Waveless Picking in Supply Chain Performance of Food and Beverages Processing Firms in Kenya

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ABSTRACT
The purpose of this study was to analyze the role of waveless picking in supply chain performance of food and beverages manufacturing firms in Kenya. The research concentrated on the 134 food and beverage manufacturers that are operating in Nairobi City County besides being registered with Kenya Association of Manufacturers. The study adopted a mixed research design with both qualitative and quantitative approaches. The target population of the study was the 134 food and beverages manufacturing firms in Nairobi County. A sampling frame of this study included a list of the 134 manufacturing companies in Nairobi County that are members of the Kenya Association of Manufacturers. The study utilized simple random sampling. A sample size of 100 was selected with the aid of Yamane 1967 formula. Both primary and secondary data was collected using a questionnaire. The questionnaire was tested pilot at 10 food and beverages manufacturing companies in Kiambu county. These pilot study questionnaires were filled out by warehouse managers. The statistical package for social sciences (SPSS) version 25 was used to analyze the data. Using content analysis, the qualitative data was analyzed. Quantitative data was analyzed using statistical methods involving descriptive and inferential data. A multiple linear regression model was applied to analyze the relationship between the variables. Analysis was also performed on the correlation. In this study, the findings were presented using tables and graphs. Data presentation made use of percentages, frequencies, means and other means of central tendencies. The study on revealed several ways to improve operational efficiency and productivity. Most enterprises have not reduced warehouse travel time, indicating potential for improvement. The study recommended reducing warehouse travel time, implementing batch picking, designating picking zones, increasing product forecasting accuracy, improving cash flow management and supply chain scheduling, accepting technology and automation, and promoting continuous learning and development.

Keywords: Warehousing, Waveless Picking, Supply Chain Performance, Food and Beverage Manufacturing Firms, Multi-order Pick, Single-piece Pick, Order Planning.

I.0 INTRODUCTION

1.1 Background of the Study
All outward transport should be scheduled in advance such that orders can be placed directly on the right lane for loading into the truck after picking up (Mukolwe & Wanyoike, 2015). Orders for order picking per wave in the WMS were issued during the day. A series of orders with identical departure times was such a wave. For each wave, the WMS made detailed calculations to bring together efficient picking tasks (Nyakiongana, 2018). In the meanwhile, response times were reduced to deliver the following day or even the same day. In the same day, incoming orders have to be selected. This makes it far too static to function per wave. Orders for order pickers become instantly available with waveless picking (Yang, Zhao & Shen, 2020). The WMS can no longer measure anything in advance, as the order set is continuously changing. Alternatively, the WMS has intelligence that takes the current situation into account and assembles last-minute operator selection tasks (Muiruri & Mwangangi, 2019). In the next wave, an immediate order no longer needs to wait. This helps warehouses to react quicker.

Providers of logistics services including retailers have adopted automated order picking in various warehouses by introducing pick-to-cart, pick-to-light, voice picking and other innovations to retain a
competitive edge (Kiriba & Ishmail, 2017). However, considering the effectiveness of these ICT solutions, the reorganization of main logistics processes can also achieve considerably higher productivity gains. Many factors depend on the optimal order picking process, such as the product selection, peak period volumes, capital, warehouse size, number of customer orders and the desired delivery times (Yimenu, Nigussie & Workineh, 2021). Any capital expenditure in an automation solution will not yield optimum performance without an analysis of these variables and the identification of the main logistics bottlenecks.

It is also necessary to decide the method of order picking and the underlying technologies can have the most advantages for single or multi-order picking, or pick-to-cart, pick-to-light, pick-by-voice, or other choices (Boysen, Briskorn, Fedtke & Schmickerath, 2019). A further differentiation is between single- and multi-order picking with static order picking. Since most orders have such a large number of SKUs, transit times between the goods are always short as well as the best solution is possibly single-order picking (Rieder & Verbeet, 2020). However, if for each order there is only a small number of objects, then multi-order picking will generate substantial time-savings. It may also be appropriate to select multiple orders for customers or for a particular carrier, which is called wave picking, within a given time window (Njuguna & Ndolo, 2021). It is possible to divide broad distribution centers into zones from which workers pick orders based on zone-specific SKUs.

