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ROLE OF PULL SCHEDULING ON SUPPLY CHAIN PERFORMANCE IN THE MANUFACTURING SECTOR IN KENYA: A CASE STUDY OF LAKE BASIN DEVELOPMENT AUTHORITY

[1*] **James Odhiambo Otieno**
Jomo Kenyatta University of Agriculture and Technology
jammesoo2@gmail.com

[2**] **Dr. Namusonge Sammy Odari**
Jomo Kenyatta University of Agriculture and Technology
samodari@gmail.com

Abstract

The purpose of this study was to determine the role of pull scheduling on supply chain performance in the manufacturing sector. The study employed a case study design. The target population comprised of 150 employees of LBDA sampled through a stratified random sampling technique. The study used primary data collected via questionnaires and secondary data. Data was classified, tabulated and summarized using descriptive measures and findings presented using tables and charts. Pearson's correlations coefficients was run to examine the relationship between the independent and dependent study variables that are set out in the objectives of the study. The study findings indicated that 76.3% of change in Supply Chain Performance at LBDA can be explained by the four variables. According to the research findings, pull scheduling had been implemented at LBDA. Make to order production, kanban pull, sequential pull and replenishment pull were found to be statistically significant with a positive impact on supply chain performance. Following the results of the study, it is evident to conclude that there is a positive relationship between role of pull scheduling and Supply Chain Performance. The study recommends that it is imperative that firms start to view pull scheduling as strategic in value.

Keywords: Pull scheduling; make to order production, kanban pull, replenishment pull, sequential pull

1. Background of the study

Supply chain scheduling has an essential role in supply chains. In a manufacturing supply chain, an order mostly links many firms whose schedules have effect on the success of the order. This presents manufacturing firms with serious challenges in this twenty-first century. Manufacturing supply chain is complex and difficult to navigate in the best circumstances. According to Li (2005) the use traditional practices manufacturing approaches are major causes of poor performance in production, such approaches weakens the competitive advantage. He further argues that push production control system in one of such practices that lead to deterioration in the poor production performance therefore advocated for the adoption of pull-based approach. This enables manufacturing firms to meet customer need as and when needed (Li, 2005). Crocker, Farmer, Jessop & Jones (2008), assert that firms that respond swiftly and accurately to customer wants are more likely to attract and retain lager customer base than those that cannot which is the key aim of pull approach.

Pull is a customer demand driven approach, which strive to design, schedule and produce what customers want just when they need it (Powell & Arica, 2014). The pull-based approaches are harmonized by true customer demand instead of forecast demand. Value addition only occurs to replace the used items. This is opposed to push approach such as Material Resource planning (MRP) system in which production is undertaken in anticipation of demand. The work Centre perform their roles and send them to the next station (Mahadevan, 2010). These add a lot of overhead cost through holding of excess inventory that ties up capital. Gonza'lez-R, Framinan (2013) support these argument stating that to remain competitive, there is need to adopt modern manufacturing practices of pull system. An event- based planning is more advantageous compared to rolling schedule approach, which form the new trends in twenty first century supply chain management practices.

Farmer *et al.*, (2008) pull and flow practices have successfully challenged the batch and queue manufacturing and supply. Pull models that include pull scheduling respond effectively to the growing uncertainty. The model expands the chance for more creatively dealing with immediate need instead of having tighter control (Hagel III & Brown, 2008). Solomon(2014) isolated specialized processes, number of machine types is significantly greater than product type, scheduling is based on WIP delivery date, continued orders are pulled through the supply chain and a buffer capacity is built in to ensure sufficient equipment capacity as key aspects of pull scheduling management.

According to Lysons and Farrington (2012), pull scheduling is one that controls the flow of works through a factory by releasing materials into production when they are needed and not before. It is based on the sales of the manufactured items and goods are only provided in response to demand. Production scheduling is based on the use or sale of the manufactured items. Pull scheduling describes a kanban system in which customer is the catalyst for manufacturing. The pace of work is dictated by customer demand. Orders are placed with suppliers based on customer demand. Within the manufacturing environment, the workstations pull the material from the previous workstation only when they want it (Handfield et. al. 2010). The pull process see goods travelling upstream and being moved onto the next stage only when required. This enables stockholding to be minimized and later deliveries to be made resulting in reduced inventory cost. Greater emphasis is placed on provision of a quality item and there is greater flexibility in satisfying customer demand as goods can undergo late customization to meet customer requirements.

For years, the world has gone through massive transformation in the manufacturing operation approaches; the adoption of lean systems and the production system has shifted from push to pull. Across the globe, companies such as Toyota, Dell Computer and supermarkets in U.S.A have implemented this system (CIPS, 2010). Pull system, which is mostly referred to Just-In-Time (JIT), started as single concept of Lean production approaches of Toyota. The initiative behind pull scheduling technique of lean manufacturing was to produce the preferred product with the least waste attainable.

