ORDER ALLOCATION PROCESS IMPROVEMENT IN A FOOTWEAR INDUSTRY

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งานวิจัยฉบับนี้ได้นำเสนอวิธีการฮิวริสติกในการปรับปรุงกระบวนการการจัดสรรคำสั่งซื้อสินค้าของบริษัทกรณีศึกษาแห่งหนึ่ง โดยอ้างอิงจากข้อจำกัดทางธุรกิจ 3 ประการได้แก่ ลำดับความสำคัญของลูกค้า, วันส่งสินค้า และขนาดของแต่ละคำสั่งซื้อสินค้า ดัชนีชี้วัดประสิทธิภาพของวิธีการฮิวริสติกที่พัฒนาขึ้นประกอบไปด้วย อัตราการเติมเต็มคำสั่งซื้อสินค้า อัตราการเติมเต็มตามปริมาณ อัตราการเติมเต็มตามชนิดสินค้า และอัตราสินค้าที่ต้องส่งติดตามในครั้งต่อไป ผู้วิจัยได้ทำการศึกษา และเปรียบเทียบผลลัพธ์ของวิธีการฮิวริสติกที่พัฒนาขึ้นกับวิธีการที่บริษัทกรณีศึกษาใช้ในปัจจุบัน และกับวิธีการจัดสรรสินค้าพื้นฐานแบบเข้าก่อนออกก่อน (First-Come, First-Serve Allocation Strategy, FIFO) โดยอ้างอิงจากชุดข้อมูลที่ได้จากบริษัทกรณีศึกษาในช่วงเวลาหนึ่ง ทั้งนี้ชุดข้อมูลทดสอบประกอบไปด้วย 2 ชุดข้อมูลย่อยที่สำคัญ คือ ชุดข้อมูลรายละเอียดของคำสั่งซื้อสินค้า และชุดข้อมูลจำนวนสินค้าคงคลัง ผลลัพธ์ของงานวิจัยนี้บ่งชี้ว่า วิธีการจัดสรรสินค้าพื้นฐานแบบ FIFO ตลอดจนวิธีการฮิวริสติกที่พัฒนาขึ้นสามารถเพิ่มประสิทธิภาพในการจัดสรรสินค้าได้ในทุกดัชนีชี้วัดประสิทธิภาพ หากแต่คุณภาพของการปรับปรุงแตกต่างกันไปในแต่ละวิธีการฮิวริสติก ซึ่งเป็นผลมาจากความเหมาะสมของชุดข้อมูล ตลอดจนข้อดี และข้อด้อยของแต่ละวิธีการฮิวริสติก อีกทั้งยังพบว่าการจัดการสินค้าคงคลังให้เหมาะสมมีผลต่อการเพิ่มประสิทธิภาพของดัชนีชี้วัด

ภาควิชา ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต ลายมือชื่อนิสิต .....

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Three heuristics are proposed to improve the product allocation process of the case study manufacturer based on three actual business constraints; customer priority, delivery time, and order size. The focused Key Performance Indexes (KPIs) include order fill rate, quantity fill rate, line fill rate, and back order rate. The proposed heuristics, together with the basic First-come-First-Serve allocation strategy, are tested with actual order and inventory data gathered from the company. The resulting KPIs are then evaluated with those of the current operation. Based on our results, all KPIs could be improved by any of the proposed heuristics, including FIFO, where the magnitude of improvement differs from one to another allocation strategy. In order to recommend the best allocation heuristic to the company, we also explore both advantages and disadvantages of each heuristic. We found that proper inventory management can play a major roll in the improvement of focused KPIs.

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CHAPTER I

INTRODUCTION

1.1 Background of Thesis

Thailand is one of the leading exporters in shoes and shoe parts, and ranks among the top 20 countries in the world. Tentatively the Asean Economic Community (AEC) will pose more of an opportunity for Thailand's footwear industry, with the possibility of 10-20% increase in export value (Posttoday website, 2016).

The footwear industry in Thailand can be categorized as one of the country's main businesses, with a growth of 6% in 2015, reaching THB 77 billion (Euromonitor website, 2016). This thesis will focus on two main product types of footwear businesses, sports and student footwear. The continuous popularity of sport fashion, with sports shoes as the main component, has drastically raised the demands of Thai consumers on the sportswear market during the past five years. Another reason is the use of sports footwear for exercise and for daily wear as street style fashion. Student footwear is also an important section in the footwear market in Thailand, accounting for around 5-8% of the business. In addition, the competition in the student footwear industry differs from other normal consumer goods markets because it is a zero-sum game, customers always buy the same brand, which means there is always a winner and a loser in the same market. Thus, this competitive nature of the market will affect the business because customers will change from one brand to another, consequently that brand will lose profit in the short term and customer satisfaction and loyalty in the long term. As there are many choices of footwear brands in Thailand, and companies of various sizes, the market see a high rate of competition.

One important factor that could increase the competitiveness of a company in this fierce market is the supply chain. This process involves both external, such as suppliers and customers, and internal factors, through the manufacturer and

distribution centre. Therefore, focusing on management in the supply chain will increase the efficiency of the operation and the potential of a company to become a market leader. Currently there are various systems to support supply chain management, especially in the process of warehouse operation, the core function of the supply chain. At the same time, some processes are still done manually due to the limitations of automatic machines or software that are not tailored to solve some specific problems. According to a survey in the company of the case study it uses software in its warehouse operation, except for in the process of order allocation, where the worker is required to plan order fulfilment and allocation manually. This is because the complexity of customers' requirements in ordering and receiving the products. Therefore, this thesis focuses on this particular process, which has the potential to help improve the effectiveness of the overall operation. Furthermore, order allocation improvement could help to close the operative gap, and increase the efficiency of the supply chain management.

In conclusion, this thesis aims to develop the supply chain management in the order allocation process of a footwear business to respond to customer demand in the right place and at the right time. Being more responsive to the needs of customers would be beneficial to the organization.

1.2 Business review

1.2.1 Company profile

This company produces and distributes footwear and related products to both domestic and overseas markets. The products can mainly be divided into five categories: student footwear, casual footwear, sports footwear, other shoes and related products (e.g. socks). The company has around 5,000 Stock Keeping Units (SKUs) with a broad line of styles, colours, and sizes.

According to Figure1, the company mainly sells products to the domestic market in Bangkok and other provinces in Thailand, accounting for 60% of all its customers. Benefiting from affordable prices and its strong distribution network, this company led the sales in the footwear market with a share value of 4%. The primary product of this company is sports footwear, which accounts for about 30% of all goods. The total annual sales value of the company in 2014 was around THB 900-1,000 million.

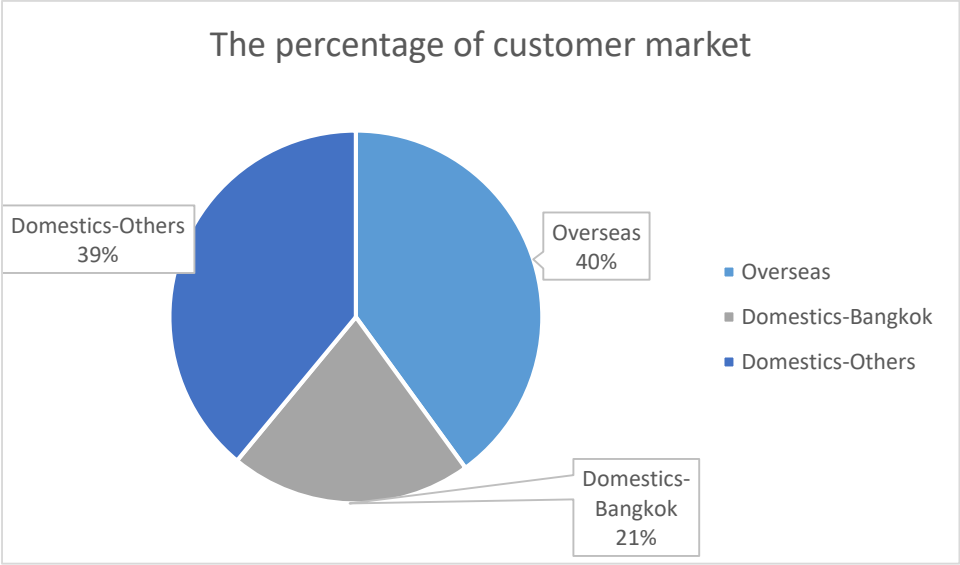

Figure 1 The percentage of customer market of a company

1.3 Statement of problem

Recently, order picking has been recognized as the general process of distribution and fulfilment operations in any business. The ability to quickly and accurately perform customer orders has become an important part of doing business (Piasecki, 2000-2012). Order picking is an essential connection with the supply chain (Petersen and Aase, 2004), a process starting with the purchase of raw materials and ending with the production and delivery of finished goods (Croom et al., 2000). The

major factor of product picking is that the order is fulfilled when the required quantity of all items in that order are available from the inventory (Simchi-levi et al., 2003).

One of the current operational issues within the warehouse, mostly caused by ineffective planning, is the allocation of products. Sometimes the inventory of the distribution centre is insufficient to match the purchase orders from customers. Therefore, the company needs to allocate the scarce products in the stock to partially serve customers. According to Rim and Park (2008), planning is the decision process of order picking and shipping in a distribution centre. Although this process is very important and related directly to customer satisfaction, there is not enough concern about distribution centre operation in businesses. Ineffective goods allocation can result in losing orders, customer satisfaction and sales value. Thus, the allocation process should be carefully planned in advance to prevent flaws and the loss of customers.

This thesis will apply the inventory management strategy in order to improve order fulfilment. Based on the analysis of order picking problems, the heuristic method is selected to create a simulation that imitates the allocation process based on the real situation. The results from this simulation could assist in the evaluation of outcomes in term of improvement of the fulfilment rate, and may help determine the problems in the warehouse system before the actual decision on applying an automatic program to the allocation process is made.

1.4 Objective

The objective of this thesis is to improve the allocation process in terms of order, quantity, and line fill rate by promoting the algorithmic system that supports the decision making in allocating the scarce products.

1.5 Scope and Assumption of the thesis

The scope of this thesis is as follows:

- The study will cover the current allocation system and decision making methods to release purchase orders.
- The study will not include the connection with the inventory management system and delivery segment.
- The study will test the case example of this company through comparison with the current method used in the allocation process of the company.
- The study will cover the algorithm, but not involve the coding and calculation methods.

1.6 Proposed methodology

As regards Figure 2, the author proposes the following detailed steps and methodologies for studying and solving the order allocation process:

- Review related literature and theories related to the warehouse management and allocation process;
- Observe the warehouse operation process at the company factory as a case study and collect data from the system of the company;
- Study and review the current performance from collected data;
- Identify causes and problems of planning in order allocation and analysis and related constraints for order fulfilment;
- Study solution techniques and select the most suitable approach based on feasibility and simplicity;
- Design the algorithm to solve the solution;
- Test the model with the case study company;

- Compare the result of the algorithm model with actual run data;
- Explain each solution including the benefit, limitation and outcome analysis;
- Conclude study and provide suggestions for improvement.

