to be inconclusive. Zeng (2010) suggested that this study will bring two contributions to the body of literature in relation to this relationship. The first being changing the focus from being on one aspect, by rather bringing a comparison using a variety of cleaner production activities: low and high cost activities. Secondly the study concurs and builds from the already existing literature which focuses on firms located in developed countries, consequently basing the extraction of data from firms in the manufacturing industry of China. This study employed the Structure Equation Model (SEM) to analyse the relationship between business performance and cleaner production. The overall results showed a positive impact of cleaner production on business performance; where the low-cost cleaner production activities proved to have greater contribution to financial performance than with non-financial performance, and the high-cost scheme of cleaner production activities had bigger contribution to non-financial performance compared to that of financial performance. Zeng concluded that this study would be very useful for manufacturing firms considering the adoption of cleaner production practices, and equally beneficial to stakeholders who intend to promote cleaner production. This study raised a valid aspect of transforming traditional manufacturing by introducing the collaboration of business performance and cleaner production concept; however this skewed the focus of the paper to be solely limited to environmental performance. Furthermore a gap is realised for manufacturing companies in developing countries, especially in Africa if this study will extract and draw up a conclusion based primarily on China's manufacturing industry. It is also important to note that manufacturing as an industry is very wide, thus such a study that isn't specific to the food processing industry might not be as significant to such a market.

Denis and Mario (2003). This paper suggested that the key for sustainability of small manufacturing firms is to increase their capacity and continuously improve their manufacturing processes and reliably maintain them. Governments have been observed as active in assisting small manufacturing firms in tackling this challenge; specifically in supporting them in the adoption of the world-class manufacturing practices. Even though this support had many benefits, its application was not often based on extensive knowledge of the targeted firms; this led to such programs yielding unsatisfactory results. This study examined a sample of 229 SMEs manufacturing firms which had received the support of this program. The study produced four profile categories of practices, namely: potential, emergent, priority and realised practices. Study further provides an idea of how SMEs can remain competitive through association of manufacturing improvement programs and practices. The outcomes of this study were believed to be very useful to corporate decision makers and business assistance programs. Denis and Mario raised a fair argument of improving the capacity of SMEs in improving the competitiveness and sustainability, however failed to incorporate the sustainable development principles, strategies and pillars. The results and recommendations might not be relevant to the food processing industry, because the SMEs sampled were not grouped as per their sector, further more none were from any country in Africa.

Leigh Smith and Peter Ball (2012):

This study argued that a society cannot be fully sustainable without efficient technologies and approaches, which mostly is provided by the manufacturing sector. Most existing literature covers and primarily emphasizes on the application of sustainability in manufacturing through the principles, however fail to provide practical guidance in ways to effectively apply these principles. Basic and practical guidelines are of utmost necessity in providing systematic analysis of manufacturing facilities and guidance on identifying and selecting improvement opportunities. Their study reports on how to develop a model of guidelines on achieving sustainable manufacturing focusing on Material, Energy, and Waste (MEW). Through employing qualitative analysis of a case facility regarding the MEW process flow maps, through which data was collected to build-up a spreadsheet model illustrating the MEW process flows, giving clear identification and selection of environmental efficiency improvements of the system. The results obtained from this analysis were generating guidelines specific to a system thus assisting in the improvement of analysing and understanding manufacturing systems using the MEW process flow modelling, ultimately improving environmental performance of that manufacturing facility.

Even though this paper raises an important aspect of practicalising the application of sustainable development principles and pillars, the Material-Energy-Waste model focuses primarily on one pillar, environment. Again the results of this study give a general manufacturing system as a recommendation, which might not be effective applicable in food processing sector, and in developing countries facing adverse economic, social, and environmental conditions.