The manufacturing industry in Kenya is a key sector for the realization of vision 2030. It is one of the key economic pillars in the vision 2030. Even though manufacturing sector make significant contribution to the national economy, KAM (2013) argues that, they still experience a number of challenges. These include; reduces consumer effective demand and drives inflation, high production cost, use of obsolete technologies, weak linkages with local supplies, competitiveness of Kenyan products and intense globalized competition.

Lake Basin Development Authority with modern rice milling machines with a throughput capacity of 25 tons per hour cleaning and drying and 3.5 tons per hour milling (24,000 tons per annum).The massive prospective in the rice sub-sector that improves food security and standard of living has not been exploited as regards to policy and institutional support. Therefore, Kibos Rice Mill Complex is part of the appropriate initiative by LBDA to develop the sub-sector to make it more competitive to achieve food security. Other opportunities exist within the complex such as; Rice seed production, Feed manufacture and Water Bottling Plant.

1.2 Statement of the problem

Manufacturing firms play critical role in improving the economic status of the country by way of production of goods and is a sector in Kenya and highly strong engine to promote economic development. Internationally, the world economy-manufacturing sector showed a growth of 5.2 percent in 2015 compared to 4.7% in 2014 (World Bank, 2015). In Kenya, manufacturing firms accounted for 3.2% of Gross Domestic Product, which has improved employment rate to the point where about 300,000 people are employed within the formal sector and more than 5 million individuals working in the informal sector ((Kenya National Bureau of Statistics, 2014).

However, in the twenty first century, business environment mostly change and manufacturing firms experience a myriad of problems with push systems. The way businesses are carried out is influenced by the ever-changing customer needs and marketplace demographics and geographies. Therefore, firms need strategies that enhance flexibility and ease to adapt such changes. According to Li, (2005) the use of traditional practices manufacturing approaches such as push approaches are major causes of poor performance in production, such strategies weakens the competitive advantage. With push approach there is incapacity to effectively respond to the changing demand patterns and even the excessive inventories because large safety stocks is required. In this context, manufacturing firms have experienced challenges of coping with scope global market place along with the supply chain when speed and flexibility is maintained. Besides there is the elimination of wasted time, effort as well as the materials from all point in the supply chain and meet the needs of customer without holding more inventories (Monica, 2013). To solve these issues, (Kumar, et. al., 2015) proposed the use of customer driven approaches such as pull scheduling.

The continued stiff competition in the rice production and water bottling industry in Kenya and beyond her border has seen a reduction of market shares and profitability of Lake Basin Development Authority as leader in the rice production being at stake. Therefore, the company's survival in this turbulent market depends on its ability to eliminate or reduce the seven wastes in the production through adoption of lean production systems. Such practices give the company to access superior performance by reducing wastes along with other related costs (Feng, Amours, & Beauregard, 2008). Even though, there are several factors that influence supply chain performance, it is not clear how each of them influence the rice and water bottling manufacturing sector, therefore, in order to access how pull scheduling contribute to the waste reduction, eliminates non value adding activities and improving end customer satisfaction and inventory management, Lake Basin Development Authority is a representative case.What strengths in pull scheduling does Lake Basin Development Authority need to employ to ensure it retains leadership in rice water bottling production and distribution?

Although various research works have been conducted on the concept and context of lean supply chain, for instance, Kimani (2013) examined the implementation of lean supply chain management in the Kenyan manufacturing sector while Mugnai,(2014) explored extent of adoption of lean thinking practices, the connection between lean practices adoption and performance. Still there is limited information within the context of Rice Manufacturing and water bottling industry in Kenya. These studies also did not explore the contributions of pull scheduling on performance of manufacturing companies in Kenya, which is also a lean concept, and this research aimed to fill this gap.

1.3 General Objective

The general objective of this study was to determine the role of pull scheduling on supply chain performance in the manufacturing sector a case study of Lake Basin Development Authority. The specific objectives of this study were:

i. To determine the role of make to order production on supply chain performance in the manufacturing sector.

ii. To find out the influence of kanban pull on supply chain performance in the manufacturing sector.

iii. To determine the effect of replenishment pull on supply chain performance in the manufacturing sector.

iv. To find out the effect of sequential pull on supply chain performance in the manufacturing sector.

2. Literature Review

2.1 Conceptual framework

The conceptual framework presents the relationship that exists between the various variables in the area of study. The conceptual framework of pull scheduling and supply chain performance is illustrated in the figure that follows.