1.2 Objective of the Study
The general objective of the study was to assess role of Waveless picking on supply chain performance of food and beverages processing firms in Kenya.

1.3 Hypothesis of the Study:
H0: Waveless picking has no significant role in supply chain performance of food and beverages processing firms in Kenya.

2.0 LITERATURE REVIEW

2.1 Theoretical Framework
This study utilized the following theory

2.1 Systems Theory
The theory of systems is an interdisciplinary study of processes (Mele, Pels & Polese, 2010). A system can be identified as an object that is a coherent whole (Ng, Maull & Yip, 2009) in such a way that a boundary around it is interpreted in order to distinguish internal and external components and to classify the input and output of the entity. A theory of systems is a theoretical viewpoint that analyzes a phenomenon seen as a whole and not just the sum of elementary components. In order to understand the organization, functioning and effects of an individual, the emphasis is on the interactions and the relationships between parts. A distinctive feature of system theories is that they have evolved concurrently through multiple disciplines and that researchers working from a system theory perspective draw on the expertise and concepts developed in many other fields (Mele & Polese, 2010).

The theory of the system argues that each system should be seen as consisting of many components that make the entire system functional, and each system should be seen in relation to the other systems that may cause a shift or reaction within the main system (Wilkinson, 2012). We have many kinds of systems viewpoints today, but this analysis will concentrate primarily on the management system. Stichweh (2011), claimed that each system is constrained by space as well as time, shaped by its ecosystem, defined and expressed by its functioning by its structure and purpose. As it demonstrates synergy or emergent behaviour, a system can be more than the sum of its parts. Changing one part of a transport management system can affect other components or the entire system (Edwards, 2011). These changes in patterns of behaviours may be possible to predict.

The advancement and the level of adaptation rely on how well the system is involved with its environment in systems that learn and adapt (Çeven & Gue, 2017). Some systems endorse other systems, while retaining the other system in order to avoid failure to streamline processes and transport products (Valentinov, 2014). The aims of the theory of systems in transport management are to model the dynamics, constraints, conditions of a system and to clarify concepts such as intention, calculation, methods and tools that can be applied to other systems at all levels of organization and in a wide range of areas to achieve optimized equivalence.
Orders are picked from the warehouse, and there are two main methods: single order picking and batch picking (Luhmann, Baecker, & Gilgen, 2013). Systems theory is based on the generalization that everything is interrelated and interdependent. Systems theory in warehouse picking shows the way the warehouse is organized. A warehousing system consists of interacting warehouse layout and design to allow for order picking. This can be achieved through multi-order picking, single order picking, and order planning. Waveless picking in warehousing is viewed that the alignment of these elements improves organizations and their operations. All these elements are required in conjunction with each other to sustain and improve the strategic quality management practice in order for an organization to be productive and competitive. Whenever elements in systems are aligned, likewise they help manouevres the integration of the success of the outsourcing relationships.

