An assessment of status-quo of lean manufacturing implementation in food industry: a critical review

Magaly Madeleine Bolipombo, Ndala Yves Mulongo and Clinton Aigbavboa
Faculty of Engineering and Built Environment
University of Johannesburg, PO BOX, 524,
Auckland Parl,2006
South Africa
magalybolipombo02@gmail.com

Abstract

Products with low quality, long lead time, and limited variety are no longer acceptable among customers due to the drastic change in the global market during the past years. Customers' demands are increasing by time and traditional production systems cannot meet this new level of demand. Hence, applying new production methods in order to produce high quality product, in short time, with low price becomes essential for survival in current competitive global market. Lean manufacturing is one of the approaches which has been used by many companies around the world to achieve these competitive advantages. However, lean manufacturing as a competitive advantage tool has not fully been implemented in the food manufacturing industry. Although numerous studies have been conducted over the past decade to address this issue there is still a gap in the current literature. Therefore, the aim of this paper is to theoretically assess status-quo of lean manufacturing. The results of the critical analysis of the current literature clearly demonstrate that there are flows in the current established body of knowledge related to various industry such as the food industry and the small and medium enterprises

Keywords
Lean manufacturing, manufacturing industry

I. Introduction

The world has become one big platform today due to globalization, advancements in technology, all the creativity big firms come up with and the level of innovation and challenges in the entrepreneurial sector. Organizations find themselves having to strive for comparative advantage, and some have adopted the application of lean manufacturing as a mechanism to stay in this fierce business. The success of organizations and managers also depends on their capacity to respond, operate and adjust to change when it comes. (Rich Charron, 2014). Lean manufacturing is a philosophy that aims to eliminate waste in all aspects of production activities. According to Rich Charron staying competitive could require looking for new ways of reducing costs and increase the quality of the company's products. Lean thinking was considered to be one potential approach for improving organizational performance. (By Rich Charron, 2014)

Lean manufacturing or lean production, frequently called "lean", is an efficient strategy for waste minimization inside an assembling framework without yielding productivity. Created by the Toyota official Taiichi Ohno (1912-90) amid post-Second World War remaking period in Japan, and promoted by James P. Womack and Daniel T. Jones in their 1996 book 'Lean Thinking.' The importance of lean has been about standardizing work processes to make problems visible and developing your team members' critical thinking ability so that they can solve those problems and improve work processes. One of the aims of every organization is to increase profit and productivity while minimizing the cost of operations and adding value to the business. (Sullivan, 2011). In today's business, there is a rapid change in technology and demand occurring. (Mathew, 2016) . Organizations seek to keep up with the demand to ensure customer satisfaction considering the fact that they are becoming aware of rising standards as they have access to wide range of products and services to choose from. There is an ever increasing demand for quality products and services and this global revolution has forced organizations to invest into adopting and implementing new strategies in order to enhance the companies' efficiency and competitiveness. For that reason, lean manufacturing has become a widely accepted and adopted best manufacturing practice across countries and industries (Baba Md Deros, 2012). The ultimate goal of a lean in organization is to create a smoothly-functioning, high-quality system that can produce, without waste, the finished products of the quality that customers demand.

