USING DMAIC TO IMPROVE AN IN-STORE DELIVERY SERVICE

Kittima Limsirivallop*
Assumption University of Thailand

Scott S. Roach
Stamford University

Vilasinee Srisarkun
Assumption University of Thailand

ABSTRACT

The objectives of this research were to identify problems, find solutions and implement actions to improve the delayed in-store delivery service process that was causing delay to customers at the AAA Company.

This research applied the DMAIC (Define-Measure-Analyze-Improve-Control) model to improve the in-store delivery service within the firm's staff pick area. The service delays affected customer satisfaction. DMAIC helped the researcher to define the service problems, measure the current service performance, and analyze the root causes. The researcher also suggested an improvement plan with recommendations in order to achieve sustainable procedures to improve the company's operations.

The result of the improvement plan has shown significant improvement in the in-store delivery service serving time. The time required for picking had been cut; therefore, customers' waiting time was reduced. The company needs to continue the improved process and also develops its own processes to cope with future changes. This is to ensure a sustained improvement carried out with practical monitoring to prevent problems from occurring.

บทคัดย่อ

จุดประสงค์ของการวิจัยนี้เพื่อที่จะระบุปัญหา ค้นหาวิธีการแก้ปัญหา และนำวิธีการแก้ปัญหาไปปฏิบัติจริง เพื่อที่จะปรับปรุงและแก้ไขกระบวนการของการบริการการจัดส่งภายในร้านค้าแก่ลูกค้าซึ่งเป็นสาเหตุหลัก

*This is a much condensed version of Ms. Kittima's MSc research report in part fulfillment of the requirements for the MSc degree in Supply Chain Management at Assumption University. Her email is: ping_32@hotmail.com

ที่ทำให้สินค้าไปถึงลูกค้าล่าช้า คำแนะนำ วิธีการแก้ไข และ วิธีการป้องกันนั้นถูกจัดเตรียมไว้ให้เพื่อป้องกันการเกิดซ้ำของปัญหาเดิม

การวิจัยนี้ได้นำกระบวนการบริหารคุณภาพ DMAIC Model ประกอบด้วย Define–Measure–Analyze–Improve–Control เพื่อที่จะปรับปรุงคุณภาพของการบริการจัดส่งภายในร้านค้า ความล่าช้าในการบริการนั้นมีผลกระทบต่อระดับความพึงพอใจของลูกค้า กระบวนการบริหารคุณภาพ DMAIC ช่วยผู้ค้นคว้าในการเข้าถึงปัญหาที่ก่อให้เกิดความล่าช้าของบริการ ตรวจสอบคุณภาพในการบริการปัจจุบัน วิเคราะห์ต้นตอของปัญหาที่ก่อให้เกิดความล่าช้าของบริการ ผู้วิจัยยังชี้ให้เห็นถึงแผนการปรับปรุง พร้อมคำแนะนำ เพื่อให้บรรลุเป้าหมายในการแก้ปัญหาและทำงานตามขั้นตอนอย่างมีประสิทธิภาพและยั่งยืน

ผลลัพธ์ในการปรับปรุงนั้นทำให้เห็นว่า ระยะเวลาในการบริการจัดส่งสินค้าภายในนั้นได้รับการปรับปรุงแก้ไข ระยะเวลาที่พนักงานใช้นั้นลดลงอย่างเห็นได้ชัด ระยะเวลาที่พนักงานใช้นั้นลดลง หมายถึงว่าระยะเวลาที่ลูกค้ารอนั้นลดลงด้วยเช่นกัน อย่างไรก็ตามบริษัทนั้นต้องมีการศึกษาและพัฒนาอย่างต่อเนื่องเพื่อที่จะตอบสนองต่อการเปลี่ยนแปลงที่ไม่สามารถคาดเดาได้ในอนาคต ทั้งนี้ทางบริษัทจะต้องมีการพัฒนากระบวนการจัดส่งสินค้าภายในอย่างยั่งยืน มีการตรวจสอบกระบวนการทำงานอย่างสม่ำเสมอเพื่อป้องกันการกลับมาของปัญหาที่เคยเกิดขึ้น

INTRODUCTION

Order picking is an activity through which warehouse employees, referred to as pickers, retrieve goods from a storage area according to purchase orders so as to satisfy customers. It is usually the penultimate or last activity before the goods are handed over to the customers. Order picking is a very labor intensive activity and accounts for 55% of the total warehouse operation cost (Koster, Le-Duc, & Roodbergen, 2007). An inefficient picking process may cause bad customer experiences as well as resulting in higher operating costs. The faster the goods are picked, the greater the chance to satisfy customers. Order picking is the most labor- intensive task compared to other warehouse activities since it needs to be conducted manually. Therefore, warehousing professionals have determined that order picking should receive the highest priority for productivity improvement (Koster et al., 2007). Improvements in factors influencing order picking productivity and efficiency such as travelling time, item pick time and other activities will provide potential for reducing costs and improving customer satisfaction (Dukic, Cesnik, & Optetuk, 2010).