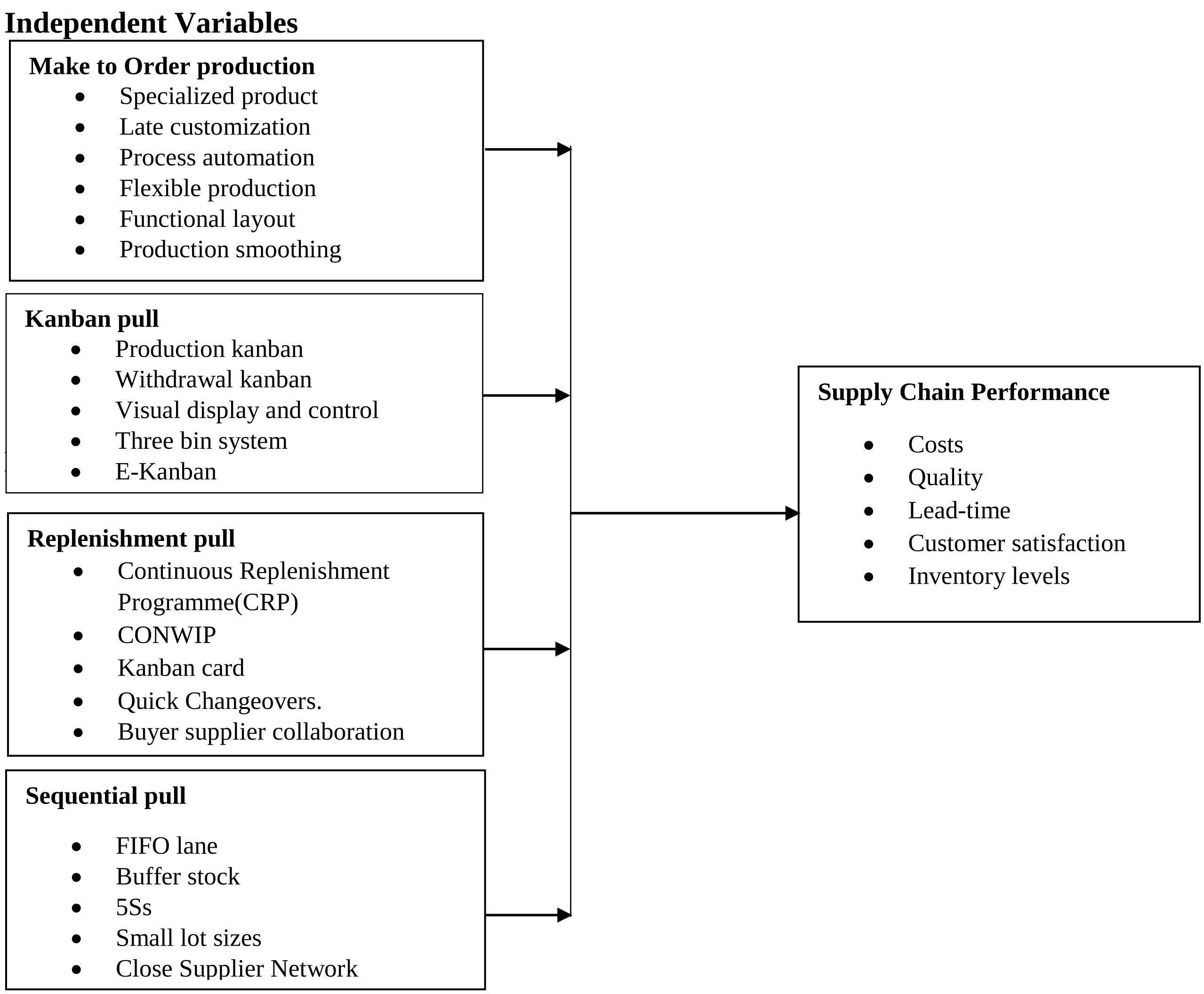

Figure 1: ***Conceptual Framework***.

3. Research Methodology

A case study research design was adopted for the case study. The choice of this design is appropriate since it allows an in-depth understanding of the behavior pattern of the concerned unit (Cooper & Schindler, 2008).

The study target population of this study comprised of the production, marketing, finance, Purchasing, Supplies and ICT Departments at LBDA in Kenya comprising of 150 respondents. Using Nassiuma (2001) formula, with a confidence level of 95%, coefficient of variation of 0.5 and precision level of 5%, the sample size of this study was 60 employees selected. The study used stratified random sampling. Stratified random sampling is a technique whereby the target population with heterogeneous characteristics is first divided into homogeneous groups known as strata to obtain the required sample size (Mugenda & Mugenda, 2003). The researcher collected both primary and secondary data. Primary data was collected using a questionnaire. Secondary data were gathered from existing credible sources such as the textbooks, internet, past research work, newspapers, magazines and CIPS publications. To determine the validity and reliability of the research instrument, a pilot study was conducted at Lake Basin Development Authority and the participating staff did not form part of the final respondents. Cronbach's alpha indicates the extent to which questionnaire items can be accepted as reliable (Cronbach, 1951). In this study, questions generating a Cronbach alpha value of 0.6 and above was acceptable (George and Mallery, 2003).

Data collected was coded, compiled, and systematically analyzed using SPSS version 21. Data were classified, tabulated and summarized using descriptive measures: percentages, mean, standard deviation. Pearson's correlations coefficient and regression analysis were run to observe the relationship among the independent and the dependent study variables that are set out in the objectives of the study. The findings were presented through frequency distribution table and pie charts with the aim of enhancing easier understanding.