I.1. Background

Global Savoury Snacks sector was valued at US$96.6 Billion in 2016 and is forecast to record a CAGR of 6.0% during 2016-2021 to reach US$129.3 Billion by 2021. North America was the leading region in the global Savoury Snacks sector with a value share of 37.6% in 2016 whilst Asia-Pacific is forecast to record the fastest value growth globally at a CAGR of 8.0% during 2016-2021. A growing population, rising urbanization rate, and improving economy will remain the primary macroeconomic factors driving the sector globally. Long working hours and consumers' busy schedules will further contribute to the snackification trend as they snack more often than usual to get a quick energy boost. Processed Snacks was the leading market with a value share of 36.4% in 2016. Share of Savoury Snacks as a percentage of the global food industry is expected to increase during 2011-2021. All the regions, except the Middle East & Africa, will witness a gain in share during the same period. Fragmented meal times due to rising busy lifestyles across the regions will result in an increase in snacking occasions. Many consumers in the Middle East & Africa are altering their eating habits to include more dairy and bakery products in their daily routine, which will boost the share of the Dairy & Soy Food and Bakery & Cereals sectors compared to Savoury Snacks in the region. Top 10 high potential countries included Japan, China, the US, Mexico, Brazil, Colombia, the UK, France, Russia, and Turkey. The US is set to continue leading the global Savoury Snacks sector, while China is forecast to record the fastest growth globally during 2016-2021. Russia is set to emerge as the fastest-growing market for Savoury Snacks in the Eastern European region with a CAGR of 8.5% during 2016-2021. Brazil represented the largest market in Latin America, accounting for 48.3% of total value sales, while the UK represented the largest market in the Western European region with 33.7% value share in 2016. Savoury Snacks with Health & Wellness attributes accounted for 15.4% of the overall global sector sales in 2016, an increase over 14.7% in 2011. This can be attributed to the strong demand for low-fat snacking options, which manufacturers are offering to appeal to health-conscious consumers. Additionally, with increased focus on healthy ingredients such as hemp seed and flaxseed, which are a natural source of amino acids and omega-3, there is robust demand from time-pressed consumers who seek convenient but healthy snacking options during short-breaks or while on the move. The overall share for private label products in the global Savoury Snacks sector stood at 9.1%, valued at US$8.7 Billion in 2016, an increase from 8.7% in 2011. Western Europe had the highest value share for private label Savoury Snacks with 18.4% of the total sales in 2016, followed by North America with a value share of 10.5%. Hypermarkets & Supermarkets was the leading distribution channel for the global Savoury Snacks sector, with a value share of 52.2% in 2016, followed by Convenience Stores with 32.2% share. The large share of the Hypermarkets & Supermarkets channel in the distribution of Savoury Snacks can be attributed to the developed organized retail industry in major countries, where most consumers prefer to buy Savoury Snacks. The report "Opportunities in the Global Savoury Snacks Sector" brings together multiple data sources to provide a comprehensive overview of the global Savoury Snacks sector.

II. GAP IDENTIFICATION IN THE CURRENT LITERARURE

To start with the critical assessment of existing literature review on lean manufacturing, the ISI web of science data based was used with “lean manufacturing” as a key word . The time frame was from 1997-2017. The search only focused on peer review and article published in English, falling under certain subjects areas. The results was about 600 documents that were critically studied by means of titles and abstract with to create additional boundaries and eliminate unrelated entries (screening phase) throughout this phase, groups of inclusion and segregation standards were established . Against with individually every single journal article was evaluated. Specifically, articles are those . which focused on lean implementation . It should be pointed out that studies that did not meet this requirements were not taken in account . This stage generated 441 focusing on lean mainly in automotive, aerospace and construction. This studies were labelled on the basis of a set of standards, for instance in this paper the studies that were assess were selected based on the citation. To this end , the table below shows the 15 studies that were critically examined in lean over the past two decades

AUTHORS	**COUNTRY**	**METHODOLOGY**		**SIZE OF COMPANY**		**TYPE OF INDUSTRY**			
						MANUFACTURING			
		Qualitative	Quantitative	SMES	Large	Aerospace	Automotive	Construction	Food(snack)
L. Bamber et al (2000)	UK		X		X	X			
Andrew A. King & Michael J.(2001)	USA		X		X				
Rothenberg et al. (2001)	USA	X			X		X		
Jaideep Motwani (2003)	USA		X	X			X		
V. Crute et al. (2003)	UK		X		X	X			
Haque & James-moore (2004)	UK		X	X	X	X			
Dinesh Seth et al. (2005)	INDIA		X		X		X		
O. Salem et al (2006)	USA		X		X			X	
Mathias Holweg (2007)	UK		X		X		X		
Ashish Agarwal et al (2006)	INDIA		X		X				
G.C Parry & C.E Turner (2006)	UK	X		X		X			
Lander E (2007)	USA		X		X				
Kumar Sahoo et al (2008)	INDIA		X		X		X		
Hung-da Wan & F. Frank Chen (2008)	USA		X		X				
R. Shah et al. (2008)	USA		X		X				