As order picking is so costly, it is crucial to analyze a company's order picking costs and the labor time spent on this activity. This analysis is not only needed to reduce costs but also to improve order picking productivity, efficiency and most importantly provide increased customer satisfaction. There are several factors influencing order picking productivity and efficiency, including operating policies, product demand, warehouse layout, racking systems and equipment (Dekker, Koster, Roodbergen, & Kalleveen, 2004).

The focus firm in this research study is AAA Company (a pseudonym for confidentiality). It is one of the world's leading companies operating in the furniture industry with more than 361 stores operating worldwide. The company has been operating in Thailand approximately five years and employs over 400 employees, supplying many different types of furniture and home may purchase both furniture and home decoration products under one roof. Currently, the company offers more than 8,000 Stock Keeping Units (SKUs) (AAA Company data, 2015).

Customers select the items that they want, record the location code from the label on the products. The company has divided its warehouse storage into two areas: the customer pick area and the staff pick area. Products in the self-pick and staff-pick areas are classified according to: the value of the product, dimensions, weight, high fragility, sales frequency, and whether it is a combination product (must purchase more than two items to complete the product i.e. kitchen products). Self-picked items are lighter, inexpensive, simple combinations, and have greater sales frequency and less damage potential.

For those items stored in the staff pick area, the staff picking process (referred to hereafter as the in-store delivery service) begins once the customer makes a payment to the cashier, at which time a purchase order is issued. The system automatically generates a pick list which is immediately printed at the staff pick station. Once the staff picker receives the purchase order, the staff record the start time. This starts the actual picking process.

A recent company survey showed that a majority of customers surveyed were not satisfied with the in-store delivery service at the goods handling area. This result was caused by a long waiting time due to the length of time required for products to be picked in the staff pick area. The survey results revealed that a significant improvement in customer waiting time was urgently required, as shown in Table 1.

Table 1: Customer Surveys Results on Satisfaction Levels after Using the In-Store Delivery Service at the Staff Pick Area

Year	Satisfied Customers	Dissatisfied Customers	Goal
2012	24%	76%	40%
2013	26%	74%	46%
2014	42%	58%	46%

Source: Adapted from Company's data

This research was designed to improve the in-store delivery service to reduce customer waiting time. It focuses on "What are the root causes of delays in the in-store delivery service at AAA Company and how can the time used to provide this service to customers be reduced?"

LITERATURE REVIEW

This chapter presents a literature review relating to this study, which enhances knowledge and the understanding of warehousing operation and strategy. This research uses a process improvement methodology called "DMAIC" to identify the root causes of slow picking and improve the operational procedure of AAA Company. DMAIC is a five step methodology which allows the researcher to Define, Measure, Analyze, Improve and Control the processes. This technique employs a number of tools to improve operational procedure. The literature review concludes by exploring each stage of the DMAIC process and their tools

Order Picking

Order picking is the activity of retrieving products from storage locations in response to customers order requests (Dukic et al., 2010). The activity is mainly to fulfill customer orders but it is a very important step in the overall process since it affects customer satisfaction levels and whether customers will return for future purchases (Manning, 2008). The main objectives in improving the order picking process are to minimize travel time and travel distance (Wutthisirisart, 2010). Tompkins (2003) has classified the various time components spent by a picker in performing one order picking. According to Tompkin's research, a pick breaks down as: 50% for travel time, 20% searching time, 15% for actual product picking, 10% for set up, and 5% for "other". This implies that reducing travel time can significantly reduce customer order response time. Therefore, this paper focused primarily on strategies and policies related to travel time and distance.

DMAIC

According to Prashar (2013); Mehrjerdi (2011), the DMAIC process improvement method and tools help to analyze and improve existing business processes. This can result in cost reduction, elimination of defects, improved customer satisfaction, improved cycle time, increased profitability, improvements in on-time delivery, logistics improvement, sales forecasting ability and improved quality of customer service. The methodology is not only used in manufacturing but also in services and in retail businesses (Kumar, Strandlund, & Thomas, 2008). The five components of DMAIC are now described.