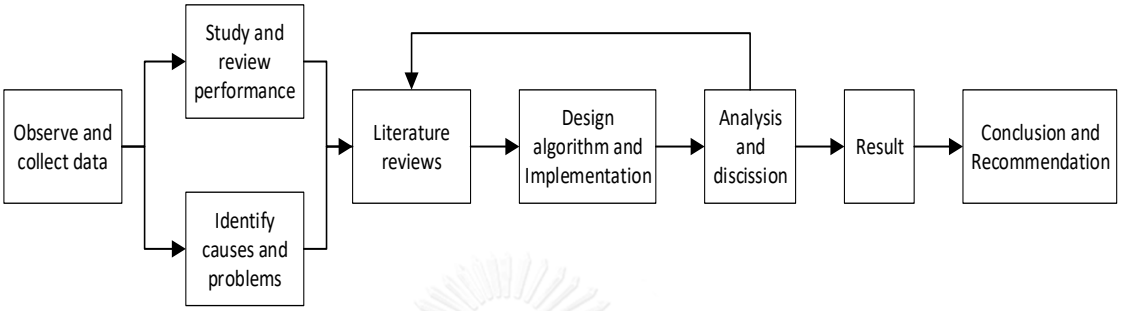

Figure 2 Overview of proposed methodologies

1.7 Expected benefits

- To increase the number of completed purchase orders and quantities ordered;
- To introduce performance tracking methods and implement them to evaluate the allocation process outcomes;
- To propose an improved system that decreases the dependency on experienced planners which is a significant factor in current allocation system;
- To increase the efficiency of workers' decision making based on system analysis;
- To propose an approach to implement the improvement of the order allocation process in the company.

The result of this thesis suggests that the model will assist the internal system of the company to improve order fulfilment, which is one part of the supply chain.

1.8 Conclusion

To summarise, this chapter provides an overview of thesis which consists of the introduction of the business, problem statement, and aims of the study. In addition, it outlines the scope and assumption of this study, and describes the proposed methodologies to achieve the expected benefits.

CHAPTER II

THEORIES AND LITERATURE REVIEW

This chapter explains theories and literature related to the order allocation process, which is one of warehouse operation processes: receiving, putting away, picking, and packing and shipping. Two possible methods, integer programming and heuristic approach, for order allocation process improvement are discussed. The related theories and literature in this thesis will include three main aspects of warehouse operation, solution technique, and optimisation.

2.1 Theories and Literature review

2.1.1 Warehouse operation

Warehouse is a planned space for the efficient accommodation and handling of goods and materials. The major role of a warehouse is the storage of goods between movements, supporting production and distribution. There are three main logistic activities in warehouse operation, namely inbound, process and outbound activities, which are divided into five processes as shown in Figure 3 (Bartholdi J.J. and Hackman S.T., 2014), (Lambert D.M. et al., 1998)

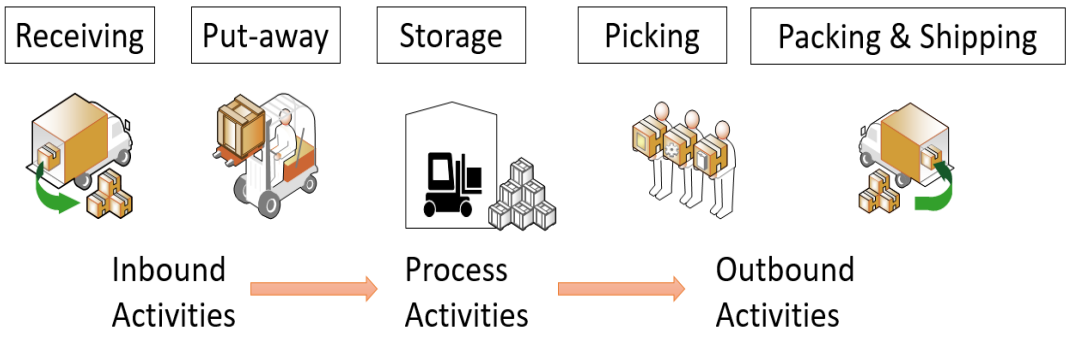

Figure 3 Warehouse operation processes

- Receiving

  The receipt of goods takes place when items are delivered to the warehouse for storage. Alacrity and accuracy are crucial for the effectiveness of primary storage and warehouse operation. Details of the operation are varied depending on the model and type of facility for storage. Products are delivered from various sources, transported in different routes and vehicles and packed in diverse ways, which may affect the receiving performance. Appropriate documentation, tracking and management of receipt packages can ease the flow of supply in the warehouse system.

- Put-away

The transportation of goods from the receipt to the storage area is important. During the process the products are pre-configured and arranged neatly in the inventory, as well as in related records. The proper arrangement and categorization of products in stock will enable secure storage, prevent accidents in the warehouse, save space, time and labour, lower maintenance, and mitigate delivery in the future.

- Order-Picking

Upon receipt of customer orders, the warehouse management system should check the availability in the inventory and generate the improved goods allocation and picking plan. A withdrawal record need to be made and the inventory should be monitored in real time to effectively coordinate with the production and storage plan. Finally, shipping documents are required and the duration of order picking and shipping is tracked to increase customer satisfaction. These activities will be succeeded by a proper warehouse management system, usually aided by software that coordinates the general activities of a large warehouse. This supports the alacrity and accuracy of delivery, and ensures the maximized fulfilment rate.

Outbound warehouse processes are initiated by the receipt of purchase orders from customers. An order can be thought of as a shopping list and usually consists of items and quantities requested. Warehouse Management Systems (WMS) will check the order against the existing inventory and identify, if any, shortages of required goods. WMS may also be able to design the layout and operation of the warehouse to achieve higher efficacy. Bringing goods from storage and gathering them in the shipping area according to the orders not only requires accuracy but also agility. The suitable picking method need to be selected to suit the product type and warehouse plan. There are four main picking methods as below:

- Discreet picking: picking as individual items and proceeding from the beginning to the end
- Batch picking: picking as a set or dozen
- Zone picking: a pick from a selected area in storage
- Wave picking: schedule the picking in short intervals throughout the day

The picking method is directly affected by the variation and quantity in customers' orders. A small batch of goods with high diversity may require long travelling distances inside the warehouse depending on the method selection, and the route through the warehouse may vary from one order to the next. Nonetheless, it enables batch picking, which should help optimise the cost and time aspect. In that environment, the challenge is to reduce travel by finding an efficient route to visit a specific place, combining the picking into the pool of goods and effectively distributing them among orders. However, customers' orders in high-volume retailers are typically large and items could be similar. Each order is likely to take several steps per unit of distance travelled, and order pickers tend to follow a common path, such as the passage of the floor. The challenge is to dig in order for work to flow smoothly and eliminate bottlenecks (Koster R.D. et al., 2007)

- Packing and shipping

Preparing the products before shipping is a step that includes packing and final inspection, to ensure the perfect quantity and quality of goods are dispatched to customers. These products are stored in boxes, cartons, pallets or containers with a barcode labelling system for recording data, including source, destination, and sender/recipient details. The transportation route is mapped based on the requested delivery date on each purchase order to achieve on-time delivery.

For the study of the order picking process, there are various related topics that influence warehouse management. In this thesis the order picking will be divided into three stages: planning, implementation, and development. First, the planning aspect is the analysis of collected data to determine the priority of orders, dependent on each customer. Moreover, particular customer requirements are also considered. Second, the implementation stage requires effectiveness and efficiency of the order picking process to fulfill the purchase order to the highest level possible. The last phase reviews the results of the order picking process and compares them to the previous batch. Subsequently the outcome is analysed until the process has been developed according to each company's needs. The first stage of this study will focus on planning the order picking.

Many studies focus on the efficiency of order picking, e.g. on route and distance. Linda et al. (2010) redesigned an engineering process for order fulfilment by accountability method in the supply chain. The result was improved performance, e.g. a reduction of the time required for the order fulfilment process, the picking cycle, and order processing, as well as increased delivery performance and higher productivity. The demand management process is a critical issue of supply chain management. The researchers suggested the model that deals with the stock in shortage, i.e. with a high level of demand, and the overstock caused by a low level of

orders. Their approach used fuzzy logic to improve order fulfilment and enhance customer satisfaction.

Amer et al. (2008) studied about the utilisation of Design For Six Sigma (DFSS) to improve key process variable of both input and output of a firm. The study also extended to cover the whole supply chain of the company, including suppliers and customers.

2.1.2 Order allocation and demand fulfilment

Order allocation aim at managing customer demand and the available inventory to fulfil customers' orders. Order fulfilment is one of the important processes that can directly impact customer satisfaction, and at the same time also affect the profit of the company. Constraints of order allocation and fulfilment are the type and quantity of each product, lead time, and order frequency.

Hoen et al. (2008) considered approximating the rate of order fulfilment with an Assemble-To-Order (ATO) system. They focused to control the set of uncompleted orders due to a shortage of inventory by using base stock policy. ATO system used both under and over estimation of the weight factor for accuracy approximation. They also applied subsystem with exponential distribute lead time for this research. As an example of optimization, in a seasonal business it is not easy to manage the inventory, especially in fashion product market.

Rim and Park (2008) approach inventory management from the order allocation aspect. They consider a case of scarcity, where goods need to be distributed to maximize the order filled rate (OFR) in the order allocation process. Their study is based on the back order fulfilment concept, the unfulfilled orders are not partially shipped and transfer to next day as a whole. They propose a linear programming mathematical system and compare it to four heuristic models based on a set

generated by a database. The result shows that in an ANOVA test, linear programming outperforms heuristic models to a considerable degree. However, the experiment is based on randomly assumed numbers of order, inventory and product distribution which may vary during each simulation and bias the comparison. Moreover, they do not account for any actual business constraints on partial shipment and unpatterned orders, or delayed deliveries.

Liu et al. (2014) studied the logistics service integrator (LSI) and several functional logistic service providers (FLSP) by using the cumulative prospect theory and an order allocation model to maximize satisfaction and capacity and minimize cost.

Ni et al. (2013) approached a new model for order fulfilment which combined order fluctuation and the production schedule. This model is used for improvement in term of income and inventory management.

Demand fulfilment is a process of forecasting the actual customer order and try to fulfil both the demand for quantity and lead time of delivery (Stadtler H. et al. 2015). Furthermore, Standtler's research explained Available-to-Promise (ATP) as the goal of demand fulfilment KPIs that is used to meet a customer service level. Fleischmann and Meyr's (2003) study about the theory of demand fulfilment and ATP of customer orders shows that mixed integer and linear programming are possible tools to solve the problem of these processes.

Chen and Dong (2014) presented a new approach to ATP by using a model of order allocation that set the priority of customers follow by order fulfilment. First, production capacity ATP is reserved for each customer priority then the proposed model is applied to improve the ATP searching rules. Second, two models for order fulfilment are focused: batch for order reception period and real-time for imitated order coming.

2.1.3 Solution techniques

2.1.3.1 ABC analysis (Pareto)

This analysis method is a concept that focuses on product categories by grading their sales or profit shares. Stock and Lambert (2001) state that the products in Group A will only consist of a few types or numbers of SKUs (Stock Keeping Units), but goods with a high sales volume or share of profits. The products with a lower sales volume are categorized as less important in Group B or C.

James and Jerry (1998) explain in 'The Warehouse Management Handbook', the second edition of the Stock Location Assignment, by mentioning the ABC Analysis as a threshold that is widely used in the placement of a product. They found that only 20% of all products in the inventory can account for 80% of the goods movement in an industry. Companies should pay more attention to monitoring and managing the products in Group A, because they are usually sold in large volumes and should be aligned to the store in a most convenient location for keeping and picking than Group B and C. Products that are divided into small groups of three or more could be divided into A, B, C and D, respectively, to distribute a percentage of sales or the movement of goods in group A.

2.1.3.2 Queuing theory

The queuing theory is generally considered a branch of operations research, as the results are often used when making business decisions about the resources needed to provide a service (Sundarapandian V., 2009).