4. Research Findings and Discussion

This chapter presents the data analysis as well as the interpretation of study findings.

4.1 Response Rate

The researcher sampled 60 respondents from Lake Basin Development Authority. However, only 49 questionnaires were filled correctly and returned. This translates to 81.67% response rate. This response rate was considered adequate as recommended by Rubin and Babbie (2008). The duo stated that a response rate of a least 50% is considered adequate for analysis and reporting.

4.2 Results of Pilot Study

A pilot study was conducted to pre-test the questionnaires for validity and reliability. A pilot study is significant for testing the reliability of the data collection instrument (Orodho, 2003). Cronbach's alpha values of 0.6 and above was considered adequate, the average Cronbach's Alpha value was 0.806 as shown in Table 1 below meaning the items under each variable were consistent.

Table 1: Reliability Test

Variable	Cronbach's Alpha	No of Items
Make to order production	.629	6
Kanban pull system	.838	5
replenishment pull system	.843	5

sequential pull system	.822	5
Supply chain performance	.896	9
Average Cronbach's Alpha	**.806**	**30**

4.3 Respondents' Distribution by Department

The respondents profile comprised of 14.27% respondents from purchasing section, 12.25% from finance department, 36.74% from production department, 12.25% from the supplies section, 16.33% from marketing department and 8.16% from the ICT department. It is evident that there was a fair distribution of the respondent's participation from various functional levels of management that directly or indirectly had roles in the production.

4.4 Descriptive analysis

Descriptive statistics are known as the brief descriptive coefficients that recapitulate a given data set, which can either be a representation of the whole population or a sample. It expressed the variables, frequencies, percentages, means and standard deviation.

4.4.1 Make to Order Production

The study sought to ascertain the role of make to order production approach on the performance of supply chain in manufacturing sector.

Table 2: Percentages distribution of respondents' perception on Make to order production

Make to order production	Strongly disagree	Disagree	Moderate agree	Agree	Strongly agree	Mean
There is late customization of products	12.2%	24.5%	42.9%	20.4%	0%	2.71
The firm products unique/specialized products	6.1%	6.1%	46.9%	16.3%	24.5%	3.47
There is flexible production system	0%	18.4%	12.2%	32.7%	36.7%	3.88
The production operates with a functional layout	0%	0%	22.4%	55.1%	22.4%	4.00
There is production smoothing	0%	6.1%	14.3%	44.9%	34.7%	4.08
There is process automation	0%	0%	26.5%	28.6%	44.9%	4.18

From Table 2 most of the respondents moderately agreed to the fact that application late customization of products at LBDA influenced supply chain performance. This is evident from the table where 12.2% strongly disagreed that late customization had influence on supply chain performance at the company, followed by 24.5% who disagreed that late customization had had influence on supply chain performance at the company while 42.9%of the respondents moderately agreed that late customization had influence on supply chain performance and 20.4% agreeing that late customization had influence on supply chain performance at the company. Even though majority of the respondents admitted that late customization influenced supply chain performance, a mean score of 2.71 is an indication of low level of influence.

On production of unique/specialized products by manufacturing firms, 6.1% of the respondents strongly disagreed and 6.1% of the respondents disagreed that the production of unique/specialized product influenced supply chain performance at LBDA, while 46.9% moderately agreed, 16.3% agreed and 24.5% strongly agreed that the production of unique/specialized product influenced supply chain performance at LBDA. A mean of 3.47 is a good indication of product specialization influence of supply chain performance at LBDA.

When the opinion of the respondents was sought after on whether the influence of application of flexible production system on supply chain performance at the firm, 18.4% of the respondents disagreed that flexible production system influenced supply chain performance at LBDA. However, 12.2% moderately agreed, 32.7% agreed and 36.7% strongly agreed that the firm uses flexible production system had an influence on supply chain performance at LBDA. Mean score of 3.88 provides an indication of presence of flexible production system influence supply chain performance.

On functional layout operation by the company, 22.4% of the respondents moderately agreed that functional machine layout influenced supply chain performance at LBDA, 55.1% agreed and 22.4% strongly agreed that functional layout in operations had influence on supply chain performance. A mean of 4.00 is an indication of application of functional layout system to a great extent influences supply chain performance at LBDA.

When the respondents were asked their opinion of whether application of production smoothing by LBDA influence performance, majority of the respondents approved to the fact. Only 6.1% disagreed that production smoothing influence supply chain performance at the company. 14.3% moderately agreed, 44.9% agreed and 34.7% strongly agreed that the use of production smoothing system had an influence on supply chain performance at LBDA. Also with a mean score of 4.08 is a strong indication of balancing of demand and supply side of the supply chain to a great extent influence supply chain performance.