### 2.2 Waveless Picking and Supply Chain Performance

Order picking is the center of warehouse operations and major studies have been carried out to enhance its effectiveness (Li, Huang & Dai, 2017). An effective batching method based on the coefficient of similarity that is determined by overlapping channels between orders is proposed at the stage of order batching. Results of their (Li, Huang & Dai, 2017) study show that under different order sizes and order structures, the proposed joint optimization algorithm has potential advantages, implying that it is successful and efficient, particularly in the online retailing of fast-moving consumer goods. B2C electronic commerce's rapid growth draws public attention to the quality of warehouse operations (Li, Huang & Dai, 2017). Order picking, as the center of warehouse operations, defines warehouse operation efficiency in terms of both cost and responsiveness. In the literature, material handling operations have gained extensive attention with a strong emphasis on order-picking operations (Larco, De Koster, Roodbergen & Dul, 2017). The option of single or multi-order picking can lead to significant differences in performance (Ukachukwu & Bagherpour, 2018). For multi-order picking, the primary objective for all order pickers is typically to minimize travel distances. This is achieved by selecting all products on a single route for several orders (multi-order picking) or by picking the total sum of one particular SKU for several clients at the same time (batch picking) (Yener & Yazgan, 2019). With these two choices, all selected products must also be intelligently allocated to the correct customer orders. It is normally achieved by using control numbers or symbol codes and a different roller package or shipping packet for each order throughout order picking (Redmer, 2020). If it takes too much time to split the products after choosing or leads to mistakes, the possible efficiency improvement decreases or the reliability of delivery suffers (Emmen, 2018). Like other approaches, the productivity boost that can be obtained with multi-order picking depends on the product selection, the number of SKUs per order, the number of order pickers and the size of the warehouse, so it must always be taken into account on a case-by-case basis (Atan, Marandi, Botman & van de Ven, 2020). It is also not worthwhile to introduce multi-order picking for several small, individual orders due to the planned delivery period, e.g., same-day delivery, for example (Chockalingam, Atan & Marandi, 2019). The order streams of logistics service providers including retailers with larger warehouses and thousands of order pickers, nevertheless, are large enough that a multi-order picking investment can typically be recovered within a short period of time (Mohamed, 2019). If the current ERP and WMS system (Karim, Rahman & Shah, 2018) has the capacity to help multi-order picking is an important consideration to take in this regard. If the pre-existing systems do not have the ability, an additional business logic layer for measuring the quantities and changing the voice dialog would also need to be added. Single piece picking is a form of order picking in which the individual pieces of an order are selected and then put in a container or carton before being shipped to the customers (Kariuki, 2014). Order picking is a labor-intensive operation requiring up to 55 percent of the overall operating costs of a warehouse or fulfillment center (Van Gils, Ramaekers, Caris & de Koster, 2018). So, it is important to select the correct method of choosing. The picker selects one order at a time in this process by visiting each aisle until the picking is complete for the order (Musau, 2018). As each aisle needs to be visited by the picker to satisfy a single order, this is a time-consuming strategy. In warehouses that handle a limited number of orders or orders with smaller amounts, single order picking is best used in (Jepherson, Ngugi & Moronge, 2021). Piece selection is more difficult and labor intensive since more handling, totes or cartons, pick faces, order faces and more work are involved (Uludag, 2014). As such, it is important for organizational productivity to streamline piece picking. Stock is placed in fixed places on static shelving or pallet rack in the simplest
order-picking process (Lu, McFarlane, Giannikas & Zhang, 2016). Following a route up and down each aisle, an order picker selects one order at a time before the entire order is selected. Any kind of picking cart will normally be used by the order picker. The picking flow architecture should be such that the order picker finishes reasonably close to the initial starting point (Otto, Boysen, Scholl, & Walter, 2017). The selection document should have the choices sorted in the same order as the selection flow.

In small operations, order-picking systems can be very simple systems or become very complicated systems using a little bit of everything (Boysen, de Koster & Weidingen, 2019). For their medium moving piece-pick goods, totes may start as a batch pick in a carousel picking area in a large process, and then move individually to a manual picking area for slow moving small-parts piece picking out of static shelving (Hanson, Medbo & Johansson, 2018). In order to allow short cuts, fast-moving goods should be stored close to the main cross aisle and additional cross aisles should be put in. Toward the end of the pick flow, larger bulkier goods will be processed (Boysen, Füßler & Stephan, 2020). With a limited total number of orders and a high number of picks per order, this simple order picking method can work well in operations. In this method of picking, activities with low picks per order will find the travel time excessive and operations with great numbers of orders will consider that the competition from many pickers operating in the same areas slows down the sorting (Vanderroost, Ragaert, Verwaeren, De Meulenaer, De Baets & Devlieghere, 2017).