Define

Antony, Bhuller, Kumar, Mindibil, and Montgomery (2012) stated that this phase is used to define the goals, scope, and business process requirements. It uses customer data and feedback to determine problems. Using DMAIC methodology can help the researcher to identify the root causes encountered when the researcher asks targeted questions. For example:

- What areas of performance cause customers to be dissatisfied with the company?
- What are the measurements used to monitor performance?
- Is data available and easy to obtain?
- Does customer waiting time really affect customer satisfaction level?

Measure

This phase uses collected data to map the current process and capture how the process is measured (Measure Phase, n.d., para 1). Information must be studied and fully understood to determine not only how the processes work but how well they perform (Wiesenfelder, 2011).

Analyze

The objective of the Analyze phase is to identify potential root causes. This step is also used to identify and isolate the major causes for which improvements will be formulated. The step is used to help resolve the root causes by analyzing the problems using the data that has been collected in prior phases (Wiesenfelder, 2011). During this stage, the researcher is able to analyze the collected information and identify potential and actual root causes of the problems. The conclusions reached during this phase are used during the next step, Improve, to find possible solutions to eliminate or mitigate and develop preventive processes so that the same problems do not recur.

Improve

The main objectives of this phase are to propose solutions to identified root causes, to evaluate the proposed solutions, to select the best solutions and to implement them (Cheshmberah & Nabavi, 2014). Beady (2005) and Pande, Neuman, & Cavanagh (2002) recommend that "Thinking outside the box" will generate creative ideas and solutions and/or eliminate ideas and solutions that are not applicable. Once solutions are selected, a pilot test should be conducted to observe how well each works, what works well and what needs modifications to improve the efficiency and effectiveness (Beady, 2005). During the pilot test, more data is collected as additional information to support the full implementation.

Control

The objective of DMAIC is not only to eliminate the weaknesses and the improve process but also to control the process so that it continues running well in the long term (Mishra & Sharma, 2014). The major aim of the Control phase is to standardize, monitor and integrate changes after implementation (Antony et al., 2012).

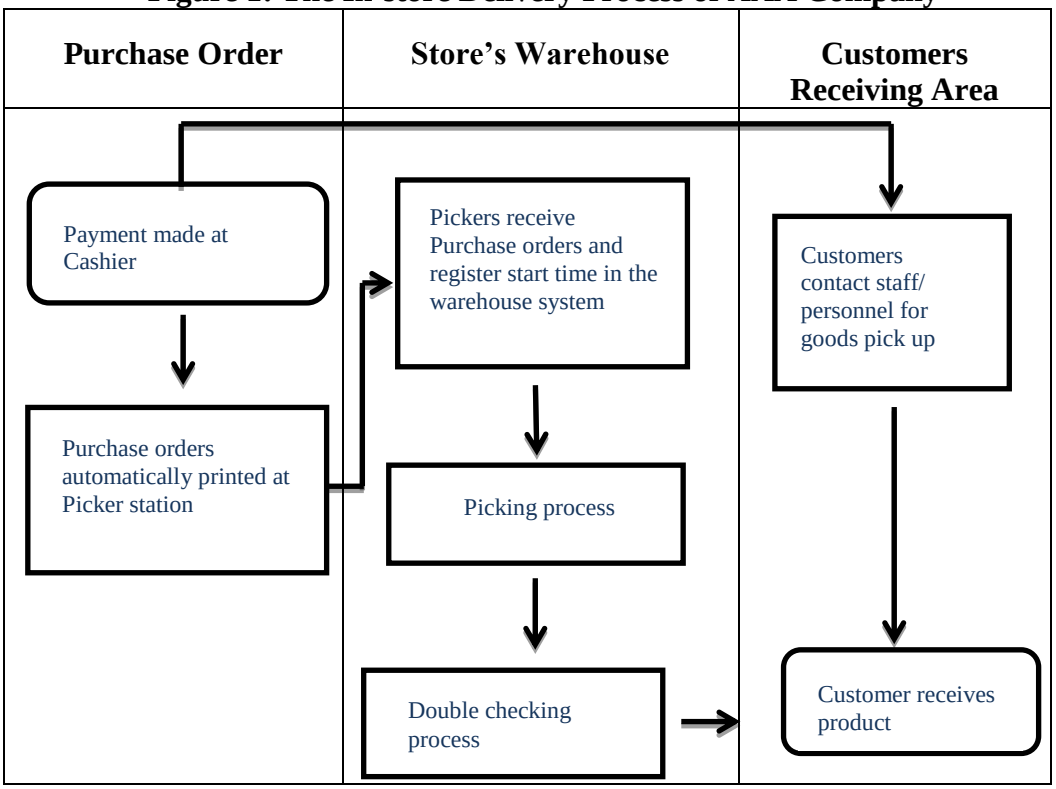
DMAIC is a tool that allows a company to Define and learn its current process, Measure performances of the process, Analyze strengths, weaknesses, opportunities and threats of the process to identify the root causes. It is important to Improve the current process by implementing the newly invented or modified process and exercise Control to ensure the sustainability of the process. However, there is no one-size-fits-all solution with DMAIC. Therefore, companies must find the most suitable solutions and tools to fix their problems.