L. Bamber et al (2000) conducted of a research study on the use of lean production techniques to a traditional aerospace manufacturing company. They described the approach taken to lean production , alongside what was successful and what was not. Two primary stumbling blocks to the application were identified which were the redundancy program and lack of knowledge in the concept and standards of lean production. Some of the techniques for lean production were considered not to be as effective as in the motor manufacturing environment , the reasons behind this included the dominant position of the organization and the consumers demand attributes. Moreover, both management and the industrials employees agreed that the change from traditional manufacturing to lean production was difficult to make. Even though the authors have contributed significantly to the body of knowledge on lean . They only focused on the aerospace sector and did not to address other sectors. Also they only focused on a quantitative approach and only in large companies and failed to cover small and medium enterprises.

In 2001, Andrew A. King et al (2001) conducted an empirical study of the environmental performance of 17,499 U.S. manufacturing organizations during 1991-1996. Lean production may have a crucial public spill improved environmental performance. Still, empirical evidence of the connection between lean production practices and environmental performance has not solved the state of the link. They found that those establishments that embrace the quality management standard ISO 9000 are likely to take the environment management standard ISO 14000. They also found strong proof that lean production, as estimated by ISO 9000 adoption and low chemical inventories, is reciprocal to waste decrease and pollution reduction. Although they contributed significantly to the established body of knowledge by the fact that they covered various industries at one they only focused on large size companies and did not cover SMEs.

Rothenberg et al.(2001) studied the link between lean manufacturing practices and ecological performance as estimated in terms of air emanations and means utilize. They draw on two interesting surveys of 31 automobile assembly plants in North America and Japan, which contained data on manufacturing practice and ecological performance, and in addition interviews with 156 plant level representatives at 17 assembly plants. Their survey results and interviews implied that lean manufacturing and decrease of air emissions of volatile organic compounds (VOCs) are related unhelpfully. Lean manufacturing practices add to more effective utilization of paints and cleaning solvents, however these in-process changes are not adequate to meet the most stringent air guidelines. They also discovered some proof to support the link between lean manufacturing and resource proficiency. Though their survey outcomes were hypothesized direction, they were not statistically meaningful. In-depth and out semi-organized interviews, still, recommend a more vigorous relationship, and they utilized them to define a few instruments by which each of the three parts of lean manufacturing (buffer minimization, work systems , and human resource management) might be identified with ecological management practices and performance. They only covered the qualitative approach and failed to do quantitative method.

Crute V. et al (2003) discussed the key factors for Lean in aerospace and explored the assumption that cross-sector transfer might be hard. Lean manufacturing seemed to hold extensive guarantee for fixing a range of simultaneous, competitive demands counting high level of process and product quality, low cost and reductions in lead times. These necessities have been acknowledged within the aerospace sector and efforts are presently well instituted to implement Lean practices. Lean manufacturing was initiated in the automotive industry. Still, since the publication of the book, The Machine That Changed the World (Womack et al., 1990) there has been a scope of documented cases of Lean implementation in a variety of sectors. Notwithstanding this proof, the recognition remains that Lean manufacturing is to some degree, an automotive idea and hard to transfer to other different industries specially when there are significant contrasts between them.. A Lean implementation case comparison explored complications that arise may have more to do with individual plant context and management than with sector specific factors. In doing so they did only focused on large organizations and failed to cover SMEs and only used quantitative approach and failed to cover the results from a qualitative approach.

In the same year, Jaideep Motwani (2003) by the use of a case study, he discussed the most significant fundamentals of lean manufacturing, the approaches used by the organization for implementing LM, and the major benefits that were added in manufacturing operations. He explained the analytical factors involved in the implementation of LM utilizing a business process change framework. The data for this study were obtained through interviews, questionnaire survey and archival sources. He focused on a medium-size automotive industry using a qualitative approach. In doing so he failed to cover the gaps in large industry and other sector.