Kris and Angappa (2012):

The author of this paper believed that the global attention that sustainable development is receiving throughout various industries is also as important for the high-tech manufacturing sector. Through this paper they gather a number of high-tech manufacturing firms' papers that are available for reviewing the critical factors driving the adoption and implementation of strategies concerning sustainable development particularly in Hong Kong. The objective of gathering understanding regarding the motivating factors led the research approach to do a comparison study of the relationships between motivating factors such as management, company's willingness and readiness (supportive measures) in the adoption of sustainable development strategies. The aim of the study was to develop a useful plan for the high-tech manufacturing sector in Hong Kong in their pursuit for sustainability management. Whilst the outcomes further achieved an incremental approach through highlighting factors enabling and motivating the implementation of sustainable development strategies. Though this paper brings an important contribution by introducing factors that potentially cause the delay in firms implementing the sustainable development practices, it however limits its area of study to high-tech manufacturing firms in Hong Kong. The outcomes could be very much relative to the environment sampled, which in a different case such as food industry and African country, they might be different. Thus a gap is realised for such a market.

Jayal et al (2010):

This study posit that to achieve sustainability in manufacturing a holistic view is required, a views that does not only cover the manufacturing processes and products involved in the fabrication, but also the supply chain in its entity, inclusive of manufacturing systems across various product life-cycles. This requires metrics for sustainability evaluation, improved models, and optimisation techniques at the level of the product, process, and system. This study presented a summarised outline of recent trends and latest concepts in the development of sustainable systems, processes and products. The primary focus was on the manufacturing of dry, near dry and cryogenic machines. Jayal et al (2010) in this study though intending to address sustainability in manufacturing holistically, the study however ends up being limited only to the dry, near-dry, and cryogenic machinery. This sector is a much specialised sector thus other manufacturing sectors such as the food, cannot possibly draw applicable learnings from it, especially those categorized as SMEs. The application of the pillars of sustainable development are not visibly applied in this study, possibly due to the matter that sustainable development was not the primary concept focused on, the study reviewed various latest concepts and trends; the general view of trends might also not be as accurately or possibly as trendy in developing countries.

J.S. Damtoft et al (2007):

This paper reports on the positive contribution of the cement and concrete industry on the climate change initiative driven by the principles and strategies of sustainable development. Amongst other positive contributions mentioned in the study these are; 1) continuous reduction of Carbon dioxide emission during the cement production, due to the increased use of biofuels and alternative raw materials. 2) Exploitation of the potential recycling of concrete so to increase the Carbon dioxide uptake rate. This paper solely argues from a position of defending the cement and concrete industry. The applications highlighted are specifically aligned with the processes and practices in that industry. From its content, the focus is primarily on the environmental aspect, specifically the climate. The food processing industry cannot adopt any of these applications. It is therefore not addressing nor contributing to any broader manufacturing field.

Qinghua Zhu & Joseph Sarkis (2007):

While Chinese industry is building their reputation as a major manufacturing prowess, they seem to encounter increasing ecological pressures from various institutional players inclusive of the government, market, and competitive sources. As a response to these environmental pressures certain organisations initiated emergent green supply chain management (GSCM) practices. The goal of the study was to examine the relationships between GSCM practices, economic, and environmental performance, integrating three moderating factors; regulatory, market and competitive institutional pressures. This was done on a sample of 341 Chinese manufacturing firms on a moderated hierarchical regression analysis of the respondents' data. The results obtained revealed that: (1) The manufacturers in China have encountered increasing environmental pressure to implement GSCM practices; (2) the existence of regulatory (coercive) and the market (normative) pressures influenced organisations to have improved environmental performances, particularly when these pressures caused adoption of green purchasing practices and eco-design; (3) manufacturing firms facing higher regulatory pressures were more likely to implement green purchasing and investment recovery; (4) the existence of competitive (mimetic) pressure significantly improved the economic benefits from the adoption of a number of GSCM practices with no harmful influences on environmental performance; (5) None of the institutional pressures contributed to or decreased the "win-win" situations for organisations. Implications for operations strategists and organisational sustainability planners from these relationships were also included in the study. Even though the study was looking into improving the negating impact of the manufacturing sector on the environment, it was primarily based in China and was focused on companies with well advance technology, it also applied the concept and practices of green supply chain management (GSCM) which only addressed the environmental aspect of sustainability and outcomes were inclusive of the economical aspect, however neglected the societal aspect. This introduces a significant gap which tends to disintegrate the sustainable development concept. It is imperative that even though one aspect is being improved, the outcomes should impact all three pillars.