János Sztrik (2012) explained this theory in the context of common service structures such as FIFO (first in first out), LIFO (last in last out), RS (random service), and Priority.

Perry and Zarsky (2012) stated about FIFO that the method is available by request of customers or clients to participate in the order that they arrived, without

prejudice or preference for other people waiting in line for the event, or who may stand in the queue. The FIFO principle is the allocation of resources to those interested in ordering their list. FIFO and their close relative terms, 'First come, first served' and 'first in time, first in right', are used by many legal applications.

2.1.4 Optimisation

Optimisation is a process whereby the best possible solution is provided, based on a mathematical relationship. This solution is called the optimal solution. In this thesis, it considers the theories in two approaches: heuristic and integer programming.

2.1.3.1 Heuristic approach

A heuristic method is designed to address a specific task. This method will provide the right answer to a search from a large volume of data. Heuristic methods attempt to simplify a problem by reducing all possibilities into step-by-step decision making. Upon deciding on the first factor, some possible answers are eliminated before next constraint is considered, narrowing down in each level until the final answer is reached. A heuristic approach will yield an optimised answer that is subject to business constraints. Nonetheless, the downside is that the answer found may only be a good answer, but not the optimal one. Some problems in real industry are huge and nearly impossible to solve by normal methods, therefore heuristics are necessary.

The heuristic function measures the possibility of solving the problem. This method will solve the problem by divided the problem into steps. The possible solutions of the first step are listed and evaluated. Results from first step will lead to the problems of second, then process is repeated. The weights, expressed with marked numbers, will be assigned to each solution nodes to indicate the tendency of solving the problem. The path that has the highest mark means that it highest possibility in yielding the optimal solution.

Park and Kyung (2014) study the particle swarm optimization (PSO) method, a meta-heuristic methodology. They try to optimize the total inventory and order fill rate by considering the initial inventory condition and information quality that lead to the bullwhip effect. Furthermore, they also determine downstream and upstream in demand and lead time information of the supply chain respectively. The outcome of the optimisation process was found to be improved.

Buckchin et al. (2012) studied about two traditional heuristics methods in order allocation: picking started when order is input or reaching the delivery requested date. They suggested the solution of problems by using MDP-H to improve and compare with those heuristics. As the results, they found the stock percentage parameter is optimized to 40%.

2.1.3.2 Linear and Integer programming

Linear programming is a technique used for solving problems in allocation factors, or resources where factors or variables are related and can be written in a linear mathematical model (Schrijver A., 1998). The aim is to solve a problem and make decisions in accordance with the operation process. The element of linear programming consists of three factors:

- Decision variable: the parameters for input into the system and a variable we can control. It is important to enter this parameter into the system in order to maximize the benefits.
- Parameters: uncontrollable values in a system.
- Objective function: an equation showing the relationship of cost to maximum or minimum profit targets.
- Constraints: shows the limitations of resources or factors in the equation or inequality.

The format of the linear programming problem can be written as Equation (1):

$$\text{Min/ Max } z = \sum_{j=1}^{n} (c_j x_i)$$

$$\text{Subject to } \sum_{j=1}^{n} (a_{ij} x_j)(\geq or \leq or =)\, b_i \qquad (1) \text{ for i = 1, …, m}$$

$$x_j \geq 0 \quad \text{for j = 1, 2, …, n}$$

Linear programming will thoroughly evaluate every possibility of variables in constraints in order to find the most optimal value for the decision variable. This will result in an ultimate solution based on the linear relationship that users created. However, the drawback is the complexity in transformation of the real-world constraint into the linear mathematical model. Also, linear programming makes no attempt to simplify the problem, which requires a vast linear system to cover all the factors from the business scheme, and requires powerful hardware to solve.

Integer programming is the subset of linear programming which all variable are limited as integer values only, not including the negative values. In addition, integer linear programming is one of the optimisation or feasibility programs that have factors in objective functions and linear constraints. Glover, F (1989), uses Tabu search to solve the problem of integer linear programming.

Henn and Wascher (2012) suggest a solution by using two heuristic methods, Tabu Search (TS) and the attribute-based hill climber (ABHC). Those heuristics are quite similar; however, the ABHC method only requires a few specific parameters. They focused to improve the efficiency of picking process in a warehouse which results in reduction of the required distance and time. Moreover, the overtime of pickers is decreased, which increases the profit margin and the customer service level. Batching order picking is one type of inventory issue for the picking process, as one purchase order normally consists of various kinds of products and requirements.

Optimisation is necessary in inventory management. Various studies highlight the effect of the order fill rate. Larsen and Thorstenson (2014) examine the relationship between orders and volume fill rates. They measure the performance in different inventory control systems. They consider a compound demand process with back ordering and stable due date delivery, because customers' demands can have direct impact on the inventory and customer service level.

Meneghetti et al. (2009) study floor storage systems of footwear products in one of the fashion companies. However, it differed from similar businesses because it offered various kinds of goods in limited quantities. The researchers combine constraint logic programming (CP), a programming method for encoding and solving concurrent processes, and large neighborhood search (LNS) models to optimise the allocation problem by considering the class level of products and aisles.

There are studies that use linear programming as a mathematical model that helps to plan and allocate warehouse space efficiently by making more space within the warehouse, fully leveraging the benefits of space and maximise operation.

Spitter et al. (2005) consider the problem of supply chain operation planning which coordinates the release of materials and resources in production. Linear programming was selected to solve this issue by using the planned due date with various ranges of consumed capacity. They suggest the different two LP model approach, as a result the cost of inventory and back ordering was reduced.

Kabak and Ulengin (2011) focus on long term supply chain networking decisions which many companies, especially the manufacturer, require a long-term strategy. The model of the supply chain was planned to response to the uncertainties of interal and external factors. They used the possibilities linear programming (PLP) to decide fuzziness of resource planning strategy for maximizing total profit. Consequently, the approached PLP model could increase an efficiency of a decision and assist in analysing the resource utilization.

The two possible approaches; Heuristics and Integer programming are explained in term of definition, important and the related literature as above. In addition, the researcher describes benefits and downsides of those two method as in Table 1 for comparison.

For this thesis Heuristic method will be studied and applied in goods allocation. The objective is to find the good enough solution within a limited time of the non-linear business environment. Therefore, a heuristic program is required to be tailored for one particular issue. Besides, some cases have a complicated allocation conditions, so the attempt to transform constraints in working process into linear mathematical model could be arduous. This cause the integer programming method not suitable. Hence, heuristic devices are the most appropriate way to resolve the problem. The heuristic model will result in a comprehensive solution that complies with all the constraint and problem condition. In most cases, the solution is justifiable, as well as applicable to the real working situation without having to work on all possibilities to seek for the optimal solution.

Table 1 Summary and comparison of Heuristic method and Integer programing

	Beneficial	**Limitation**
Heuristics	- Assigning the heuristic can help suggest the best corrective measures to planners - There is the appropriateness of that optimization method to solve a business problem and provide value - Following a discrete decision or rule tree the algorithm may miss solutions that are better – it doesn't try every possible combination (Russell C., 2013) - Work well in high volume, complex and constrained environments	- It requires knowledge and experience to apply the heuristics effectively (Molich, R. and Nielsen, J., 1990) - Trained usability experts are sometimes hard to find and can be expensive. - The evaluation may identify more minor issues and fewer major issues (Nielsen, J., 1990)
Integer Linear programming	- Approaches to solving supply chain challenges are best applied to longer-term, aggregate , and strategic problems - Find the one best answer in a set of potential solutions	- Do not scale well to large or detailed problems with many constraints (Sethy P., 2016) - Parameters appearing in LP are assumed to be constant, but in practical situations it is not so - Every constraint must be linear, but several business and industrial problems are nonlinear in nature

2.2 Conclusion

Various theory regarding warehouse system and management are discussed. The inbound and outbound processes are explained with the focus on order picking and allocation. The ABC analysis for classified products or customers grade is mentioned. The different methods of queuing theory are discussed. Diverse optimization researches have been conducted such as particle swarm optimization, picking triggered process and its effect in supply chain and order fulfilment based on generated database by integer programming and heuristic methods. Two optimization methods, integer programming and heuristic, are discussed including their advantages and weak points. The Heuristic method is chosen for this thesis due to the complexity of real business constrains and their relationships.

CHAPTER III

STUDY AND ANALYSIS OF CURRENT ALLOCATION PROCESS

In this chapter, Key Performance index (KPI) is identified in term of its important and related factors. In this thesis, four main KPIs will be concerned; order fill rate, case fill rate, line fill rate, and back order rate. Therefore, current performance measurement is done to evaluate the efficiency of order allocation process. Next, the order allocation process of the case study company is addressed to define the problems, since receiving order from customer until delivery. The process is then analysed for problems and impacts that should be improved, leading to the purpose of this thesis. Finally, this thesis scope the focus into improvement of warehouse management policy. In addition, the inventory management and order management policy is mentioned in suggestion and recommendation section.

3.1 Measurement order allocation process

3.1.1 Key performance index (KPI)

In order to evaluate the performance of the company, Key Performance index is one of the methods that can help estimate a current working level as well as identify the root cause of problems. This measurement are usually applied in form of number and unit of measure combined called indicators. The result can be used as an insight information to understand, manage and improve organization activities. Proper indicators can help in below aspects: (Franceschini et al., 2007):

- Identifying how well the activity is undergoing
- Verifying if the goal is reached
- Understanding of the process

- Tracking of customer satisfaction level
- Analysing for the flaw and possibility of improvement

Beamon (1999) mentions that common performance measurement usually focus on creating new indicators for the specific application as well as benchmarking and categorizing of existing KPIs. He introduced a method in categorizing KPIs in to three types: Resources, Output and Flexibility, as shown in Table 2. He claims that traditional supply chain performance measurement mostly focus on Resources and Output, only few concern on evaluating the flexibility of the system. The dynamic nature of supply chain process need to be monitored as well as other aspect in order to reactively adapt to the environment.

Table 2 The performance measurement in supply chain (Beamon, 1999)

Performance measure type	**Targets**	**Aims**
Resources	High level of efficiency	The efficiency of resource management is affected to the profit of company
Output	High level of customer service	The customer service level is one of the factors to decide the success of supply chain.
Flexibility	Able to respond to changing of environment	The fluctuated environment directly impact supply chain from upstream to downstream

In this thesis, key performance indexes that are used to measure efficiency of allocation process are as follow;

- Order fill rate: the percentage of order completed within due date

- Case fill rate: the percentage of quantity in each order completed within due date
- Line fill rate: the percentage of line in each order completed within due date
- Back order rate: the percentage of unfilled order when due date is reached

3.1.2 Importance of KPIs

Neely et al. (2005) and Mentzer & Konrad (1991) have proposed the definition of a performance measurement as “the process of quantifying the efficiency and effectiveness of an action”. While Mentzer & Konrad (1991) defined efficiency as the ratio of resources utilised against the available; and effectiveness as the degree to which a goal is achieved, Neely et al. (2005) approached the definition of efficiency and effectiveness in another sensible way. They assumed that customer satisfaction is the ultimate goal of the organizations. Thus, the terminology of effectiveness is defined as the extent in which customer requirements are met, while efficiency is a measure of how economically the resources are utilized when the certain level of customer satisfaction is achieved.