Because the order picking process entails significant costs and can impact levels of customer satisfaction, a growing number of changes have been proposed to assist businesses with this supply chain problem (Babik & Bertilsson, 2020). Selecting an order picking system depends on a variety of criteria, including cost, sophistication, complexity, customer order volume, as well as item size but also order size (Chabot, Lahyani, Coelho & Renaud, 2017). Every company has specific requirements, and one solution for order picking can fit one company and not another. In several warehouses, the picker-to-part method is widely used (Ogesi, 2020). A storage area, a picking area, and a material handling device that refills the picking positions from the storage area are included in the process. That handling system, like gravity flow racks, can be forklift-based or more advanced.

This same picking operators get the goods from the picking area to satisfy each customer's order. As the items are in a smaller area than the general storage area in the standard warehouse, the order can be met more effectively by the picking operators (Gajšek & Herzog, 2020). In picker-to-part methods, including pick-to-light including voice picking systems, there are a range of technical advances. By shining a light on it, pick-to-light systems warn the picking operators of which product to pick. Voice picking systems let operators understand which things to choose through headsets (Gupta & Jones, 2014). The system of part-to-picker uses the same elements as the method of picker-to-part: the storage area, the picking area and the system of material handling. The difference is that a set of picking bays make up the picking area for this technique (Fang & An, 2020). Products are transferred and shipped to the picking bays from the storage room. The products for one or more orders are obtained from each bay. After they are shipped to their bay, the picking worker then collects the goods and fulfills customer orders.

2.3 Conceptual Framework

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Supply Chain Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waveless Picking</td>
<td></td>
</tr>
</tbody>
</table>

3.0 RESEARCH METHODOLOGY

The study adopted a mixed research design with both qualitative and quantitative approaches. The target population of the study was the 134 food and beverages manufacturing firms in Nairobi County. A sampling frame of this study included a list of the 134 manufacturing companies in Nairobi County that are members of the Kenya Association of Manufacturers. The study utilized simple random sampling. A sample size of 100 was selected with the aid of Yamane 1967 formula. Both primary and secondary data was collected using a questionnaire. The questionnaire was tested pilot at 10 food and beverages manufacturing companies in Kiambu county. These pilot study questionnaires were filled out by warehouse managers. The statistical package for social sciences (SPSS) version 25 was used to analyze the data. Using content analysis, the
The study aimed to determine the role of waveless picking in supply chain performance of food and beverages processing firms in Kenya. The following aspects were used to evaluate the goal: multi-order pick, single-piece pick, and order planning. The 5-point Likert scale (5= [SA] Strongly Agree, 4= [A] Agree, 3= [N] Neutral, 2= [D] Disagree, and 1= [SD] Strongly Disagree) was used to gauge the degree to which study participants agreed with the statements regarding the role of waveless picking in supply chain performance of food and beverages processing firms in Kenya. The research used mean average and standard deviations, as shown in table 1, to convey the main results of waveless picking in food and beverage production firms.

Majority of the food and beverages processing firms in Kenya had not reduced travel time on the warehouse floor of their respective firms as shown by a mean of 2.4692 and a standard deviation of 1.00085. It is evident that a significant portion of the respondents Disagreed with the statement based on the five-point scale Likert mean score of less than 3.4 as well as an average standard deviation. Also, majority of the food and beverages processing firms in Kenya fulfilled large batches of items at a time as revealed by a mean of 3.4769 and a standard deviation of 1.12774. It is evident that a significant portion of the respondents agreed with the assertion based on the five-point scale Likert mean score of greater than 3.4 as well as an average standard deviation.

Additionally, majority of the food and beverages processing firms in Kenya’s pickers have mastered the layout of the entire warehouse as indicated by a mean of 3.5846 and a standard deviation of 1.31461. It is evident that a significant portion of the respondents agreed with the assertion based on the five-point scale Likert mean score of more than 3.4 as well as an average standard deviation. Further, majority of the food and beverages processing firms in Kenya had created picking zones to reduce travel time and increase productivity as shown by a mean of 3.9780 and a standard deviation of 1.16407. It is evident that a significant portion of the respondents agreed with the assertion based on the five-point scale Likert mean score of greater than 3.4 as well as an average standard deviation.