RESEARCH METHODOLOGY

This section focuses on the use of tools and methodology of DMAIC, consisting of Interviewing, Observation, Cause-and-Effect Analysis, Pareto Chart Analysis, Nominal Group Technique, and Brainstorming. All these tools were used to identify the problems, areas for improvement and solutions to improve the in-store delivery process. The in-store delivery process that was captured by observation is shown in Figure 1.

Tables 2 and 3 provide data that was recorded when pickers received those pick lists which included combination products. The number of items picked was 50 items and the KPI indicates that products should be handed to customers within 56 minutes.

Figure 1: The In-store Delivery Process of AAA Company



Source: Author

Table 2: Time of In-Store Delivery Service (During Weekdays)

Step	#	Activity	Senior picker		Junior picker			
			#1	#2	#1	#2	#3	#4
1.		Picker receives pick list	5 minutes	2 minutes	3 minutes	5 minutes	4 minutes	5 minutes
2.		Picking process	47 minutes	50 minutes	55 minutes	56 minutes	55 minutes	56 minutes
	2.1	Pick up trolley						
	2.3	Pick up goods						
	2.4	Double checking	9 minutes	8 minutes	8 minutes	9 minutes	8 minutes	10 minutes
	2.4.1	If correct, proceed to 3						
	2.4.2	If incorrect, calls pickers and return to 2.3 then 2.4 (On average)	5 minutes	5 minutes	5 minutes	5 minutes	5 minutes	5 minutes
3.		Customers receive products	66 minutes	65 minutes	71 minutes	75 minutes	72 minutes	76 minutes
Average time used			65.5 minutes		73.5 minutes			

Source: Author

Table 3: Time of In-Store Delivery Service (During Weekends)

Step	#	Activity	Senior picker		Junior picker			
			#1	#2	#1	#2	#3	#4
1.		Picker receives pick list	6 minutes	5 minutes	4 minutes	5 minutes	5 minutes	3 minutes
2.		Picking process	50 minutes	54 minutes	60 minutes	63 minutes	62 minutes	70 minutes
	2.1	Pick up trolley						
	2.3	Pick up goods						
	2.4	Double checking	13 minutes	12 minutes	13 minutes	12 minutes	12 minutes	11 minutes
	2.4.1	If correct, proceed to 3						
	2.4.2	If incorrect, calls pickers and return to 2.3 then 2.4 (on average)	5 minutes	5 minutes	5 minutes	5 minutes	5 minutes	5 minutes
3.		Customers receive products	74 minutes	76 minutes	82 minutes	85 minutes	84 minutes	89 minutes
Average time used			75 minutes		85 minutes			