Currently, the case studied company does not have the criteria for evaluation in operation department, but there is the measurement on sales function in term of monthly sales value. Therefore, the company is unable identify the actual cause and effect in allocation process including the rate of order fulfilment, filled line, and back lot order. These KPIs act as measurement for planners to keep track of current efficiency as well as finding opportunities to improve the process. When new model is proposed for the improvement of order allocation process efficiency, the current result can be used as based line for comparison before the actual implementation will take place. In addition, the positive aspects are as follow;

- Increase the delivered quantity, leading to increase in sale volume

- Increase competitive advantage by systematic allocation process that can increase customer satisfaction
- Reduce error from manual process in planning and picking that can lead to low level of efficiency and re-working.
- Reduce the amount of operators' work as well as time spent in allocation process

Lai et al. (2002) mentioned, in supply chain perspective, that in order to cover the entire supply chain operation, the organization must use integrated performance indicators. They also bolster the previous study that the measurement system should address both effectiveness and efficiency aspects of activities. The authors used SCOR model in Figure 4 as a framework for measurement. The four parameters; supply chain reliability, flexibility/responsiveness, costs and asset, are used to measure the logistics system in supply chain. The first two parameters are used to measure the effectiveness (customer facing) of the system while the other two indicate the efficiency (internal facing) which cover the following KPIs:

- Customer facing: delivery reliability, order fulfilment, supply chain response time, and production flexibility.
- Internal facing: total logistics management cost, value adding activities, cash to cash cycle time, return processing costs, assets turns.

	Customer facing			Internal facing	
Metrics	Reliability	Responsiveness	Flexibility	Costs	Assets
Perfect order fulfillment	✓				
Order fulfillment cycle time		✓			
Upside supply chain flexibility			✓		
Upside supply chain adaptability			✓		
Downside supply chain adaptability			✓		
Supply chain management costs				✓	
Costs of goods sold				✓	
Cash to cash cycle time					✓
Return on supply chain fixed assets					✓
Return on working capital					✓

Figure 4 SCOR model (Lai et al., 2002)

3.1.3 Detail of KPIs

Fulfilment rate is also known as a satisfaction rate of purchased orders, how much consumers is satisfied from existing stock. In other words, it measures the ability of inventory to meet demands at the particular time.

Order fill rate, acting as a perfect or completed order rate, is the performance measurement of successful orders. These orders are completed and delivered within requested delivery date as well as allocating right item and quantity to each one. The calculation of order fill rate is detailed as below;

$$\text{Order fill rate} = \frac{\text{Order completed without incident}}{\text{Total daily order placed}} \quad (2)$$

Case fill rate is the amount of quantities which can be completed in each order against the total quantities ordered by customers. The calculation of case fill rate is detailed as below;

$$\text{Case fill rate} = \frac{\text{Number of quantities shipped on the initial order}}{\text{Total number of quantities orderd}} \quad (3)$$

Line fill rate is the number of lines delivered in shipments compared to the total ordered lines amount. This measurement may or may not take requested delivery date into account. The calculation of line fill rate is detailed as below;

$$\text{Line fill rate} = \frac{\text{Number of order lined shipped on the initial order}}{\text{Total number of order lines ordered}} \quad (4)$$

Back lot order rate is as an indicator of successful forecasting, both material purchasing and inventory holding. In case that, demand is dramatically increased in short period of time, there is chance for temporary high back order rate. However, if the back lot order rate continue or increase after the peak order period, it indicate poor planning and lacking of flexibility in the supply chain system.

$$\text{Back lot order rate} = \frac{\text{Order unfilled at time of purchased}}{\text{Total daily order placed}} \quad (5)$$

Regard to Lai et al. (2002) mentioned that a performance measurement in supply chain is related to both customer and internal facing in term of cost and asset. Therefore, the proposed key performance indexes in this thesis illustrates both impacts to customer and company as shown in Table 3.

Table 3 Company versus Customer view

KPIs	Company view	Customer view
Order fill rate	- Can deliver completed order - No loss in service level - Make customer satisfy - Retention in long term - Effect to efficiency of both demand planning and inventory management	- Satisfaction - Effective planning of purchase and sales forecast
Case (Quantity) fill rate	- The amount of quantity is effect to net value sale - Effect to demand forecasting - Impact to inventory cost	- No out of stock issue - increase percent on shelf accuracy
Line fill rate	- The amount of line can be used for forecasting demand and planning the production	- Proper planning on variation of received product - Can enable the sales campaign and promotion properly
Back order rate	- Effect to efficiency of both demand planning and inventory management - Directly relate to transportation cost - Re-work processing	- Lost time due to waiting - Inefficiency planning of demand and marketing - Dissatisfaction

3.2.4 Current performance measurement

With regard to above section, this company has never measured any key performances. Therefore current performance measurement will be evaluated according to the definition in section 3.1.3. as illustrated in Table5. The actual purchase orders and allocation data are collected from the case study company, with certain limited information on customer constraints and real-time inventory, in period of August 2016 as shown in Table 4.

Table 4 The collected database of case study company during 17 – 31 August 2016

Day	Order	Uncompleted order	Total quantity-in	Total quantity-out	Total lines-in	Total lines-out
1	35	6	6,575	5,547	797	639
2	53	8	15,026	14,497	1,638	1,539
3	40	11	10,877	9,993	787	746
4	34	3	4,592	4,436	851	817
5	27	3	5,839	5,059	504	483
6	17	1	2,236	2,224	466	465
7	35	7	6,095	4,725	941	860
8	33	11	7,037	6,097	930	831
9	43	6	8,716	8,302	839	814
10	11	1	2,774	992	158	109
11	13	1	1,741	1,732	235	226
Total	**341**	**58**	**71,508**	**63,604**	**8,146**	**7,529**

Table 5 Current Key Performance Indexes

Day	Order fill rate	Quantity fill rate	Line fill rate	Back order rate
1	82.9%	84.4%	80.2%	17.1%
2	84.9%	96.5%	94.0%	15.1%
3	72.5%	91.9%	94.8%	27.5%
4	91.2%	96.6%	96.0%	8.8%
5	88.9%	86.6%	95.8%	11.1%
6	94.1%	99.5%	99.6%	5.9%
7	80.0%	77.5%	91.4%	20.0%
8	66.7%	86.6%	89.4%	33.3%
9	86.0%	95.3%	97.0%	14.0%
10	90.9%	35.8%	69.0%	9.1%
11	92.3%	99.5%	96.2%	7.7%
Overall	**82.99%**	**88.95%**	**92.41%**	**17.01%**

Table 4 represents the actual data from the case study company collected from 11 consecutive days, accounts for 341 orders. This data set was analysed into KPIs; order fill rate, case fill rate, line fill rate, and back order fill rate as shown in Table 5. It will be used as indicators to compare with the results after simulation of proposed optimization methods.

1. Order fill rate: the company missed to complete total of 58 orders to customer which have the overall order fill rate of 83%.

2. Case fill rate: According to this kind of business, the unit of goods is in pair. Therefore, it compares 1 pair equal to 1 case in KPI criteria. There is approximately 8,000 each delivery missing, about 13.6%. This result has the directly impact to the business in term of income and profit.

3. Line fill rate: The number of missed line items to fulfil order is approximately 9%. The result shown that the inventory management cannot meet the demand of customers. It is an error in forecasting and planning of production.

4. Back order rate: Orders were delivered as a partial order and they will be delivered next time when the missing item is filled back into the inventory. Back lot order against the total order to allocation process is account for 17%. This rate showed the indirect impact to both operation and business. For the operation, it increases the re-work processing which affect to working man-hours and duplicate processing. When the remained order is completed, it will be delivered to customer, so the re-delivery cost will be applied and reduce the profit.

All of fill rates and back lot rate are the figures that the company has to concern for improvement in the allocation operation efficiency, Moreover, they illustrate the current performance of operation function of company, which has never been evaluated, as well as help finding the root cause of problems in this allocation system.

3.2 Order allocation process

In the supply chain system of the case studied company, the allocation of products to satisfy customer orders is one of the key issues. As illustrated in Figure 5, the operation of inbound warehouse process connects the relation between buyers and the company. First of all, customer activity starts the chain by placing an order via sales representatives, or directly contact the enterprise. Once orders are received, the order fulfilment process will start: This process consist of 2 phases; order processing and implementation phases. The order processing phase mainly deals with receiving orders from both via Electronic Data Interchange (EDI) and direct calls from customers. The flow of information starts from sales representatives receive orders from customers, and then send the order into the internal system called Salesforce. The

information proceeds to the Enterprise Resource Planning (ERP) system. After checking customer credits in every morning, approved orders are then sent to the warehouse. The implementation phase is the key activities in the warehouse, starting from collecting the purchase orders to product allocation using Warehouse management system (WMS). The staffs manually sort the products to fulfil orders according to given rules and conditions. Once it is done, the products will finally be delivered to customers.

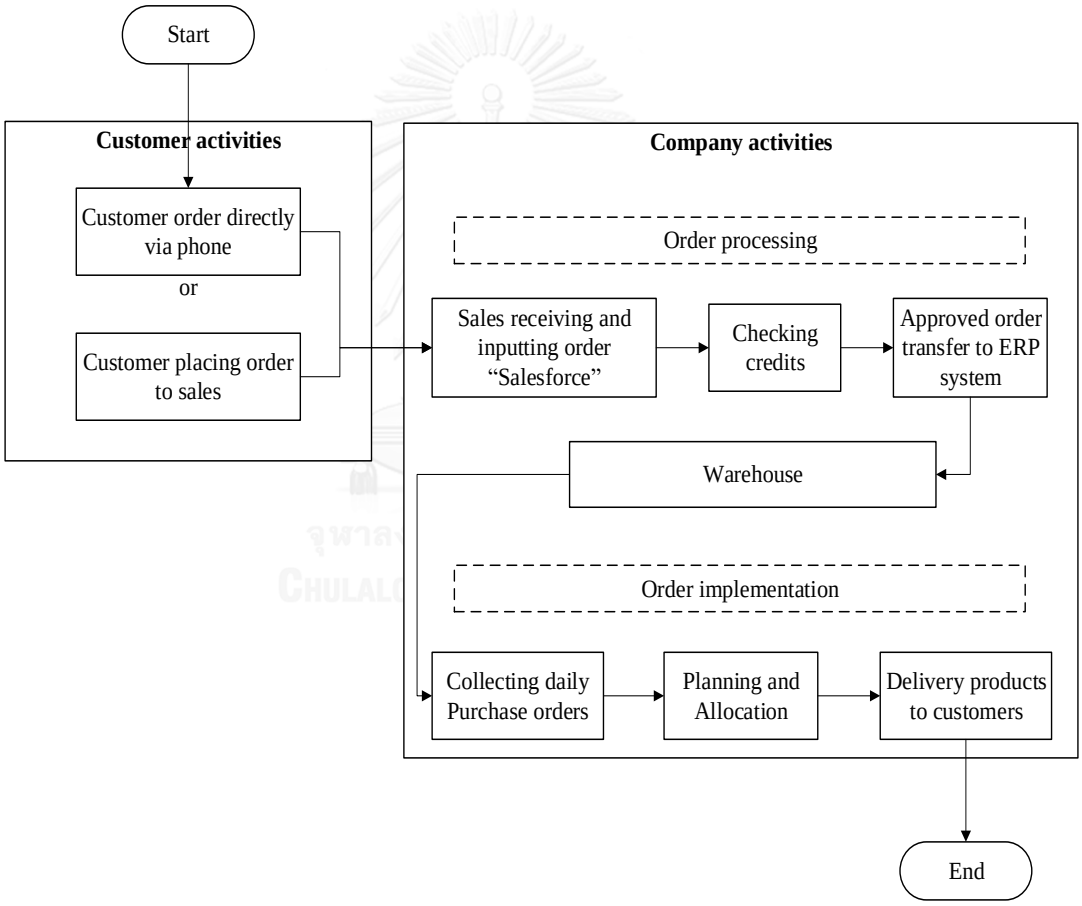

Figure 5 Inbound process divided into two sides; customer and company

3.3 Root cause analysis

3.3.1 Define problem

This company focus to improve its supply chain system. The management board invested in computer application such as ERP and WMS to the internal system. Nonetheless, one of the main processes that has still been done manually is order allocation. This process is important for order fulfilment which related to the inventory and delivery management. Therefore, if this process gets problems, such as inaccuracy or delay, it will directly impact customers. Consequently, the company could receive the negative complaints from customers and possibility of reduction in customer satisfaction and loyalty.