F. Birkin et al. (2006):

In this paper F. Birkin et al. (2006) explored the necessity of establishing new sustainable business models in China, this was achieved through applying a mixed method to sample and analysed a sample of Chinese 20 manufacturing in Guangzhou and Shenzhen, with the aim to establish the level they operating at regarding sustainable development core beliefs; societal responsibility, environmental awareness and performance, performance drivers and barriers, coupled with other sustainability issues. The tool used to sample from the 20 firms was questionnaire survey and interviews. The outcomes drawn from that data brought the conclusion and evidence that manufacturing companies in China treat sustainable development with no significance, judging from their operational practices. However Small and Medium sized enterprises showed great interest in this area and further wanted to contribute positively by adopting concepts like triple bottom line. The key concerns were on the operational side regarding sourcing of alternative sustainable raw materials, changing to renewable energy, closing the gap of the supply chain, and many more. Challenges which seemed to hinder the progress of the embedment of sustainable development in these companies were lack of finances, skills and knowledge resulting in a poor performance towards implementing or achieving the desired results. The study therefore concluded that the establishment of a new business model according to sustainable development is more than necessary; the urgency of this matter would require a joint effort and support of the Chinese government.

F. Birkin et al. (2006) conducted a very significant study; however the study was limited to manufacturing firms in China. The results obtained would sure differ from country to country, thus no learnings would be relevant to any other country except for China. It would be necessary to also cover the gap of analysing per sector for an example; have conclusive results for SMEs in food processing sector, this would be more useful than the conclusion drawn on an overview of the whole manufacturing sector.

#### **4. CONCLUSION**

The rapidly increasing advancements in manufacturing sector has created pressure for manufacturers to rethink and redesign their existing systems in order to cope with the challenges that emerged with globalization and environmental concerns. This trend brought about the introduction of the sustainable manufacturing concept; this concept of sustainable manufacturing is generally referred to as "green business" which emerged towards the end of the 20th century. An increase in customer awareness and pressures from stakeholders shifted manufacturers' focus; no longer

were financial benefits the primary concern in the contemporary business environment. As a result, many innovative strategies were brought into the realm of manufacturing systems, such as lean, green, agile, and sustainable manufacturing practices. Sustainable manufacturing has been acclaimed in recent years for its significant benefits directed at triple bottom line factors (social, environmental, and financial) also known as the sustainable development pillars. Even though many studies have been conducted on sustainable manufacturing, the critical assessment conducted in this study posits that there is much gap to be covered as far as research in this field is concerned. Considering this gap, this study aimed at theoretically assessing sustainability in food manufacturing SMEs. The results of the critical appraisal of the current literature, clearly illustrate that there is a gap in the current body of knowledge particularly with SMEs. These can feed in future endeavours of crafting a framework for sustainable manufacturing for food manufacturing SMEs. Even though many studies have been conducted on sustainable manufacturing, the above assessment posits that there is much gap to be covered where SMEs in food manufacturing are concerned. It was also identified through the critical analysis that the application of the sustainability concept has a significant gap which is due to the disintegration or partly fulfillment of the full concept. It is imperative that even though one aspect of sustainability is being improved in a study, however the outcomes should impact all three pillars. In this regards all the above studies failed to execute and address sustainability in food manufacturing SMEs.