Source: Author

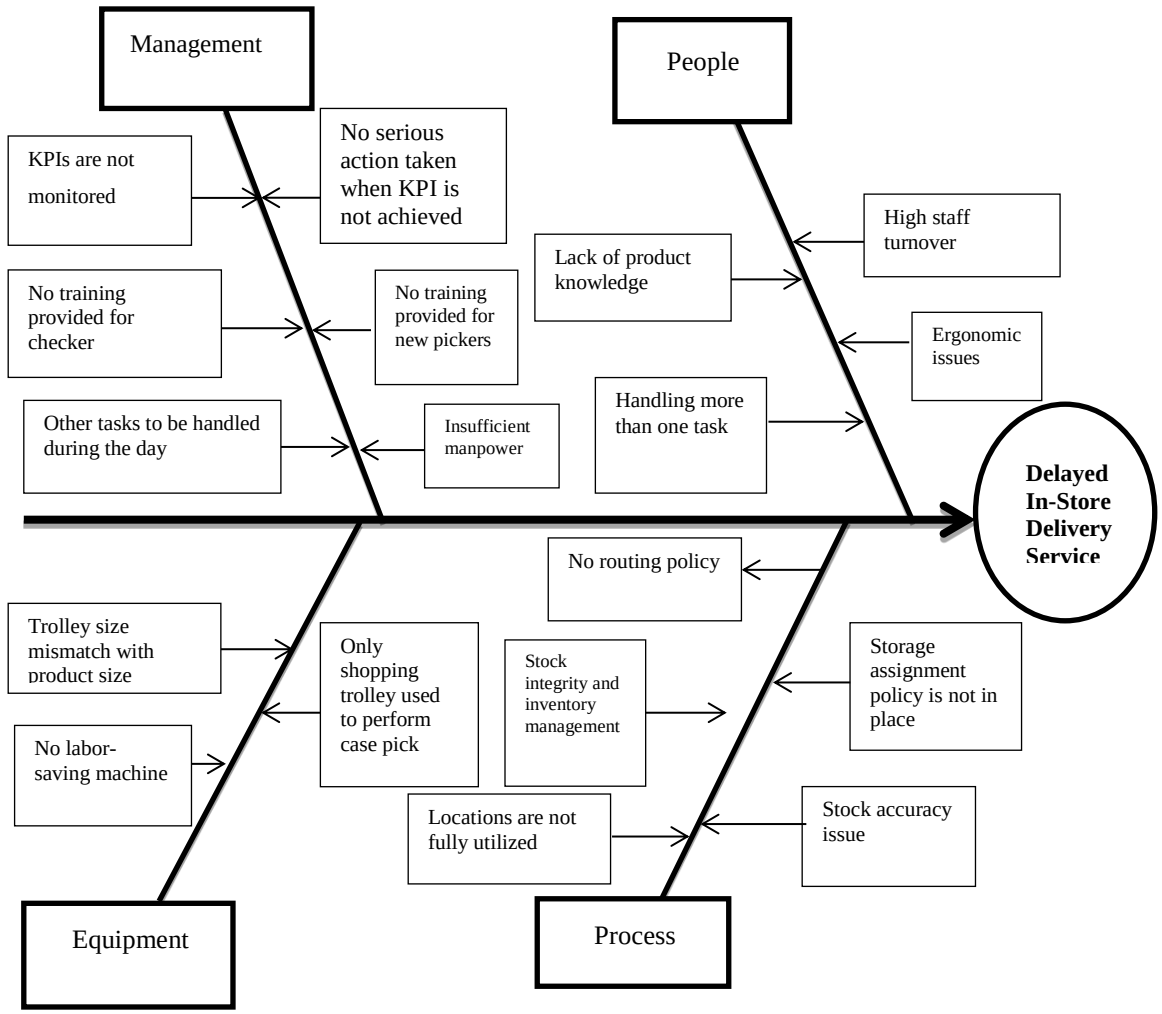
Brainstorming and Nominal Group Technique

A Brainstorming session was conducted to generate ideas and learn the opinions of both experienced and junior employees. It suggests that the session should be very open and any inappropriate assumption should be immediately eliminated (Brainstorming, n.d., para 5). The ideas and solutions expressed during the session should not be criticized, critiqued or rewared since judgements can hinder the production of creative ideas about how the problem can be solved. The researcher selected five employees who were involved in the in-store delivery process (one supervisor, two experienced pickers, one junior picker and one senior checker) to brainstorm and scrutinize each step of the in-store delivery service. The intention of this session was to identify the causes of delay in the in-store delivery service which leads to long waiting times for customers. Group discussion was not the only technique used to gather data from the participants. Individual expression was also used to encourage each participant to give ideas and opinions anonymously that may not have been offered in the group setting. This also helped to avoid the chance that one person would dominate the discussion.

Cause-and-Effect Analysis

A Cause-and-Effect Analysis (fishbone diagram) was constructed during the brainstorming session to identify the root causes of delay in the in-store delivery service. The concept behind the tool is to construct a diagram showing relationships between possible causes and an effect as its aim to encourage discussion and educate others about processes and problems (Doggett, 2005). Figure 2 shows the constructed diagram where the 'fish head' represents the effect or problem which is 'Delay in the in-store delivery service'.