Badr Haque et al. (2004) considered that Lean Thinking and its principles as stated by Womack and Jones have been effectively applied to manufacturing and operations environments, and linked case studies and research literature have been published broadly. However the same cannot be said for Lean application to the new product

introduction (NPI) or development processes. They aimed of to explain the application of the Womack and Jones principles of Lean Thinking to the NPI process (from concept development to detailed design through to customer delivery). Although techniques such as concurrent engineering (or concurrent product development) have been implemented and have been quite successful in improving NPI, there is still a shortfall in the expected or desired improvements to NPI. This shortfall they believed can be bridged through the application of Lean Thinking to NPI; in particular, the five lean principles proposed by Womack and Jones. The five Lean principles are briefly 'specify value', 'identify the value stream and eliminate waste', 'make the value flow', 'let the customer pull the process', and 'pursue perfection'. In this paper each principle is defined and characterized within the context of NPI. Their work was developed on the Society of British Aerospace Companies' UK Lean Aerospace Initiative involving 40 aerospace companies of all sizes from across the UK. Two case studies from the industry are also presented to demonstrate aspects of Lean application in NPI (in particular, in product design and development). They concluded by summarizing the key methods and tools that enable Lean in NPI, and by discussing the key adjustments required to the manufacturing/operations definitions of waste and value to accommodate the demands of effective and efficient NPI. Though they brought very important contribution to the body of knowledge they only covered the aerospace industry and not others.

Dinesh Seth and Valib (2005) found that for the recent years the majority of manufacturing industries have been trying to get 'lean'. A headlong rush to offer a value to the consumers by becoming lean and responsive has made a determination for analysts and experts to apply new instruments and strategies to address different wastes. The way toward mapping the material and data flows of all components and sub-assemblies in a value stream that incorporates manufacturing, providers and distribution to the consumers is known as a value stream mapping (VSM). VSM has demonstrated efficient in recognizing and eliminating wastes in an facility with comparable or same items routings, for example, in assembly facilities. In their study , an attempt has been made to utilize VSM as a strategy to accomplish profitability increase at supplier end for an auto industry. Both present and future ('as is' and 'to be') conditions of supplier shopfloor situations are talked about utilizing value stream ideas. This is broke down alongside takt time calculations and the utilization of other gap regions. Lastly, gain in production output per person, reduction of work in process and finished goods inventory affecting productivity are likewise revealed. They used a quantitative approach in the large companies. Even though they brought significant contribution to the body of knowledge they only focused on one sector and failed to cover other industries. They only looked at large size companies and failed to cover SMEs.

Salem O. et al (2006) compared the methods created for lean construction with those produced for lean manufacturing. Lean manufacturing and lean construction methods share numerous normal components notwithstanding the undeniable contrasts in their assembly environments and procedures. Manufacturing plants and construction sites are distinctive from numerous points of view that may clarify why lean production theories and practices don't completely fit the construction sector. Despite of the fact that numerous lean development instruments and components are still in an embryonic state, lean construction procedures are picking up fame since they can influence the bottom line of projects. Furthermore, they an investigated of a construction project in which particular lean construction components were tried. Every procedure was assessed as far as its effect on the execution of the task. In view of the discoveries of the investigation, another "lean evaluation apparatus" is proposed to measure the consequences of lean usage. The appraisal device assesses six lean development components: last organizer, expanded representation, cluster gatherings, first-run thinks about, five S's, and safeguard for quality. They gave a basic and complete approach that is transferable to any development venture. In doing so they did only focused on large organizations and failed to cover SMEs and only used quantitative approach

G.C Parry et al. 2006) focused on visual process management instruments that have been produced by lean professionals as communication aids and are utilized to help drive tasks and procedures in real time. Three case studies from aerospace companies described the physical visual devices that have been actualized to facilitate execution estimation and communication in various engineering processes . Rolls Royce showed a case of how ERP outputs are communicated and controlled in a lean manufacturing process. At Airbus UK (Filton) visual process sheets are utilized to deal with a intricate knowledge and individuals based process bringing numerous supplier contributions to the production aircraft support manuals. Senior manager at Weston Aerospace are utilizing visual process control to run and report on work package, assets and procedures all through their companies. These frameworks work as an augmentation to metrics, and in themselves might be considered as a dynamic estimation framework as they give instant feedback and can be utilized to anticipate a likely result if no action is made. The learning and topics that have made these implementations fruitful is displayed and examined into an arrangement of rules for consideration while actualizing visual process management tools. Although they brought significant contribution to the established body of knowledge, the authors focused on the aerospace sector

only and failed to cover other industries. They used a qualitative method and failed to cover the outcomes from a qualitative method.