In addition, majority of the food and beverages processing firms in Kenya increased picks per order than number of orders as shown by a mean of 3.6549 and a standard deviation of 0.97025. It is evident that a significant portion of the respondents agreed with the assertion based on the five-point scale Likert mean score of greater than 3.4 as well as an average standard deviation. Moreover, majority of the food and beverages processing firms in Kenya placed high-velocity SKUs in highly accessible locations as indicated by a mean of 3.5275 and a standard deviation of 1.27663. It is evident that a significant portion of the respondents agreed with the assertion based on the five-point scale Likert mean score of more than 3.4 as well as an average standard deviation.

Also, in majority of the food and beverages processing firms in Kenya did not improve product forecasting in plan production needs as shown by a mean of 2.5022 and a standard deviation of 0.95708. It is evident that a significant portion of the respondents agreed with the assertion based on the five-point scale Likert mean score of more than 3.4 as well as an average standard deviation. Besides, majority of the food and beverages processing firms in Kenya improved supply chain scheduling as revealed by a mean of 3.7549 and a standard deviation of 1.15818. It is evident that a significant portion of the respondents agreed with the assertion based on the five-point scale Likert mean score of less than 3.4 as well as an average standard deviation. Generally, selecting an order picking system depends on a variety of criteria, including cost, sophistication, complexity, customer order volume, as well as item size but also order size (Chabot, Lahyani, Coelho & Renaud, 2017). Every company has specific requirements, and one solution for order picking can fit one company and not another.
Managers of warehouses must be well-versed in both the staffing needs for continuous uninterrupted picking along with the inventory as well as order management systems for utilization in order to adopt waveless picking. Additionally, they must make sure that the warehouse is set up with the goods placed in readily accessible areas to enable expedient picking and order fulfillment. Consequently, waveless picking is an extremely efficient approach for boosting the speed and accuracy of order fulfillment in warehousing operations.

Table 1: Descriptive Findings of Waveless Picking

<table>
<thead>
<tr>
<th>Statements</th>
<th>Mean</th>
<th>Std. Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our firm has reduced travel time on the warehouse floor of our firm.</td>
<td>2.4692</td>
<td>1.00085</td>
</tr>
<tr>
<td>Our firm fulfils large batches of items at a time.</td>
<td>3.4769</td>
<td>1.12774</td>
</tr>
<tr>
<td>Our firm’s pickers have mastered the layout of the entire warehouse.</td>
<td>3.5846</td>
<td>1.31461</td>
</tr>
<tr>
<td>Our firm has created picking zones to reduce travel time and increase productivity.</td>
<td>3.9780</td>
<td>1.16407</td>
</tr>
<tr>
<td>Our firm has increased picks per order than number of orders.</td>
<td>3.6549</td>
<td>.97025</td>
</tr>
<tr>
<td>Our firm has placed high-velocity SKUs in highly accessible locations.</td>
<td>3.5275</td>
<td>1.27663</td>
</tr>
<tr>
<td>Our firm has improved product forecasting in plan production needs.</td>
<td>2.5022</td>
<td>.95708</td>
</tr>
<tr>
<td>Our firm has improved supply chain scheduling.</td>
<td>3.7549</td>
<td>1.15818</td>
</tr>
<tr>
<td>Our firm has created efficient cash flow management to meet our financial needs.</td>
<td>3.5055</td>
<td>1.12915</td>
</tr>
</tbody>
</table>

The respondents of the study were asked to point out the other elements of waveless picking in their respective firms. The findings in table 2 depict that majority (23.1%) of the food and beverages processing firms in Kenya have included the element order routing, 22.0% advanced shipping notice (ASN), 18.7% storage methods, 14.3% order volumes, 14.3% order processing speed and only 7.7% have included the element of density in their waveless picking operations. The prominence of order routing (23.1%) reflects its crucial role in optimizing picking efficiency. By pre-determining the most efficient sequence for pickers to visit product locations, order routing minimizes travel time, reduces errors, and ultimately increases order fulfillment speed. This focus on optimizing the physical picking process highlights Kenyan food and beverages manufacturing firms’ commitment to streamlining warehouse operations.