## 5. REFERENCES

1. J Odour et al, "African Economic Outlook 2017", Page 80-82, 2017
2. K Wynen, P Goel , "United nations programme", 14th edition international model, page 12-13, 2017
3. Y Koren et al, "Reconfigurable manufacturing systems", CIRP analysis Volume 48, page 527-540, 1999
4. H Jim, "Sustainable development in South Africa" ,page 5-7, 2015
5. N Hami et al, "The impact of sustainable manufacturing practices and innovation performance of economic sustainability", Volume 26,pg 190-165, 2015
6. R Sousa, "Linking quality management to manufacturing strategy: an empirical investigation of customer focus", Journal of operation, page 1-18, 2003
7. G Ingarao, "Manufacturing strategies for efficiency in energy and resources use", Journal of cleaner production, page 2872-2888, 2017
8. R Peters, "South African journal of business management, volume 44", page 13-24, 2013
9. S Suering, "A review of modelling approaches for sustainable supply chain management", page 1513-1520, 2013
10. M Butler, "Green paper on an environmental policy for south Africa", page 1-7, 1996
11. B Kramer, "Support for sustainable manufacturing in NSF" page 12-17, 2010.
12. Charles Mather, The growth challenges of small and medium enterprises (SMEs) in South Africa's food processing complex, Pages 607-622, 2005.
13. David Bell, Determining the role of Quality Management Systems in South African food processing industry, 2003.
14. Renan O. Zocca et al, Introduction to sustainable food production, 2018
15. Tyler Biggs, African SMES, networks, and manufacturing performance, Journal of Banking & Finance, Volume 30, Issue 11, Pages 3043-3066, November 2006.
16. Joyce I. Boye & Yves Arcand, Current Trends in Green Technologies in Food Production and Processing, Volume 5, Issue 1, pp 1-17, 2012
17. A.J. van der Goot et al., Journal of Food Engineering 168 (2016) 42-51, Concepts for further sustainable production of foods, 2015.
18. Farid Chemat et al, Review of Green Food Processing techniques: Preservation, transformation, and extraction, Innovative Food Science and Emerging Technologies (2017), Vol. 41, p. 357-377, 2017.
19. Zhuming Bi, Revisiting System Paradigms from the Viewpoint of Manufacturing Sustainability, 2011
20. Pipatprapa Anirut et al, The Role of Quality Management & Innovativeness on Green Performance., Volume 24, Issue 3, Pages 249-260, 2017
21. Marc A. Rosen , Sustainable Manufacturing and Design: Concepts, Practices and Needs, 2012

22. Ricardo J. Hernández, Sustainable Product Service Systems in Small and Medium Enterprises (SMEs): Opportunities in the Leather Manufacturing Industry, 2012
23. S.X. Zeng et al, Impact of cleaner production on business performance, 2010
24. Denis Lagace and Mario Bourgault, Linking manufacturing improvement programs to the competitive priorities of Canadian SMEs, 2003.
25. Leigh Smith and Peter Ball, Steps towards sustainable manufacturing through modelling material, energy and waste flows, 2012
26. Kris M.Y.Law and Angappa Gunasekaran, Sustainability development in hightech manufacturing firms in HongKong, 2012
27. Sissel A. Waage, Re-considering product design: a practical “road-map” for integration of sustainability issues, 2006
28. James Scott Baldwin et al, Modelling manufacturing evolution: thoughts on sustainable industrial development, 2004
29. Tobias Schoenherr, The role of environmental management in sustainable business development, 2011
30. Qinghua Zhu & Joseph Sarkis, The moderating effects of institutional pressures on emergent green supply chain practices and performance, 2007
31. A.D. Jayal et al, Sustainable manufacturing: Modeling and optimization challenges at the product, process and system levels, 2010.
32. J.S. Damtoft et al, Sustainable development and climate change initiatives, 2007
33. Q. Zhu et al, Production energy optimization using low dynamic programming, a decision support tool for sustainable manufacturing, 2014.
34. F. Birkin et al., New Sustainable Business Models in China, Pages 64-77, Volume18, 2006.