Matthias Holweg (2007) stated that lean production did not just effectively challenged the acknowledged mass production practices in the automotive sector, essentially moving the exchange amongst productivity and quality, yet it likewise led a rethinking of a variety of manufacturing and services beyond the high-volume redundant manufacturing condition. The book 'The machine that changed the World' that presented the term 'lean production' in 1990 has turned out to be a standout cited reference in operations management in the course of the most recent decade. Regardless of the fact that the just-in-time of time (JIT) manufacturing idea had been known for almost 10 years , the book played a key part in scattering the theory outside of Japan. While the specialized parts of lean production have been broadly talked about, his study explored the advancement of the examination at the MIT International Motor Vehicle Program (IMVP) that led the origination of the term 'lean production'. Moreover, he explored why – notwithstanding the pre-existing knowledge of JIT – the program was so persuasive in advancing the lean production theory. In accordance with a repeating series of interviews with the key authors, contributors and analysts of the time, the study exhibited a verifiable record of the examination that led to the creation and spread of a significant manufacturing paradigms of recent period. The authors focused on a quantitative approach and therefore failed to elaborate on the results that could have been obtained using a qualitative methodology.

E. Lander(2007) studied how the Toyota Production System has prompted a movement of 'lean production' concentrated on removing waste from value streams. Most applications have been to high volume, and moderately standardized items. Under this system work turns out to be very standardized determining to the second what the operator should do. Buffers are correctly measured and controlled through different kinds of pull signals. Whenever possible, utilization of one-piece stream cells result in a totally adjusted production line. The performance advantages of these lean systems are usually outstanding , enormously improving quality, cost, and delivery. In any case, what of organizations that are not making standardized items at high volume? What would they be able to gain from lean? In his study he argued that there is a basic misconception of TPS, seeing it as a particular tool kit technically implemented in a formulaic to accomplish pre-indicated results. TPS is a philosophy that can be better depicted as an arrangement of general standards of sorting out and dealing with an enterprise which can enable any firm to get on a way of positive learning and change. A case of a low volume, very customized artistic clay tile organization represents the procedure by which the firm utilized TPS to figure out how to comprehend its procedure, pick up security and control, enable its workforce, and wind up undeniably gainful. The study’s focus on a qualitative methodology fails to educate the reader on the results issuing from a quantitative methodology

Ajit Kumar Sahii et al (2008) addressed the implementation of lean philosophy in a forging organization with an attention on radial forging production lines. Here, the prime reason was to advance and test a few methodologies to eliminate waste on shop floor . In their research, a deliberate approach is recommended for the implementation of lean principles. They described an utilization of value stream mapping (VSM). Subsequently, the present and future conditions of significant value stream maps are built to enhance the production procedure by distinguishing waste and its sources. Moreover, Taguchi's strategy for plan of examinations is pursued here to limit the forging defects made because of imperfect working conditions. A clear reduction in set-up time and work-in-process (WIP) stock level is substantiated. At long last, they finished up with a dialog of managerial implications and the future extent of research. Even though they brought crucial contribution to the established body of knowledge by the fact that they covered various industries at one they only focused on large size companies and did not cover SMEs. Hence there is still a gap in that.