The widespread adoption of ASN (22.0%) underscores the value of information visibility in waveless picking. By receiving prior notification about incoming orders, Kenyan food and beverages manufacturing firms can prepare warehouse resources, improve picking accuracy, and ensure timely dispatch. This proactive approach fosters smooth collaboration between production, warehousing, and transportation functions, contributing to overall supply chain agility. The inclusion of storage methods (18.7%) and order volumes (14.3%) indicates a recognition that waveless picking effectiveness hinges not only on routing but also on strategic product placement and managing workload fluctuations in Kenyan food and beverages manufacturing firms. Optimizing storage layouts based on product characteristics and pick frequency minimizes picker travel distances, while adapting to varying order volumes ensures efficient resource allocation and minimizes bottlenecks.

The focus on order processing speed (14.3%) emphasizes the importance of minimizing delays between order placement and picking initiation. By streamlining order processing workflows and integrating them seamlessly with waveless picking systems, Kenyan food and beverages manufacturing firms aim to reduce lead times and improve customer satisfaction. The relatively low adoption of density (7.7%) as a waveless picking element is intriguing. However, density-based picking algorithms consider product dimensions and weight, optimizing space utilization within storage units and potentially leading to more efficient picking routes and warehouse layout.

Table 2 Other Elements of Waveless picking

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Frequency</th>
<th>Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order routing</td>
<td>21</td>
<td>23.1</td>
<td>23.1</td>
</tr>
<tr>
<td>Advanced shipping notice (ASN)</td>
<td>20</td>
<td>22.0</td>
<td>45.1</td>
</tr>
<tr>
<td>Storage methods</td>
<td>17</td>
<td>18.7</td>
<td>63.7</td>
</tr>
<tr>
<td>Density</td>
<td>7</td>
<td>7.7</td>
<td>71.4</td>
</tr>
<tr>
<td>Order volume</td>
<td>13</td>
<td>14.3</td>
<td>85.7</td>
</tr>
</tbody>
</table>
Order processing speed | 13 | 14.3 | 100.0
Total | 91 | 100.0

**Correlation Analysis for Waveless Picking**

For this investigation, the Pearson Product Moment Correlation was used to determine the strength and direction of the linear relationship between the independent variable (waveless picking) and the dependent variable (supply chain performance), and the results are summarized in table 3. The study found that waveless picking had a positive, significant, linear relationship with the supply chain performance of food and beverage processing firms in Kenya, with a Pearson correlation coefficient of .625 at .01 level of significance. This implied that there was a positive correlation between waveless picking and the supply chain performance of food and beverage processing firms in Kenya. These findings mirror those of Bansal et al., (2021) who established the existence of a positive correlations between waveless picking and performance of the supply chain.

**Table 3 Correlation Analysis Between for Waveless picking and Supply Chain Performance**

<table>
<thead>
<tr>
<th>Supply Performance</th>
<th>Supply Chain Performance</th>
<th>Waveless picking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>1</td>
<td>.625**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>91</td>
<td>91</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.01 level (2-tailed).**

**Regression Analysis for Waveless picking**

The use of regression analysis seeks to determine whether a set of research factors predicts a specific dependent variable and so makes an effort to considerably improve the estimate's adequacy.

**H₀:** Waveless picking has no significant effect on supply chain performance of food and beverage processing firms in Kenya.

The OLS Model: \( Y = \beta_0 + \beta_1X_1 + \epsilon \)

The ordinary least square regression model was used. Model 1 results are shown in Table 4. Waveless picking and supply chain performance have a positive relationship (\( R = .625, R^2 = .390 \)) and \( F (1,89) = 56.975, p = .000 \), according to the findings in the table below (table 4). The findings are similar to those of Bansal et al., (2021) who established a positive linear relationship between waveless picking and performance of the supply chain. The independent variables can explain the variations in the dependent variable using the \( R^2 \). Waveless picking can account for 39.0 percent of the variability in supply chain performance of food and beverage processing firms in Kenya, according to an \( R^2 \) of .390.