Figure 2: Cause-and-Effect Analysis of In-Store Delivery Service



Source: Author

Pareto Chart Analysis

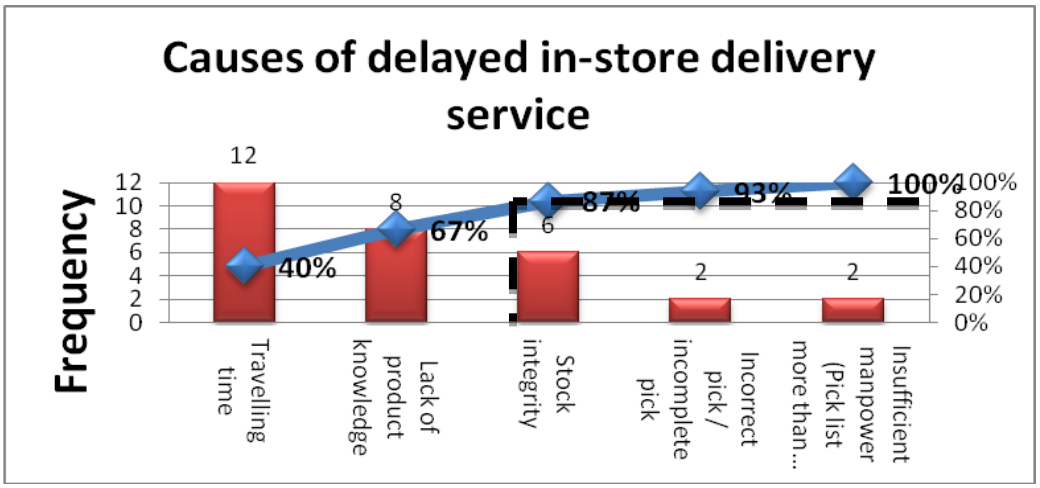
In the previous section, Cause-and-Effect Analysis was used to define the relationship between causes and their effects. It shows the frequency of effects or problems in rank order from the highest to lowest. Then the 80-20 rule is applied. The 80-20 rule states that 80% of problems encountered are the result of 20% of causes (Pareto Chart, n.d., para 2). There were a number of causes identified in that process. Therefore, a Pareto Chart Analysis was used to categorize the problems for review and help to point out the more prevalent problems, so the researcher could see to it that they are causes resulting in the most problems addressed.

Table 4: List of Causes and Frequency

Causes	Frequency
Delay in picking time caused by long travel time (Storage assignment policy)	12
Stock integrity	6
Incorrect pick / Incomplete pick	2
Pick light items before heavy items (Lack of product knowledge)	5
Unaware that two trolleys are required to pick huge items (Lack of product knowledge)	3
Insufficient manpower (Number of pick list more than expected)	2

Source: Adapted from Company data

Figure 3: Pareto Chart Analysis: Frequency of Causes of Delay



Source: Author

IMPLEMENTATION, RESULT AND IMPROVEMENT

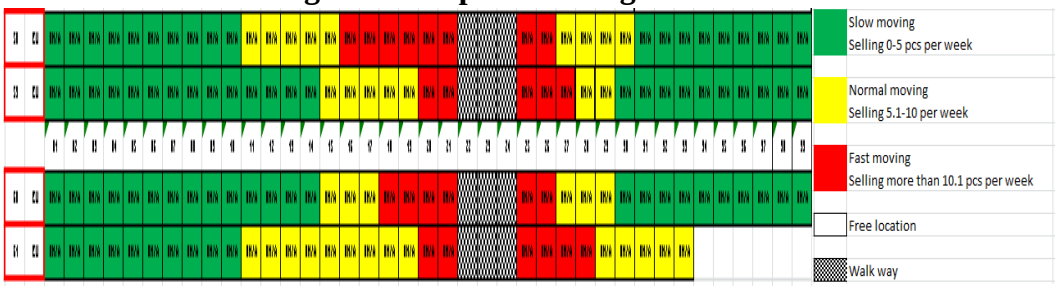
The main propose of the Improve phase of DMAIC is to improve processes and resolve the problems identified in the firm's in-store delivery. This section

addresses those improvements. Figure 3 displays the major problems, which have been categorized into four areas: Management, Equipment, People and Process. Table 4 shows that delay in picking time is due to long travel times (Process) and lack of product knowledge (People). These are the top two reasons that cause the delays. The researcher focused on efforts to resolve these two problems with corrective actions, and proposed measures to monitor and control the process. Management issues include how the working processes are managed and how the results of service time are monitored as well as the training provided to the pickers.