When the opinion of the respondents was sought on process automation effects on supply chain performance, all respondents agreed that the supply chain performance at the companies affected by automation production processes. Specifically, 26.5% moderately agreed, 28.6% agreed and 44.9% strongly admitted that process automation influenced supply chain performance at LBDA. With a mean of 4.18 provides a strong indication of use of machines in the production process influenced the supply chain performance at the firm. These findings concurred with (Beauregard *et al.*, 2008) that in make to order production; the system only produces what is required at upstream stages in the supply chain in reaction to customer demand signals in the downstream stages. It also agrees with finds of Weru, (2015) that lean systems ensured reduced costs, better quality products and increased production. It ensures firms leveled customer demand by capacity and variety, while maintaining production level as constant.

4.4.2: Kanban pull system

The study sought to establish the role of Kanban pull system on the performance of supply chain in manufacturing sector.

Table 3: Percentages distribution of respondents' perception on Kanban pull system

Kanban pull system	Strongly disagree	Disagree	Moderate agree	Agree	Strongly agree	Mean
The application of production kanbans	6.1%	30.6%	42.9%	8.2%	12.2%	2.90
The use of withdrawal kanbans	18.4%	12.2%	18.4%	30.6%	20.4%	3.22
The use of visual display and control	6.1%	0%	30.6%	42.9%	20.4%	3.71
Application of three bin system	6.1%	0%	38.8%	36.7%	18.4%	3.61
The use of electronic Kanbans	6.1%	14.3%	14.3%	46.9%	18.4%	3.57

From table 3 on production kanban; 6.1% and 30.6% strongly disagreed and disagreed respectively of the respondents indicated that the application of production did not influence supply chain performance at LBDA. 4.29% of the respondents indicated that production kanban influenced supply chain performance at LBDA moderately, whereas 8.2% of agreed while 12.2% of the respondents strongly agreed that production kanban influenced supply chain performance at LBDA. Mean score of 2.90 suggest that production kanban influence on performance as insignificant.

On withdrawal kanban by the manufacturing firm, 18.4% of the respondents strongly disagreed and 12.2% of the respondents disagreed that the use of withdrawal kanbans influenced supply chain performance at LBDA, while 18.4% moderately agreed, 30.6% agreed and 20.4% strongly agreed that withdrawal kanban influenced supply chain performance at LBDA. A mean of 3.22 is a good indication that withdrawal kanban influenced of supply chain performance at LBDA.

When the opinion of the respondents was sought on whether visual display and control influenced on supply chain performance at the firm, 6.1% of the respondents strongly disagreed that visual display and control influenced supply chain performance at LBDA. Whereas 30.6% moderately agreed, 42.9% agreed and 20.4% strongly agreed that the use of visual display and control had an influence on supply chain performance at LBDA. Mean score of 3.71 is an indication that visual display and control influence supply chain performance.

On three-bin system by the company, 6.1% of the respondents strongly disagreed that the use of three-bin system had an influence on supply chain performance at LBDA. Whereas 38.8% moderately agreed, 36.7% agreed and 18.4%strongly agreed that the use of three-bin system influenced supply chain performance at LBDA. An arithmetic mean of 3.61 is an indication of an agreement that three-bin system had an influence supply chain performance at LBDA.

When the respondents were asked their opinion of whether the use of electronic kanban by LBDA influence performance, 6.1% and 14.3% of the respondents strongly disagreed and disagreed respectively that electronic kanban influenced supply chain performance at LBDA. Whereas 14.3%, 46.9% and 18.4% of the respondents moderately agreed, agreed and strongly agreed respectively that the electronic kanbans influenced supply chain performance at the company. An arithmetic mean 3.57 implies that there is an agreement that electronic kanbans influence supply chain performance at LBDA. These findings infer with the findings by (Volkmann et al., 2005), that a pull system occurs when a work center is allowed to produce only when it has been signaled that there is a need for more parts in a downstream (user) department. This finding supports the study by (Mungai 2014) which concluded that Kanban systems reduced cost of information processing, ensured smooth information transmission and increase production process transparency.

4.4.3 Replenishment Pull

The study sought to establish the role of Replenishment Pull on the performance of supply chain in manufacturing sector.

Table 4: Percentages distribution of respondents' perception on Replenishment Pull

Replenishment Pull	Strongly disagree	Disagree	Moderate agree	Agree	Strongly agree	Mean
Application of continuous replenishment programme system	6.1%	6.1%	46.9%	28.6%	12.2%	3.35

Constant work in progress(CONWIP)	0%	8.2%	63.3%	16.3%	12.2%	3.33
There is use of kanban cards	2.0%	18.4%	12.2%	46.9%	20.4%	3.65
Quick changeover in the production system	2.0%	12.2%	32.7%	28.6%	24.5%	3.61
Buyer supplier collaborations	2.0%	6.1%	26.5%	46.9%	18.4%	3.73

From analysis, results are presented in table 4, on influence of replenishment pull system on supply chain performance. 6.1% strongly disagreed and 6.1% disagreed that application of continuous replenishment programme had influence on supply chain performance at LBDA. While 46.9% moderately agreed, 28.6% agreed and 12.2% strongly agreed that the use of continuous replenishment programme had an influence on supply chain performance at LBDA. An arithmetic mean of 3.35 suggests that CRP had an influence on Supply chain performance at LBDA.