Moreover, the unfulfilled orders may affect to both margin and market share of the company due to the tight competition in footwear industry. Failing to fulfilled orders may create an opportunity for competitors to take away the portion of market share.

As the current manual operation, there are the three mains impacts to the company in planning efficiency as follows:

- Improvement opportunity: With the limited capability, the planner will decide to allocate the product by prioritizing the net sales value. This may cause the company to loss opportunity to get maximum profit and customer loyalty. Furthermore, manual planning and picking have higher tendency to create mistakes compare to the automatic process because there are tremendous product type and SKU.

- No reliability: Based on manual process, the effectiveness of the allocation to fulfil orders in each day can be different. The monitoring and optimizing of product allocation become difficult since the decisions are varied based on skill and experience of planners.

- Flexibility: With variety of products, order fulfilment need to be flexible. In some cases, there are possibility of urgent cases coming from high prioritized customers. The process needs to be promptly react and made instantaneous decision. The re-planning and re-assigning of goods in response to sudden change while optimizing the outcome is hardly done by human. The system can ease the adjustment and fulfilment the requested orders by customers in shorter time.

3.3.2 Analysis of causes and effects

According to define problem section, the main problem is the low efficiency of order allocation process which is classified into 2 factors, internal and external as shown in Figure 6. Internal factors consist of four main causes namely method, labour, inventory, and system. While, the customer requirement is the major external factor of this issue.

Internal factor

- Method:

  Order fulfilment planning is the main factor that affect to ratio of fill rate because this company based the order allocation method on the priority of customers. Therefore, pickers will consider picking orders by their experiences and they do not aware the important of lead time or queuing, consequently this process will be take time and fluctuate of fulfilment level.

- Labour:

  Resulting from using manual process in order picking, workers are the main factor that affect the performance of this process. Human error could happen in every step of the company and it will be easier to make mistake in the complicated processes. Especially, this company has various types of products and sizes, account for about 5,000 SKU. Moreover, there are almost 5,000 customer accounts spread over every provinces of Thailand.

- Inventory:

Filling the orders will only depend on the available stock, therefore the quantity of each item is the most important to every KPI in this thesis. A good demand forecasting is necessary for proper production planning to fill the inventory. Not enough stock and out of stock are the status of poor inventory management which could impact the sale volume and customer satisfaction. In contrast, some SKUs may have high inventory level that can lead to extra cost of inventory holding and low turnover rate. At the same time, the demand forecasting of this case study is planning from sales team which calculated from the historical data and negotiation with customers. Therefore, the forecasting result has high chance to swing and mislead the production planning. Finally, the inventory will have both too high and too low level stock in some SKUs and cannot completely serve the customers' demand.

- System:

According to the previous section, this company has already invested systems in many parts of the supply chain. However, they are individually implemented in each function, do not link to each other. So, the company cannot perfectly utilise the invested systems, resulting in inefficiency of information and goods tracking. Because allocation process needs to connect in both customer and inventory function, the systems are necessary to be used to its maximum potential from beginning of the supply chain to the end. Warehouse management system (WMS), showing the amount of inventory, and ERP or SAP program, showing the order processing and tracking for every customer, need to be connected to allow smooth information transfer for proper allocation process.

External factor

- Customer requirement:

Each customer has different conditions in ordering process such as lead-time, term of payment and ordering pattern, so they are difficult to control. However, they can be managed through communication between sales and customers for mutually agreement in term of order processing and logistics. However, customer satisfaction should be the main focus at all time. So, sales should share the information of each customer to company for proper record and responding to customer's demand and latent need.

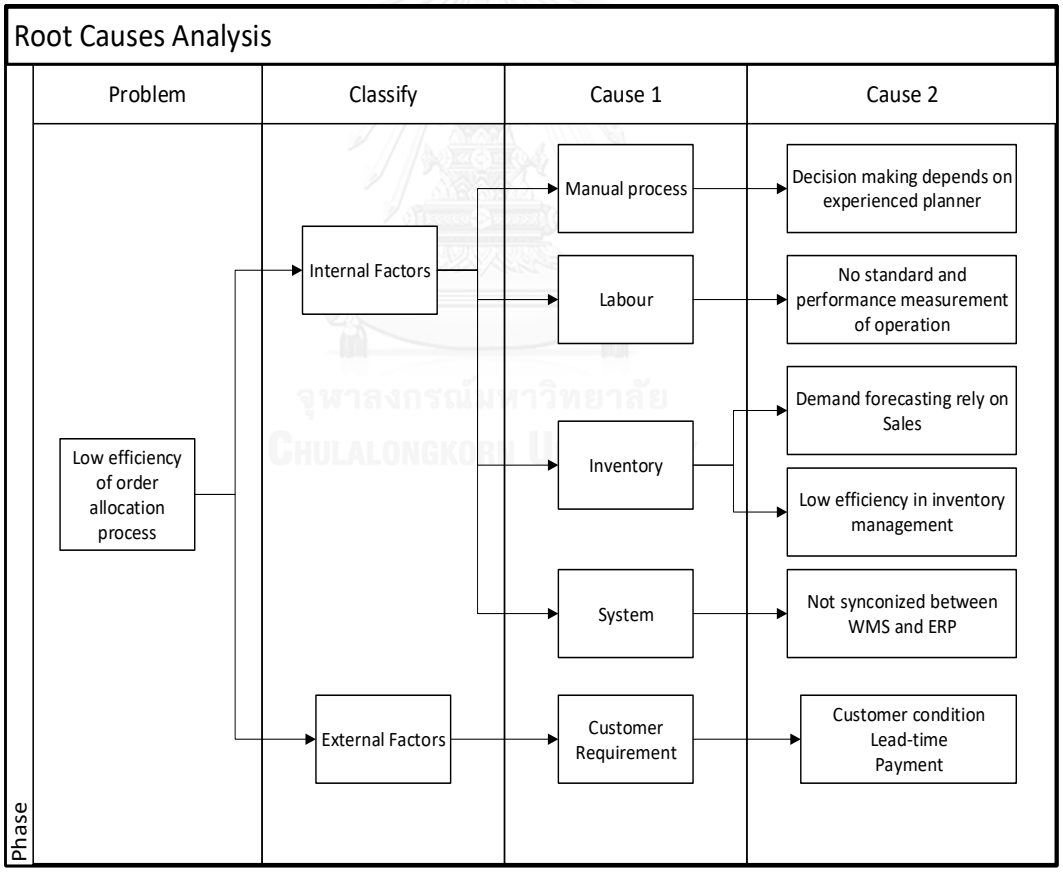

Figure 6 Summary of Root cause analysis

3.4 Proposed improvement

According to root cause identification, steps to improve the efficiency of order allocation process are proposed as shown in Figure 7. It is divided into three main policy; warehouse management, inventory management an order management as follows;

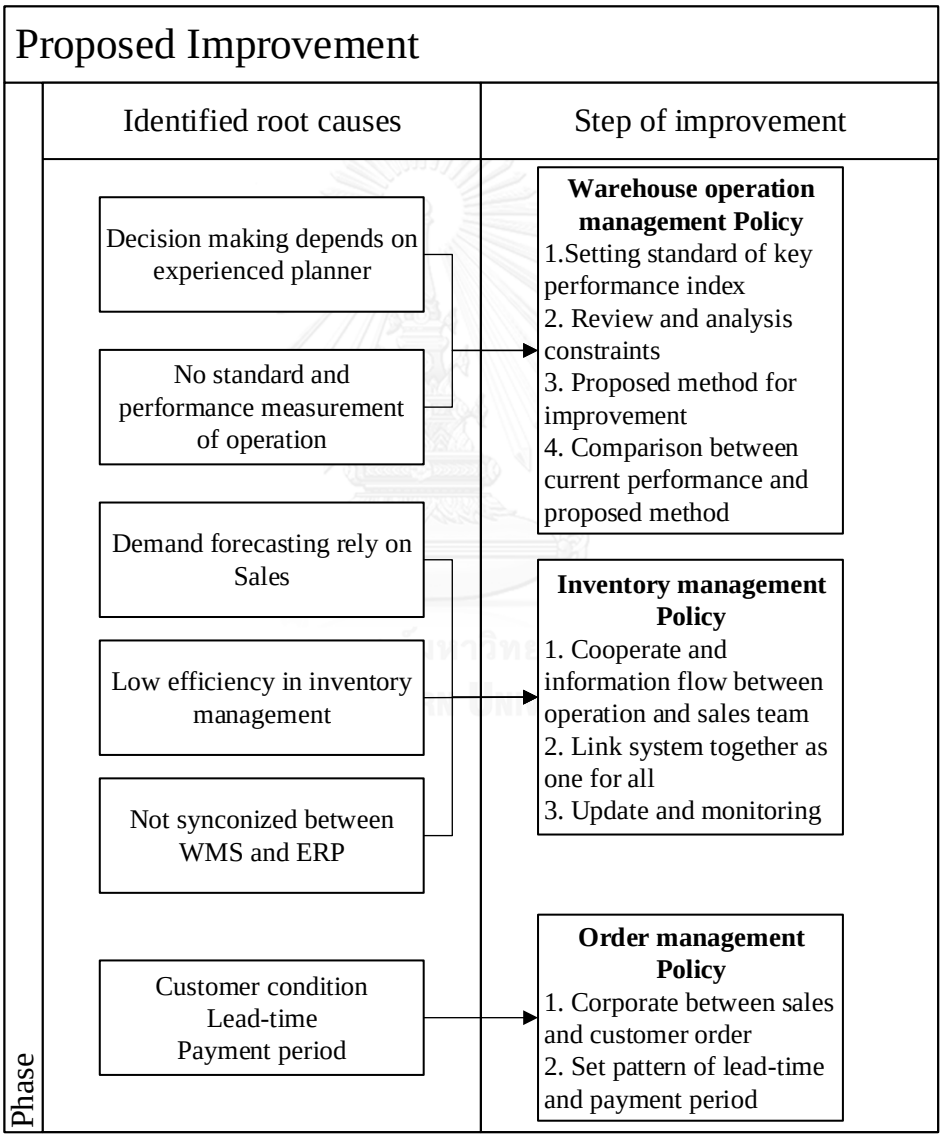

Figure 7 Summary of proposed improvement

Warehouse operation management policy

1. Setting the standard of key performance index:

Regarding the previous section, this company has never measured the performance of operation. Therefore, it is hard to evaluate the efficiency of working, especially order allocation process. So, the KPIs need to be set as the standard to measure the efficiency of fulfilment process.

2. Review and analysis constraints:

According to the result of current performance, each factor that effect to ratio of each KPIs will be analysed to find the related constraints.

3. Proposed method for improvement:

Regarding analysis of constraints, the suitable method for this case study will be applied according to verified constraints. The programming and simulation will be evaluated for the result of proposed allocation methods.