Storage Assignment Policy

From the interview with the supervisors, it has been determined that products stored within the staff pick area are mainly combination products. The term "combination products" means that the products are meant to be sold together in order to form a single product. The combination products are sold by function and family. For example, "family A" group stored in rack 58 includes the highest turnover articles and are shown in red (sold more than 10 pieces per week: a fast moving item). These items are to be placed next to the main aisle, followed by the articles that are sold 5-10 pieces per week (marked in yellow), followed by slower selling items which are shown in green (sold less than 5 pieces per week). All as shown in Figure 4.

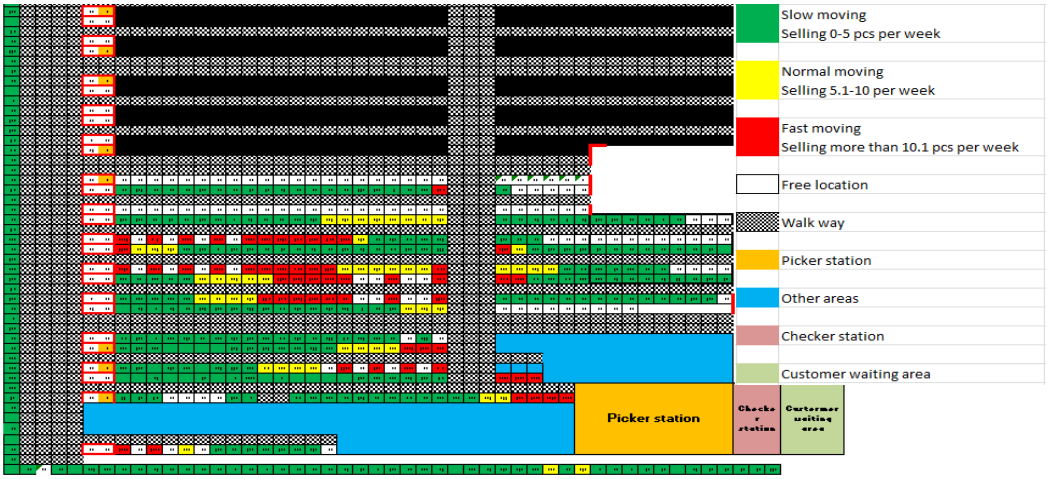
Figure 4: Proposed Storage Assortment



Source: Author

The result of the rearrangement is shown in Figure 5. The products are grouped according to function, family and sales frequency. To complete a kitchen, customers need a basic combination, such as, kitchen frame, kitchen door front, kitchen drawer, kitchen shelf, kitchen work top, and kitchen fittings. Therefore, all the kitchen combinations are grouped close to one-another to reduce pickers' travel time. However, assigning products according to their function and family does not allow all the high turnover items to be located close to the main aisle. This is because not every product within the family has a high turnover rate.

Figure 5: Final Storage Assortment at Level 00



Source: Adapted from Company's Data

Training

Training is essential for employees to improve their skills and performance and thereby improve the in-store delivery service for customers. It is recommended that AAA Company should provide training to its employees throughout the year. During the research, there have been two training programs conducted to improve the service. This training has included product knowledge training and on-the-job training.

Product knowledge is identified to be the second highest reason causing delays in the in-store delivery service. There are two types of training developed to improve product knowledge: product training sessions and on-the-job training. The product knowledge training sessions are conducted by product experts (sales persons). On-the-job training is a method where pickers are trained briefly in meetings conducted by warehouse supervisors. This is combined with actual hands on training when performing order picking to serve customers. Supervisors train pickers regarding the product placement within the warehouse. For example, bedroom products are mainly placed in rack 61 and kitchen products are placed in racks 54 through 60.

In order to assess the results of the improvements, order picking time was monitored to see whether the actual order picking time has improved. The results after the improvement are shown in Table 5 and Table 6.