On constant work in progress, 8.2%of the respondents disagreed that CONWIP influenced supply chain performance at LBDA. Whereas 63.2%, 16.3% and 12.2% of the respondents moderately agreed, agreed and strongly agreed respectively that CONWIP influenced supply chain performance at LBDA. A mean of 3.33 is an indication of an agreement that CONWIP influenced supply chain performance.

When the respondents were asked their opinion of whether on the use of kanban cards and SCP at LBDA. 2.0% and 18.4% of the respondents strongly disagreed and disagreed respectively that kanban cards influenced supply chain performance at LBDA. Whereas 12.2%, 46.9% and 20.4% of the respondents moderately agreed, agreed and strongly agreed respectively that the kanban cards influenced supply chain performance at the company. An arithmetic mean 3.65 implies that there is an agreement that kanbans cards influence supply chain performance at LBDA.

On Quick changeover by the manufacturing firm, 2.0% of the respondents strongly disagreed and 12.2% of the respondents disagreed that the Quick changeover in the production system influenced supply chain performance at LBDA, while 32.7% moderately agreed, 28.6% agreed and 24.5% strongly agreed that quick change over in the system influenced supply chain performance at LBDA. A mean of 3.61 is a good indication that quick changeover influenced supply chain performance at LBDA.

When the opinion of the respondents was sought on whether Buyer supplier collaborations influence on supply chain performance at the firm, 2.0% and 6.1% of the respondents strongly disagreed and disagreed respectively that Buyer supplier collaboration influenced supply chain performance at LBDA. Whereas 26.5% moderately agreed, 42.9% agreed and 18.4% strongly agreed that buyer supplier collaborations had an influence on supply chain performance at LBDA. Mean score of

3.73 is an indication that Buyer supplier collaborations influenced supply chain performance at LBDA. The findings agree with (Carr & Duenyas, 2000), that typical method of pull control improves supply chain performance by allowing limited and constant buffers (CONWIP) between workstations, hence being a key feature of JIT production and therefore, supporting the finding by Kimani (2013). The study was on lean supply chain management in manufacturing firms in Kenya. The study established that pull controls delivers customer value by lowering lead times, eliminating waste, improving quality, and reducing the total cost of ownership.

4.4.4 Sequential pull

The study sought to ascertain the role of Sequential pull on the performance of supply chain in manufacturing sector.

Table 5: Percentages distribution of respondents' perception on sequential Pull

Sequential Pull	Strongly disagree	Disagree	Moderate agree	Agree	Strongly agree	Mean
Application of FIFO lane system	0%	24.5%	28.6%	22.4%	24.5%	3.47
Presence of buffer stock	0%	12.2%	53.1%	16.3%	18.4%	3.41
5Ss in stock control system	0%	12.2%	24.5%	44.9%	18.4%	3.69
Production in small lot sizes	0%	6.1%	55.1%	30.6%	8.2%	3.41
Close supplier network within the supply chain	0%	6.1%	14.3%	59.2%	20.4%	3.94

Table 5 above presents the analysis results on influence of sequential pull on supply chain performance. On application of FIFO lane system, 24.5% of the respondents disagreed that the use of FIFO lane had an effect on supply chain performance at LBDA. While 28.6%, 22.4% and 24.5% of the respondents moderately agreed, agreed and strongly agreed respectively that application of FIFO lane approach influenced supply chain performance at LBDA. A mean of 3.47 indicates an agreement that FIFO lane system influenced the SCP.

When the respondents were asked their opinion of whether the presence of buffer stock at the stores influence performance, 12.2% of the respondents were of the opinion that buffer stock had no influence on supply chain performance. While 53.1%, 16.3% and 18.4% of the respondents moderately agreed, agreed and strongly agreed respectively that influenced supply chain performance at LBDA. A mean of 3.41 is an indication that presence of buffer stock influenced supply chain performance at LBDA.

On 5s stock control system, 12.2% of the respondents disagreed that the application of 5s stock control system influenced supply chain performance at LBDA, while 18.4% moderately agreed, 44.9% agreed and 18.4% strongly agreed that withdrawal kanban influenced supply chain performance at LBDA. A mean of 3.69 is a good indication that 5s stock control system had an influence on supply chain performance at LBDA.

When the opinion of the respondents was sought on whether small lot size production influenced supply chain performance at the firm, 6.1% of the respondents disagreed that small lot size production influenced supply chain performance at LBDA. Whereas 30.6% moderately agreed, 42.9% agreed and 20.4% strongly agreed that the use of visual display and control had an influence on supply chain performance at LBDA. Mean score of 3.71 is an indication that small lot size production influenced supply chain performance at LBDA.