4. Comparison between current performance and proposed method:

The result from the proposed methods will be compared with the current actual performance by based on the same database to see the differences and the possibility of actual implementation will be discussed.

Figure 8 represents the overview of warehouse operation management policy which is the main steps of improvement for this thesis. Root causes of this company are the manual operation, planning and allocation by workers.

Figure 8 Overview of Warehouse management policy

Inventory management policy

1. Cooperation and information between operation and sales team:

Information and communication is the main factors to reduce the misunderstanding and mistake. Data synchronization improves visibility and streamlines ordinarily labour-intensive data integration tasks.

2. Link system together as one for all:

From the discussion with the operation and information system managers, there is no real-time inventory tracking data. Normally the single value of database will be collected in the morning and used as the reference value of stock that day. This information is used to manually match with the orders on the same day by experienced planner. Consequently, mistake or errors from both labour and system could happen because the stock could be changed during processing or operation. Asset tracking paired with a warehouse management system (WMS) could help provide the automatic data necessary for maximizing warehouse productivity.

3. Update and monitoring:

Inventory data is one of the most important information that can enormously affect production and commercial functions. Therefore, information from production can help provide insight information in advance about the shortage or inventory filling period of particular goods. Those will help sales person to properly plan incoming orders, communicate with customers about situation and manage order placement to support production scheme.

Order management policy

1. Corporate between sales and customer order:

Efficiency of order management cannot depend only on the company aspect, but also on customers. Therefore, communication between company and customers could be able to increase customer service level and create the good relationship with

customers. Moreover, it can help reduce the gap of information flow for fulfilling satisfaction level of customers.

2. Set pattern of lead-time and payment period:

Lead-time of customer is one of the criteria in setting the cycle time for opening order and transportation cut-off. This method could be able to increase the efficiency of order management because company can plan customers' demand and manage transportation route. Theses help the company to deliver completed order and on time.

3.5 Conclusion

Currently for the case study company, there is no measurement of operation performance in order allocation process. Thus, the company can neither evaluate the current working efficiency nor create the standard working procedure. Consequently, the owner of this business cannot improve the warehouse operation in the upstream area to respond to customers' need at the downstream of supply chain. Therefore, this thesis explains the important of Key Performance Indexes (KPIs) for measurement the current operation performance and set up four criteria: order, quantity, line or SKU, and back order. Additionally, their different impacts on both customers and company aspects are defined.

The evaluation on KPIs of this company found that order fill rate and case fill rate are below 90%, while line fill rate is about 91% which practically these three KPIs are normally set in business criteria as 95 – 98%. These show that this process has lower efficiency than the normal standard and should have possibility for improvement. Furthermore, there is a high level of back order rate at 15%, implying the poor inventory management. In addition, this rates also impact indirectly to customer satisfaction. Thus, order allocation process is analysed to find the root cause

of low efficiency which are identified into two factors; internal and external. In this study, the researcher focus on the internal factors namely method, labour, inventory, and system. Moreover, the improvement in scope of warehouse management policy is defined to increase the efficiency of order allocation process.

CHAPTER IV

METHODOLOGY

The objective of this phase is to propose methodologies to improve KPIs of order allocation process. Firstly, research structure is outlined and explained on how to achieve the result. Secondly, the data collection at the company is done and relevant factors are analysed. Lastly, the concept of heuristic systems based on different approaches are constructed, aiming to improve the goods allocation process.

4.1 Research structure

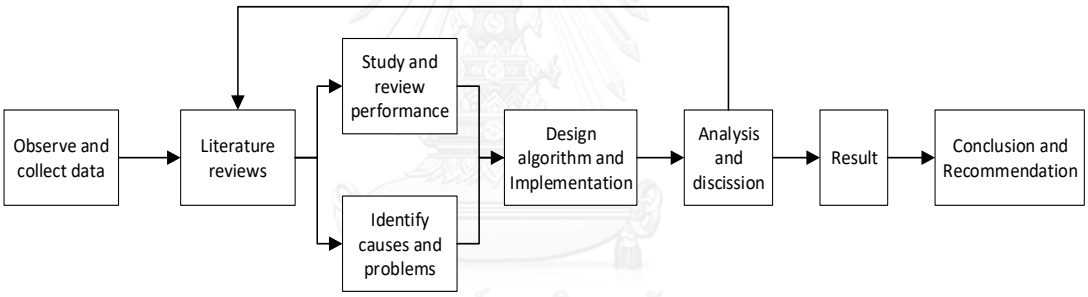

Figure 9 Overview of research structure

Figure 9 outlines the structure of this research. Since this thesis is mainly based on an actual industrial scale of the company, the data need to be collected directly from the related people, especially operators, and system at site. This data will be used as a basis for the design of optimisation methods, calculation, as well as comparison of KPIs between current processes and improved one. Theories and literatures are reviewed in order to identify causes and gaps for improvement. They are studied to find possibilities to improve the order allocation process, through mathematical methods, as well as the relationships and effects between processes in warehouse management. Based on data collected from the company and reviewed

researches, the root causes analysis is conducted and constraints are verified. These are the basis for designing an algorithm and systems to improve the allocation and increase the performance. The program coding is implemented, using actual business orders and inventory data collected in the first state. The results of simulation are used to compare with the current performance. The analysis and discussion are done based on the related literatures and finally the results are evaluated.

4.2 Research methodology

4.2.1 Data collection

After the overall process of the company is studied, described in Chapter II, site visiting is conducted together with the meeting with company owner, operation manager, and information technologist to gather insight operational conditions and problems. Currently, the company has invested software to improve the supply chain management in both order processing and warehouse operation. SAP and warehouse management system (WMS) have been applied, nonetheless, separately in each department, making unconnected flow of data in the system. In the company, orders are input through SAP system with corresponding customer codes, requested delivery date, quality and quantity. Orders are collected in daily basis before sending to warehouse on the next day. Then, customers' conditions are checked, including credit term and delivery requested, and orders are processed on both operational and financial aspects. The inventory, however, has no real-time tracking system. The data of available goods in warehouse need to be manually pulled every morning and used as basis for all allocation done on that day. The bill of materials, allocated goods list, is created manually by operation manager who decided solely based on his expertise. In case that an inventory cannot serve all items of orders, the remaining will be

delivered partially or back dated orders that need to wait for production. Hence, they will impact directly to customer satisfaction and profit of the company.

4.2.2 Constraint Analysis

Currently, the allocation process need to be manually done due to various factors need to be consider before distributing the goods to customers. These conditions are solely based on experience and there is no actual guideline or standard rules. There are some minor supports from Warehouse Management System (WMS) implemented in inventory process including storage layout and coding system. After discussion and data collection, allocation of goods are subjected to various industrial constraints and uncertainty, including good acceptance condition when the order is not fulfilled; partial, back dated or cancels order. Nonetheless, some factors is solely based on negotiation and can be adapted, so we categorized the main constraints that affect goods allocation performances as below:

- Order processing sequence

Even orders are collected based on daily basis, the sequence of goods allocation are random. Sometime the distribution is based on product ordered the most on that particular day, while another may run on First Come, First Serve basis. Randomized sequence is also founded when many operators individually allocate goods at the same time. These decisions are made based on expertise of planners, who normally chose the least difficult methods in their opinion to work with. This non-standardized working process can affect the KPIs and create fluctuation and unreliable calculation. This untraceable performance creates the difficulty in identifying possibility of improvement. This issue can be addressed simply using program, sorting the order in the desired sequence before allocation occur, but arduous to execute manually, especially when many huge orders are on the same day.

- Priority of customers

There are four main types of customers; retailers, wholesalers, modern traders and factories. Each customer has their own credit term and liability as well as priority in receiving allocated goods. Currently this constraint is evaluated mainly based on relationship and negotiating conditions, no system or calculation addressing this factors. In case of scarcity, the operation manager will decide how to distribute the goods for each customer, some special conditions such as urgent and overdue order are also manually considered. Customer who has long term relationship with the planner, even the sales amount is not high or order is not frequent, could be able to get the goods first. This practice can help maintain some customer satisfaction, however, may not improve order or goods filled rate. There are various types of customer classification but the most recognized one is to grade them in to ABC according to their order or sale volume. Practically, customers in grade A will account for about 80% of total goods sales, which is very important to maintain the relationship and their high satisfaction level. This factor could affect the KPIs in negative ways due to the freedom in good allocation is reduced.

- Delivery date

Request delivery date is usually specified together with the purchased orders, however some are not. The company then assigned the delivery date for that orders automatically based on amount of day required for transportation. Each customer is assigned standard shipping time, up to three days, based on delivery locations across Thailand. Nonetheless, there is no practical listed or system generated for this value, the data is added into the system by sales representative or operation manager; decision on delivery date in this case is made by users. When the requested delivery date is not reach, the available goods will be assigned and locked for that particular order, waiting to be fulfilled from the next day inventory or partially shipped when

time comes. This constraint could pay an important role in improvement of KPI in term of quantity fill rate, due to the goods could be fully utilised if the system has flexibility in adjusting the good allocation.

4.2.3 Algorithmic design

After constraints are gathered and studied, the heuristic approach is chosen to solve this allocation problems. Based on the analysis of constraints, we plan to improve the allocation from the least complicated decision and add up to the most complex issued as shown in Figure 10. There are four main approaches as follows;

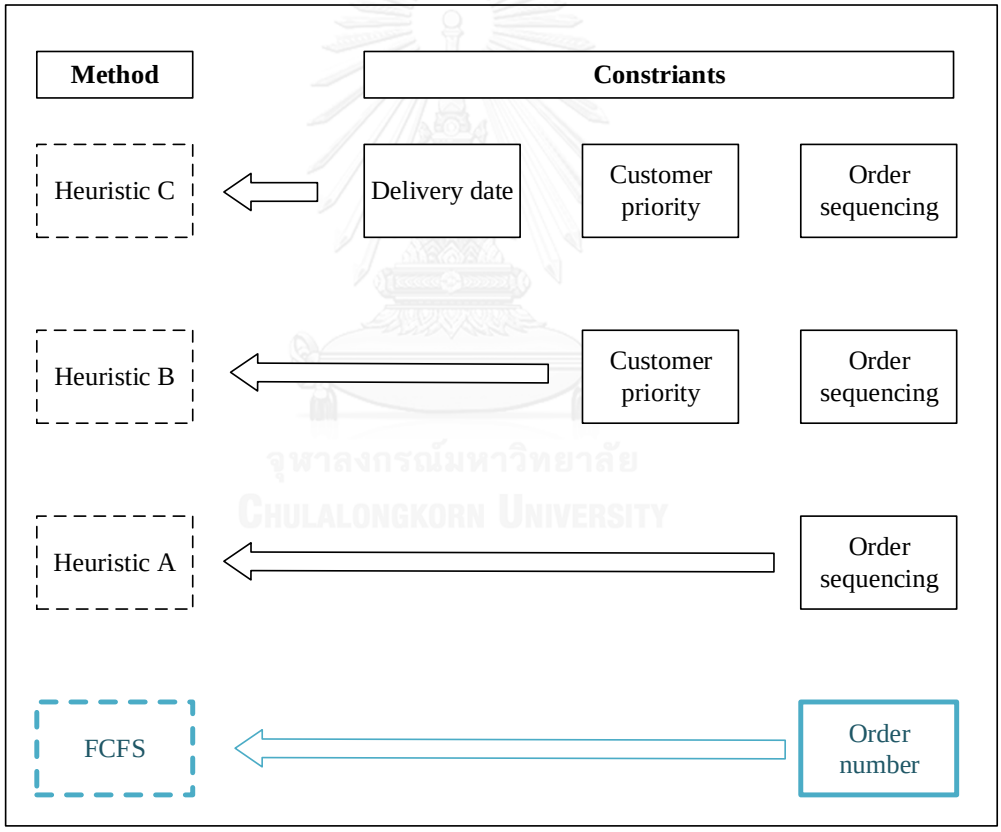

Figure 10 The Overview of method approaches

- FCFS

First-Come, First-Serve (FCFS) is the simple and straight forward method to allocate the good based on time of arrival. Each order will be assigned Sale Order (SO) number based on sequence of inputting into the SAP system. The

programming code will assign goods based on SO number, in ascending order, until complete the order list. This method will be used as a basis for comparison due to the company itself is planning to use FCFS to improve the current system while working on the optimization.