J. Jayaram et al (2008), rather than past literature, they recommended that loyalty to lean strategy should go before building close relationship with key supplier chain partners (suppliers and clients). They studied two parts of lean strategy, lean manufacturing and lean design . They hypothesized that relationship building decidedly influences the two parts of lean strategy, which thus constructively impacts firm performance. To test these connections, we utilize information from the best 150 auto suppliers to the 'Huge Three' unique gear producers (OEMs). The outcomes demonstrated positive connections between (1) relationship building and lean design, (2) relationship building and lean manufacturing, and (3) lean design and firm performance. Their research recommended that relationship building is more significant for improving the 'product' aspects of lean strategy instead of the 'process' aspects of lean strategy. Process aspects of lean strategy seem to be mostly a function of internal efforts. Although they brought significant contribution to the body of knowledge, the authors focused on the automobile sector only and failed to cover other industries. They used a quantitative method

Hung-Da Wan (2008) suggested a unit invariant leanness measure with an independent benchmark to evaluate the leanness level of assembling frameworks. Different lean devices and systems have been produced for process

improvement. Keeping in mind the end goal to track the progress, lean metrics were created correspondingly. Notwithstanding, an incorporated and quantitative measure of overall leanness level has not been set up.. Advanced from the concept data envelopment analysis (DEA), the leanness measure removes the value-adding investments from a production procedure to decide the leanness frontier as a benchmark. A linear program based on slacks-based measure (SBM) determined the leanness score that demonstrates how lean the framework was and how much waste existed. Utilizing the score, effects of different lean activities can be evaluated as choice help information complementing the current lean metrics. This study's approach was mostly quantitative which failed to cover a more qualitative point of view.

R. Shah et al. (2008) utilized implementation and performance information from an sample of 2511 plants, the research aimed to uncover associative and predictive pattern of implementation between 15 Lean practices and the Six Sigma program. Consolidating Lean practices with Six Sigma hag gained massive popularity in the past decades . Regardless of whether a joined Lean-Six Sigma approach is the most recent management trend, or leads to significant performance benefits that surpass detached implementation isn't yet evident. Their outcomes demonstrated two main discoveries. To start with, implementation of any practice from a wider set of Lean practices improves the probability of implementing Six Sigma. Furthermore, practices commonly packaged under quality management anticipate and recognize the group of plants implementing Six Sigma broadly from non-implementers. Second, the regression results demonstrate an important contrast in the performance levels of the Six Sigma implementers group compared with the non-implementer group. These primer outcomes are an initial steps towards isolating fact from fiction. The research adopted a quantitative approach to the work and in so doing, failed to bring about results from a quantitative point of view.

IV. CONCLUSION

Products with low quality, long lead time, and limited variety are no longer acceptable among customers due to the drastic change in the global market during the past years. Customers' demands are increasing by time and traditional production systems cannot meet this new level of demand. Hence, applying new production methods in order to produce high quality product, in short time, with low price becomes essential for survival in current competitive global market. Lean manufacturing is one of the approaches which has been used by many companies around the world to achieve these competitive advantages. However, lean manufacturing as a competitive advantage tool has not fully been implemented in the food manufacturing industry. Although numerous studies have been conducted over the past decade to address this issue there is still a gap in the current literature. Therefore, the aim of this paper is to theoretically assess status-quo of lean manufacturing. The results of the critical analysis of the current literature clearly demonstrate that there are flows in the current established body of knowledge related to various industry such as the food industry and the small and medium enterprises

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Biographies

Magaly Madeleine Bolipombo is currently completing a master's degree in the Faculty of Engineering and the built Environment , University of Johannesburg. She holds a bachelor of technology in operations management from the university of Johannesburg, South Africa. Her research interests include manufacturing, simulation, optimization, reliability, scheduling, manufacturing, and lean.

Ndala Yves Mulongo is currently a PhD candidate in the Faculty of Engineering and the built environment, University of Johannesburg. He holds bachelor of engineering in extraction metallurgy and master of engineering in engineering management from University of Johannesburg, South Africa. His research interests involve life cycle approach, cost of electricity production, energy efficiency measures, green supply chain management, impact of mining operations on environment, mineral processing, manufacturing processes.

Prof Clinton Aigbavboa is currently a Senior Lecturer and vice-dean of research and innovation in the Faculty of Engineering and the Built Environment, University of Johannesburg, South Africa. He has got a Doctor of Engineering Management degree from the University of Johannesburg where he has been supervising masters and PhD students during the current decade. He has published several journal articles and conference research papers. His research areas include construction management, project management, process optimizations, manufacturing processes, supply chain management, sustainability, production planning, energy efficiency, waste reduction, product development and marketing, product quality related issues, cost analysis, etc