On close supplier network within the supply chain, 6.1% of the respondents disagreed that close supplier network within the supply chain had an influence on supply chain performance at LBDA. Whereas 14.3% moderately agreed, 59.2% agreed and 20.4% strongly agreed that close supplier network within the supply chain influenced supply chain performance at LBDA. An arithmetic mean of 3.94 is an indication of an agreement that close supplier network within the supply chain had an influence on supply chain performance at LBDA. These findings concurred with Abdulmalek *et al*., (2006) who indicates that firms that have adopted pull system had cut inventories and cycle time by 50% in each wave of their lean approaches. In this study, we largely follow ((Romano *et. al.*, 2009), that FIFO lane places material in the front queue which helps in avoiding overproduction and ensure quality products to the customers.

4.4.5 Supply chain performance

Respondents were asked the extent to which the company has realized business values on their supply chains as a result of pull scheduling.

Table 6: Percentages distribution of respondents' perception on benefit of adoption of pull scheduling and Supply chain performance

Supply chain performance	**Strongly disagree**	**Disagree**	**Moderate agree**	**Agree**	**Strongly agree**	**Mean**
Cost reduction	0%	18.4%	12.2%	36.7%	32.7%	3.84
Reduced wastage	0%	6.1%	30.6%	38.8%	24.5%	3.82
Reduced lead-time	0%	6.1%	18.4%	51%	24.5%	3.94
Reduced WIP	0%	6.1%	10.2%	34.7%	49%	4.27
Reduced inventory	0%	6.1%	16.3%	30.6%	46.9%	4.18
Improved product and service quality	0%	0%	14.3%	36.7%	49.0%	4.35
Reduced set up time	6.1%	10.2%	24.5%	4.1%	55.1%	3.92
Improved customer satisfaction	0%	0%	14.3%	34.7%	51%	4.37
On time delivery	0%	12.2%	8.2%	36.7%	42.9%	4.10

As shown in the table 6 above, the mean scores obtained by the respondents on the statements measuring benefits of pull scheduling and supply performance ranged from 3.82 to 4.37. The highest ranked benefit were; "improved customer satisfaction (4.37)"and "improved product and service quality (4.35)". On the other hand, the lowest ranked benefits were; "reduced wastage (3.82)" and "cost reduction (3.84)". Based on these findings, it emerged that all the statements on the scale measuring firm supply chain performance on manufacturing firms obtained mean scores above 3.00, an implication that majority of the respondents agreed.

4.5 Correlations of the Study Variables

Table 7 below illustrates the correlation matrix among the independent variables. Correlation is mostly used to discover the relationship among a combination of variables (Pallant, 2010).

Table 7: Pearson Correlation

Correlations

		Make to order production	Kanban Pull	Replenishment pull	Sequential pull	Supply chain performance
Make to order production	Pearson Correlation	1				

	Sig. (2-tailed)					
	N	49				
Kanban Pull	Pearson Correlation	.353*	1			
	Sig. (2-tailed)	.013				
	N	49	49			
Replenishment pull	Pearson Correlation	.676**	.606**	1		
	Sig. (2-tailed)	.000	.000			
	N	49	49	49		
Sequential pull	Pearson Correlation	.559**	.551**	.670**	1	
	Sig. (2-tailed)	.000	.000	.000		
	N	49	49	49	49	
Supply chain performance	Pearson Correlation	.117	.344*	.325*	.609**	1
	Sig. (2-tailed)	.042	.015	.023	.000	
	N	49	49	49	49	49

Table 7 indicated that Kanban pull and MTO have significant positive relationship as attributed by the correlation coefficient of 0.353 and p-value of 0.013. Logically Kanban systems provide the signal for MTO to start. The results shows presence of a positive and significant strong relationship between replenishment pull and MTO as proved by the p-value and the correlation coefficient (r=0.676, p=0.000). Normally replenishment ensures the storage of the specific raw materials parts and components necessary for the production. There is a strong and significant relationship between replenishment pull, Kanban pull since the p value of 0.000 is less than 0.05 level of significance, and the correlation coefficient is 0.606.

The correlation matrix table shows presence of strong and significant positive relationship between sequential and MTO (r=0.559, p=0.000). This is because sequential pull provides the actual customer demand that triggers the begging of production process. There is an evidence of significant moderate relationship between sequential pull and kanban systems as attributed by the p value and correlation coefficient (r=0.551, p=0.000). Furthermore, the results of the table show presence of a significant strong positive relationship between sequential pull and replenishment pull as proved by the Pearson correlation coefficient of 0.670 and a p-value of 0.000.

From the table, all the independent variables are positively related to supply chain performance as attested by the respective correlation coefficients: MTO (r=0.117, p=0.042), Kanban pull (r=0.344, p=0.015), replenishment pull (r=0.325, p=0.023) and sequential pull (r=0.609, p). All the relationships are rendered significant since their p values are less than 0.05. Accordingly, the ranking of the independent variables with their contribution to supply chain performance was: sequential pull contributed more to supply chain performance of LBDA (60.9%), followed by Kanban pull (34.4%), followed by replenishment pull (32.5%) and finally MTO (11.7%).