- Heuristic A

  The first heuristic will be designed to increase order fill rate KPI by addressing the sequence of order processing. The main idea is, with the scarcity of goods, completing the order in systematically method should yield the better improved result than the non-standardised one. The consideration will be made between two decision methods:

  Type1: The ascending in amount of line in orders

  Type2: The descending in amount of line in orders

  The comparison will be done based on the order fulfilment KPI and the proper method will be used to study the improvement. This design result will compare to FCFS and the more improved result will be used as a base line for further heuristic methods

- Heuristic B

  Heuristic B will consider additional constraints of customer priority. The customers are classified, based on the collected data, into groups according to their ordered quantities. The highest priority group will contribute mostly to overall goods sold and will get allocated product first. However, in the same priority group, the fewest quantity orders will be filled first in order to improve the order fill rate, based on the result of Heuristic A.

- Heuristic C

  This heuristic approach will address the issue of delivery date. This approach is mainly focus to optimise the quantity fill rate on top of previous

methods. The condition is that amount of day remaining before reaching requested delivery date will be compare to the standard transportation time required. Only the order that meet this requirement will be considered for goods allocation, aiming to reserve the products for orders that need to be delivered only. This will ensure that the allocated goods are delivered in actual business scheme, not just reserve and wait for delivery. In case that various orders need the same SKU within the same day, the allocation priority will follow the method of Heuristic B.

Table 6 Summary the different of four methods approach

Method approach	Differences
FCFS	Based on arrival sequence of order; who order first, get the products first.
Heuristic A	Centred around SKU per order, trying optimizing the order fill rate; studying the effect of systemic order completion
Heuristic B	Adjusted of Heuristic B based on actual industrial constraints of customer priority; the most important customers will receive the products first.
Heuristic C	Utilizing scarce resources, serving the one who only needed. Actual delivery is made with no opportunity wasted from delivery waiting time.

As Table 6, the researcher summarizes main concept in developing the optimization methods based on the four different approaches. The based methods

FCFS will be evaluate first as a standard for comparison. The Heuristic A, B and C will be done and compare with both current operation and FCFS in term of KPIs, set in Chapter 3.

4.3 Conclusion

The current order allocation process of studied company could be able to improve due to the data collected during meeting and site visit that most of the processes are manual. The decision in distributing the good is based on preference or experience of operators, no actual guideline or system supporting these decisions. The factors relating to goods allocation performance are collected, analysed and classified into 3 main constraints: processing sequence, customer priority and delivery date. First-Come, First-Serve approach and three heuristics are constructed based on discussed constraints to try improving the allocation process in diverse aspects.

CHAPTER V

DESIGN AND IMPLEMENTATION

The purpose of this chapter is to explain the design phase which includes database design, algorithm creation, and simulation design based on pseudo diagram and code, and output solution.

5.1 Design phase

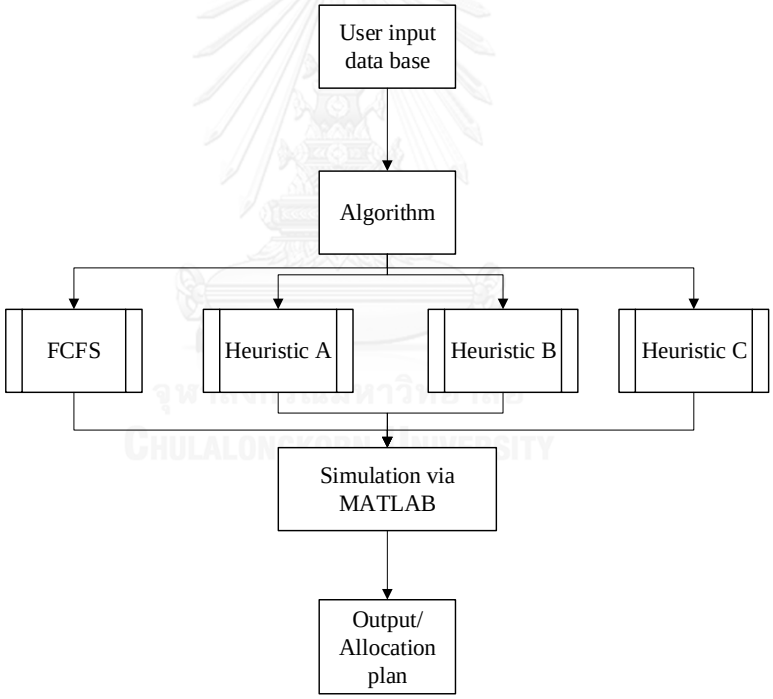

Figure 11 Overview concept of design phase

The concept of allocation process improvement is to support the planning of operation manager to standardise the solution for fulfilment the products to each order. The aim is to increase the order fulfilment rate and strategic planning for support decision of allocation. Figure 11 illustrates the overview concept of this design phase

which divided into three main modules; user input database module; algorithm design module; algorithm, simulation, and output module.

First, this model starts with a user in the planning position input database which is set as a standard template. The template is in term of Microsoft Excel file (.xlsx) which consists of, in order from left to right column, customer code, customer name, order number, delivery date, ordered style, product description, and quantity. All information is sourced from the collected daily orders from the ERP program. User is also required to enter the inventory input, grade of customer, and location as another sheet in the template file. Second, algorithm module, explained in pseudo diagram, indicates the step of order allocation, starting from customer demand until fulfilment finish. In this thesis, researcher proposes four options based construction idea in Chapter4: First-Come, First-Serve (FCFS), Heuristic A, B, and C which are different in the concern of constraints. Lastly, output module is the solution for allocation plan which shown detail of order for the amount of goods allocated, goods not enough in stock, out of stock items and not reach delivery orders.

5.1.1 User input database module

- User inputs

This module is the preparation phase before starting a simulation system which consist of 3 Microsoft Excel sheets; customer order, grade and location, stock as the template of database. In this section, it will explain the preparation of all sheet and include analysis of location and grade of customer that will be used as considered constraints.

Database design

The database is an information template which user need to prepare this database daily, but the limitation is the order of column which have to set according to a template sheet. The database is separated into 3 sheets which consists of order

customer, grade and location, stock. The example of database is shown in Table 7, 8, and 11 respectively

Sheet1: Customer order

Regard to Table 7, it shows the example of detailed customers' order database which generated directly form SAP program. Customer code and name are in a customer mapping, while style and description are in a product mapping. Order number and order date come from order processing, while delivery date and quantity is the detailed from purchase orders of customers. The unit of quantity used is in "each". This data generated from SAP system can be input directly into the simulation. Example of collected database is shown in Appendix II.

Table 7 Example of order customer database

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B0046	204413	16/8/2016	18/8/2016	11207 H6140	12
B0046	204413	16/8/2016	18/8/2016	11207 H6141	12
E0117	204415	16/8/2016	18/8/2016	1G112 176F	24
E0109	204416	16/8/2016	17/8/2016	11401 02040	30
S0357	204440	16/8/2016	19/8/2016	11405 22043	3

Sheet2: Grade and location

Table 8 shows the example of grade and location database which is the constraint database. Customer code is generated from the SAP program as in customer mapping. Location is the province of each customer in Thailand which comes from the address of customer mapping data as well as sales function to confirm the delivery place. The number of transport day is the amount of day required to make the on-time delivery.

Table 8 Example of grade and location database

Customer code	Location	Grade	No. of transport day
E0109	Bangkok	A	1
E0117	Pattalung	A	3
C0236	Rayong	B	2
B0046	Nonthaburi	A	1
N0084	Lampang	C	3
S0357	Pattaya	C	2

Grade of each customer come from the analysis, using Pareto analysis. The analysed method based on ordered quantity as a criterion for calculating the percentage of cumulative quantity. In addition, this company is a local business in Thailand, thus the relationship as well as credibility are the criteria that should be concerned to identify the grade of customer. Figure 12 shows the ABC analysis graph of customer grade. In addition, the company also concern customers in term of relationship, payment term, creditability, purchase characteristic and negotiation ability. Grade of each customer of this case study is analysed as shown in Appendix I.

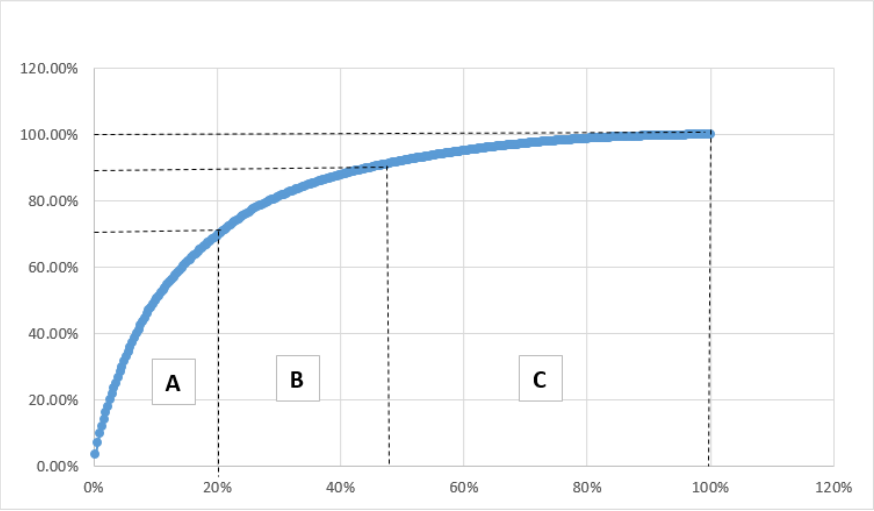

Figure 12 ABC analysis of grade customers

Table 9 Criteria of each grade of customers

Grade	Level of priority	Criteria
A	High	-Long term relationship -Good payment credit -Big quantity per order
B	Medium	-Good relationship -Small-to-medium lot per order -Able to negotiate
C	Low	-Newly customer -Small lot order -Delayed payment

Number of transport day is taken from area of each customer in Thailand; Bangkok and boundary, Central, Northeast, North, South, West, and East as show the detailed of each region and number of transport day respectively in Table 10. This data is extracted from the shipping department as well as sales person of that particular area. However, this value is applied for standard shipping without the concern of any special requirement e.g. urgent delivery request or goods pick up at site arranged by customer.

Table 10 Number of transport day

Area	Period
Bangkok Metropolitan Region	1
Central	2
Northeast	3
North	3
South	3
West	2
East	2

Sheet3: Stock or inventory

Table 11 shows the example of stock which come from the warehouse management system by generating real time stock. The unit of stock quantity is in "each". This stock will be generated only once a day in early morning before the actual allocation process takes place. However, there is no proper method in tracking the amount of inventory during the picking process. So, in this thesis, the researcher will use this inventory data based on day-by-day basis as a representative value of inventory for the allocation process on that particular day.