**Table 4 Model Summary for Waveless picking**

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>Change Statistics</th>
<th>R Square Change</th>
<th>F Change</th>
<th>df1</th>
<th>df2</th>
<th>Sig. Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.625*</td>
<td>.390</td>
<td>.383</td>
<td>.70306</td>
<td></td>
<td>.390</td>
<td>56.975</td>
<td>1</td>
<td>89</td>
<td>.000</td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), Waveless picking

**ANOVA for Waveless picking**

The results in table 5 showed that the F-ratio was 56.975, with a P value of .000 being less than .05 in model 1. This indicates that the regression model used in the investigation has a high degree of goodness of fit. This suggests that the independent variable (waveless picking) in the model is unlikely to be due to chance and do indeed explain a significant portion of the variance in the dependent variable (supply chain performance).
Table 5 ANOVA* for Waveless picking

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regression</td>
<td>28.162</td>
<td>1</td>
<td>28.162</td>
<td>56.975</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>43.992</td>
<td>89</td>
<td>.494</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>72.154</td>
<td>90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Dependent Variable: Supply Chain Performance
b. Predictors: (Constant), Waveless picking

Test of Significance for Waveless picking
Table 6 shows the significance of test results for waveless picking and supply chain performance. The results of Model 1 revealed a positive and significant relationship between waveless picking and supply chain performance (b1 = .086, p = .000, β = .625). Supply chain performance is anticipated to grow by .094 for every unit increase in waveless picking. The results of this study align with the research conducted by Bansal, Roy, and Pazour (2021), which demonstrated that the implementation of waveless picking led to a notable increase in picker efficiency as well as consumer satisfaction.

The OLS Model: Supply Chain Performance = 2.691 + .086WP …………. Equation 5

Table 6 Coefficients* for Waveless picking

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>2.691</td>
<td>.161</td>
<td>16.734</td>
</tr>
<tr>
<td>Waveless picking</td>
<td>.086</td>
<td>.011</td>
<td>.625</td>
<td>7.548</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Supply Chain Performance

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary
The study established that majority of food and beverage processing firms in Kenya have not reduced travel time on their warehouse floor, fulfilled large batches of items at a time, and created picking zones to reduce travel time and increase productivity. They also increased picks per order, placed high-velocity SKUs in highly accessible locations, and did not improve product forecasting in plan production needs. Additionally, most firms have improved supply chain scheduling, and created efficient cash flow management to meet financial needs.

5.2 Conclusion
The study on warehouse waveless picking in Kenya's food and beverage production sector reveals several ways to improve operational efficiency and productivity. Most enterprises have not reduced warehouse travel time, indicating potential for improvement. Batch picking can increase picking time, and designing zones can save travel time. Strategically grouping merchandise and developing picking areas can speed up picking. Product forecasting accuracy should be enhanced to reduce stockouts and optimize production schedules. Supply chain scheduling and cash flow management have also been improved, demonstrating a proactive approach to operational efficiency and supply chain flow.

5.4 Recommendations
The study suggests several recommendations to improve operational efficiency and productivity in Kenya's food and beverage production industry. These include reducing warehouse travel time, implementing batch picking, designating picking zones, increasing product forecasting accuracy, improving cash flow management and supply chain scheduling, accepting technology and automation, and promoting continuous learning and development. By optimizing warehouse layout, implementing batch picking, designating picking zones, and investing in advanced forecasting techniques, businesses can reduce stockouts and improve production schedules. Additionally, implementing warehouse management systems (WMS) and automation technologies can improve order fulfillment, inventory management, and tracking. Regular
training sessions and fostering a culture of continuous improvement can lead to enhanced customer service, fewer stockouts, more efficient processing schedules, and increased industry competition.

REFERENCES