This is in agreement with the findings of Mungai (2014) where the study concluded that demand-pull strategy is positively correlated with supply chain performance because all the independent variables are positively related since their p-values are less than 0.05.

4.6 Regression Analysis Results

A multiple linear regression analysis was done to examine the relationship of the independent variables with the dependent variable. The adjusted R^2 is the coefficient of determination. This value explains how supply chain performance varied with MTO, Kanban pull, replenishment pull and sequential pull. The model summary table 8 below shows that four predictors can explain 76.3% of change in Supply chain performance namely; MTO, Kanban pull, replenishment pull and sequential pull an implication that the remaining 23.7% of the variation in supply chain performance could be accounted for by other factors not involved in this study.

Table 8: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.885[a]	.783	.763	.939

a. Predictors: (Constant), MTO, Kanban pull, replenishment pull and sequential pull

Analysis of variance (ANOVA) was done to establish the fitness of the model used. The ANOVA table shows that the F-ratio (F=8.800, *p*=.000) was statistically significant. This means that the model used was appropriate and the relationship of the variables shown could not have occurred by chance. The results were as in table 9 below.

Table 9: ANOVA

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	11.283	4	2.821	8.800	.000[b]
	Residual	14.104	44	.321		

Total	25.388	48

a. Dependent Variable: Supply chain performance

b. Predictors: (Constant), MTO, Kanban pull, replenishment pull and sequential pull

The estimated coefficients (βs) show the contribution of each independent variable to the change in the dependent variable. The coefficients table 4.10 below results show that MTO (β=.283, *p*=.039) positively and significantly affected supply chain performance at LBDA. The results also show that Kanban pull (β=.020, *p*=.045) positively and significantly affected supply chain performance at LBDA. Replenishment pull (β= 0.014, *p*=.016) and Sequential Pull (β=.609, *p*=.000) also were found to be positively and significantly affecting supply chain performance at LBDA.

Table 10: Coefficients of Determination

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	3.151	.448		7.036	.000
	MTO	.283	.133	.335	2.133	.039
1	Kanban pull	.020	.108	.027	.185	.045
	Replenishment pull	.014	.130	.020	.107	.016
	Sequential pull	.609	.127	.768	4.792	.000

a. Dependent Variable: Supply chain performance

From the multiple regression results in the table 12 above, the equation $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$ becomes:

$$Y = 3.151 + 0.283X_1 + 0.020X_2 + 0.014X_3 + 0.609X_4$$

Where:

$Y =$ Supply chain performance of manufacturing firms

$X_1 =$ Make to order production.

$X_2 =$ Kanban pull

$X_3 =$ Replenishment pull

$X_4 =$ Sequential pull

According to the regression equation established, holding all independent factors constant then Supply Chain Performance will be 3.151. From the regression equation, taking all other independent variables at zero, a unit increase in MTO will lead to a

0.283 increment in Supply Chain Performance. A unit increase in Kanban pull will lead to a 0.020 increment in Supply Chain Performance. A unit increase in replenishment pull will lead to a 0.014 increment in Supply Chain Performance and a unit increase in sequential pull will lead to a 0.609 increment in Supply Chain Performance. This insinuates sequential pull contribute more to the supply chain performance followed by the MTO.

At 5% level of significance and 95% level of confidence, MTO had a 0.039 level of significance; Kanban pull showed a 0.045 level of significant, replenishment pull showed a 0.016 level of significant and sequential pull had a 0.000 level of significant. Hence, the most significant factor is sequential pull.

5. Conclusion and Recommendations

5.1 Conclusion

From the study, the findings point that significant positive relationship existing between the components of pull scheduling techniques namely; make to order production, kanban pull, replenishment pull and sequential pull systems with supply chain performance. The study reveals that MTO approach employs a late customization system which ensure optimal inventory level hence reduced inventory holding costs. The result also revealed that kanban pull system has a direct relationship with production process and finally improving the supply chain performance at LBDA. Both electronic and card based kanbans play a significant role in triggering the beginning production process. The findings in addition revealed that sequential and replenishment pull systems contribute immensely in controlling inventory levels within the supply chain.

5.2 Recommendations

Given the role pull scheduling have on supply chain performance, it is important that manufacturing firms to view pull scheduling as a techniques for elimination of non-value adding activities and eliminate wastes. The study recommends that management of manufacturing firms in Kenya should take into account the variables considered since the findings shows that there is sufficient relationship between the predictors; make to order production, kanban pull system, sequential pull and replenishment pull and supply chain performance in manufacturing firms in Kenya.

5.3 Areas for Further Research

This study was not exhaustive by any means consequently it is recommended that another study be replicated in other sectors of the economy, such as retailing, service, and health sectors. Also the regression model summary shows that the variables considered do not explain 100% variation in the dependent variables meaning that the study had left out other important variables which should be considered in future studies.

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