Table 5: Results of the Time of In-Store Delivery Service (During Weekdays) after the Storage Assortment Implementation

Step	#	Activity	Senior picker		Junior picker			
			1st	2nd	1st	2nd	3rd	4th
1.		Picker receives pick list	1 minutes	1.5 minutes	1 minutes	2 minutes	1.5 minutes	1 minutes
2.		Picking process	25 minutes	28 minutes	33 minutes	38 minutes	34 minutes	37 minutes
	2.1	Pick up trolley						
	2.3	Pick up goods						
	2.4	Double checking	4 minutes	5 minutes	5 minutes	4 minutes	5 minutes	6 minutes
	2.4.1	If correct, proceed to 3						
	2.4.2	If incorrect, call pickers and return to 2.3 then 2.4 (On average)	5 minutes	5 minutes	5 minutes	5 minutes	5 minutes	5 minutes
3.		Customers receive products	35 minutes	39.5 minutes	44 minutes	49 minutes	45.5 minutes	49 minutes
Average time used			37 minutes		47 minutes			

Source: Author

Table 6: Results of the Time of In-Store Delivery Service (During Weekends) after the Storage Assortment Implementation

Step	#	Activity	Senior picker		Junior picker			
			1st	2nd	1st	2nd	3rd	4th
1.		Picker receives pick list	1.5 minutes	1 minutes	1 minutes	2 minutes	1.5 minutes	1 minutes
2.		Picking process	30 minutes	29 minutes	33 minutes	38 minutes	34 minutes	37 minutes
	2.1	Pick up trolley						
	2.3	Pick up goods						
	2.4	Double checking	6 minutes	7 minutes	5 minutes	4 minutes	5 minutes	6 minutes
	2.4.1	If correct, proceed to 3						
	2.4.2	If incorrect, call pickers and return to 2.3 then 2.4 (On average)	5 minutes	5 minutes	5 minutes	5 minutes	5 minutes	5 minutes
3.		Customers receive products	42.5 minutes	42 minutes	44 minutes	49 minutes	45.5 minutes	49 minutes
Average time used			42.25 minutes		54 minutes			

Source: Author

The researcher compared the result between before and after implementation of the storage assignment policy. The result indicates that there is a significant improvement in the picking time for both Weekdays and Weekends. The picking time was reduced by 28 minutes during Weekdays and 31 minutes during Weekends. The result is shown in Figure 6.

Figure 6: Comparisons Result between Before and After Implementation

Weekdays	**Weekends**
Before 65.5 - 73.5 minutes After 37 – 47 minutes	Before 75 – 85 minutes After 42.25 - 54 minutes

Source: Author

Due to time constraints, the expert training took place after the picking time results were monitored. However, information gained in the research has shaped the training to help pickers to improve their picking service even more. In the product knowledge training sessions, pickers have been trained by experts who have expertise in product dimensions and in the various possible product combinations. For example, an individual picker has learned about the combinations required for a kitchen cabinet. This consists of the frame, the door front, drawers, shelves and hinges. The pickers have not only learned about the combinations but also the sizes of the combinations.

When the improvements were put in place and the trial was completed, the researcher-proposed KPIs are to be closely monitored. It is recommended that the supervisors use the KPIs as a control mechanism to measure the actual performance of the picking process, individual pickers as well as customer satisfaction levels and the number of customer complaints made against the in-store delivery service. Supervisors should not only look at the day to day performance but also should maintain a record to look at the overview performance as a team. The researcher has suggested that the supervisors should maintain a monthly performance record to track the total average time used as well as the trends in number of order picking requests and associated pick times. The total average time used for pickers to pick each pick list is calculated by using total time used divided by the total number of picks which allows AAA Company to know customers' average waiting time.

The researcher has not only focused on the pick time results but also how performance has to be monitored. Based on the findings of this study, the researcher has strongly encouraged the supervisors to conduct scheduled training

sessions for all pickers. This training should be based upon the findings of the data collected in the Control measures that have been instituted, so as to address specific causes identified in that data.

SUMMARY

This research was conducted to identify the root causes and find solutions of the delays encountered by the customers utilizing the in-store delivery service of AAA Company. These delays caused the customer low satisfaction. The researcher reviewed the related literature and determined that DMAIC was a suitable model for identifying the root causes, solving or mitigating those problems, and proposing sustainable solutions

The major causes of in-store delivery delays discovered during the research using DMAIC model were the pickers' travel time and lack of product knowledge which both contributed to the delays in the service. There were two major areas where corrective actions were devised by the researcher to improve working process and resolve problems. These included the development and implementation of a storage assignment policy and employees training in product knowledge, warehouse layout, proper lifting methods and KPIs.

The resulting reductions in service time required for in-store delivery after implementation of the storage assignment policy and employee training showed an improvement from average of 65 minutes and 85 minutes (weekdays and weekends, respectively) to 37 minutes and 54 minutes (weekdays and weekends, respectively).The reduction in customer waiting of 28 minutes for weekdays and 31 minutes for weekends should have a positive effect on customer satisfaction levels. The time improvements were the result of a reduction in the pickers' travel time.

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