Table 11 Example of stock in company as case study

STYLE		Quantity
1BA01	070F01	473
1BA01	091F01	473
1BA01	104F01	477
1BA01	131F01	462
1BA02	091F01	158
1BA02	104F01	339
1BA02	120F01	331
1BA02	160F01	336
1BA03	091F01	470
1BA03	104F01	474
1BA03	120F01	467
1BA03	160F01	476

Regarding the concern of different constraints in each optimization method, the data base to run the simulation is also varied. Table 12 summarize the data base sheets required in the simulation for each approach.

Table 12 Summary database sheet of four method

Method	Database sheet
FCFS	- Customer order - Inventory
Heuristic A	- Customer order - Inventory
Heuristic B	- Customer order - Grade and Location - Inventory
Heuristic C	- Customer order - Grade and Location - Inventory

5.1.2 Algorithm design module

- Algorithm

In this module, the heuristic algorithm technique is used to find the solution of order allocation issue in the case study company. Pseudo diagram is the flowcharts showing the steps in program from inputting of information to calculation for the results. The researcher briefly described four approaches to solving the order allocation process problems: FCFS, Heuristic A, B, and C respectively. For the approach to order fulfilment, a representative algorithm by pseudo diagram for each of four approaches as well as pseudo coding of the MATLAB program together with the explanation and example will be discussed.

5.1.2.1 First-Come, First-Serve (FCFS)

The First-Come, First-Serve is the base line in arranging order which assigned customer orders priority based on the sequence of arrival in the system. In this

thesis, arrival time of customer order is represented by order number. As in Figure 13, pseudo diagram and the following subsection is shown and details are as follow;

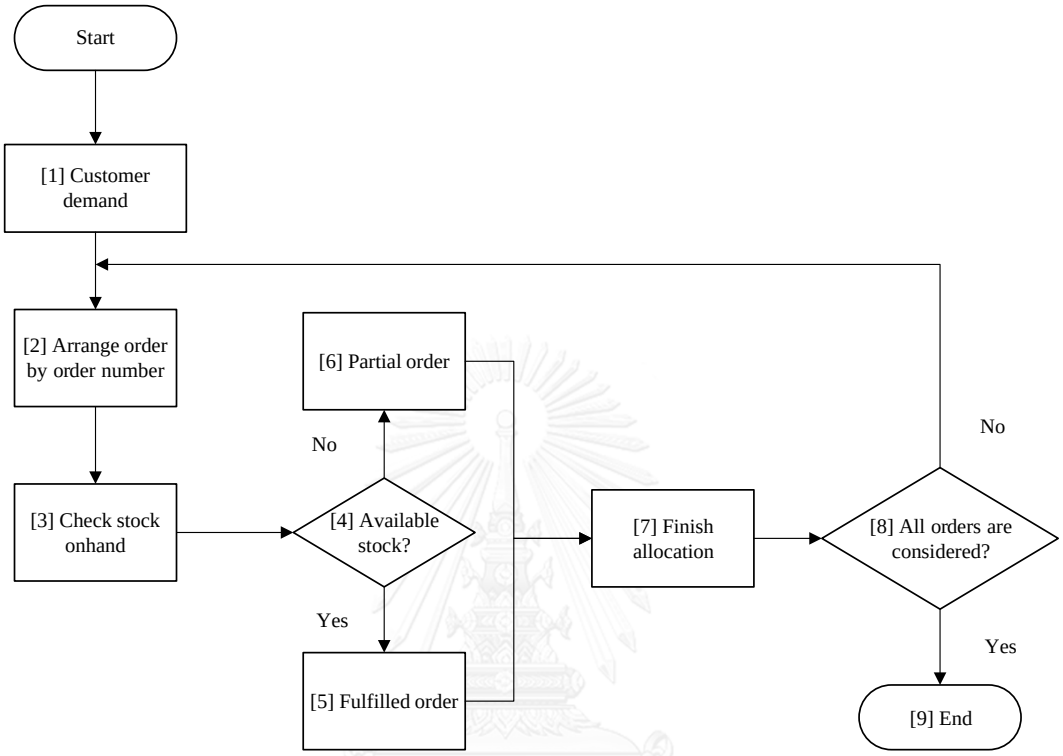

Figure 13 Pseudo diagram of FCFS approach

[1] Customer demand

The database is necessary for this process for starting of the model in MATLAB. Customer demand is in a sheet of order customer database which include all essential information of customer such as order date, order number, customer code, and quantity demand.

[2] Arrange order by order number

At this step, the priority of customer is created by the order number. The sequence will follow the order of input time that Salesforce input into software which is

generated in ascending order number in the SAP system. An example of arranging order is shown in Table 13.

Table 13 Example of arranging order by order number

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B0046	204413	16/8/2016	18/8/2016	11268 52743	12
B0046	204413	16/8/2016	18/8/2016	11268 52744	12
B5473	204414	16/8/2016	23/8/2016	1G305 02037	24
E0117	204415	16/8/2016	18/8/2016	1G152 176F01	48
E0117	204415	16/8/2016	18/8/2016	1G172 220F01	36
C0032	204447	16/8/2016	18/8/2016	11272 32241	1
C0298	204448	16/8/2016	18/8/2016	1205S 02041	36
C0298	204448	16/8/2016	18/8/2016	1205S 02042	24

[3] Checking stock on hand

At this stage, the ordering of customer demand has already arranged in the criteria of both due date and customer grade. Therefore, products are allocated to each order, into each SKU, accord to the priority. The amount of inventory in each SKU is necessary to fulfil order, so the next process will check the available stock to each customer order.

[4] Available stock?

The customer demand is checked with the current stock in this process. There are three possible outputs for this stage. First, the amount of current stock has equal or more than the order quantity, the amount will be assigned and the amount of remaining stock will be adjusted according to the Equation (6). Second, there is current

stock less than customer demand which is shown the status as not enough stock. Third, SKU of customer demand cannot match with the stock database, it will be defined in term of out of stock.

$$S_{new} = S_{current} - O_{qty}(i) \quad (6)$$

Where

$S_{current}$ represents stock on hand

S_{new} represents the available stock after allocation process

$O_{qty}(i)$ represents the quantity of customer (i) demand

[5] Fulfilled order

This step is the result from amount of current stock is equal or more than the ordered quantity in every SKU of the order. Thus, this order will be marked as completed order and moved to the stage [7].

[6] Partial order

This step is the result of current stock is less than customer demand or the ordered line are discontinued in the stock system of company. There are two possible statuses; out of stock and not enough stock. After that it will be moved to the next process.

[7] Finish allocation

The allocation plan is created for this option. As assumed, this plan will be represented that all customer accept partial order in all condition.

[8] All orders are considered?

At this stage, the model will search in the customers' demand for orders which have not been allocated yet. If there is any remaining order, the order will be sent to the stage of arrange orders by order number for re-generating.

[9] End solution

Once the system confirmed that all customer order have been finished to allocation, the model is completed and presented the results to user with allocation plan.

- Simulation

  The pseudocode of the algorithm is shown in Figure 14. This algorithm expects the list of customer order sorted by the time of arrival, done in SAP system, as its input. The program coding will work from the top of the order list to the bottom, according to order number.

```
Input:  Order_list    %% list of customer orders arranged by time of arrival
Input:  Inv_list      %% actual inventory data at beginning of the day
Output: Allocation_list   %% list of orders together with allocated goods

for start to the end of Order_list
|  for start to end of Inv_list
|  |  if product code of Order_list == product code of Inv_list
|  |  |  if amount of product in inventory - order amount >= 0
|  |  |  |     add allocated goods into Allocation_list;
|  |  |  |     remaining inventory = inventory amount- allocated amount;
|  |  |  else
|  |  |  |     "Not enough stock"        %% items are not enough to fill the order
|  |  end
|  end
end

for start to end of Allocation_list %% check for the absolute shortage in inventory
|   if Allocation result is empty
|   |   "Out of Stock";
|   end
end
```

Figure 14 Pseudo code of First-Come, First-Serve

The program coding for First-Come, First-Serve system requires two main inputs; list of order and current inventory holding, naming “Order_list” and “Inv_list” respectively. The program will match the product code between customer orders and inventory, starting from lowest order number. If the goods in inventory is enough to fulfil the requested amount, the products will be assigned to that particular order, otherwise the item will be marked as “Not enough stock”. Additionally, if the matching of product code is fail, meaning there is no such item in the inventory, the item will be marked as “Out of Stock” in the output file naming “Allocation_list”

5.1.2.2 Heuristic A

As discussed in the previous chapter, the main purpose of this thesis is to increase order allocation efficiency. The rate of fulfilment is depended on many constrains. However, this case focus on the order sequencing by line amount. The amount of line can be sorted in either ascending or descending order, and evaluation is need to be done to find the better methods. Pseudo diagram of heuristic A system is shown in Figure 15.

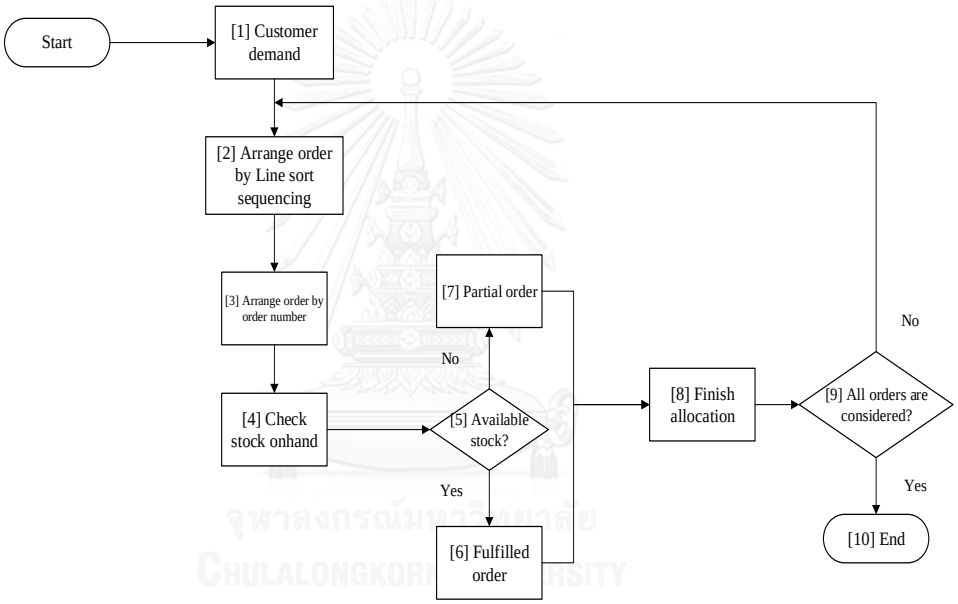

Figure 15 Pseudo algorithm of Heuristic A

[1] Customer demand

Customer demand is the data base necessary in this model. This data is stored in sheet of customer orders database which include all essential information of customer such as order date, order number, customer code, and quantity demand.

[2] Arrange order by line sort ascending/descending

When the customer demand template is entered into the system, the order will be sorted by the amount of line. According to the previous chapter this step will be separated into two types;

Type1: The smallest number of line in purchase order will be chose as the first priority. Then, the priority is arranged in ascending amount of SKUs in orders.

Type2: The largest number of lines in purchase order will be chose as the first priority. Then, the priority is arranged in descending amount of SKUs in orders.

If there are any orders that contain the same amount of line, this system will consider the order number as the second constrains which will be explained in [3].

[3] Arrange order by order number

At this step, the priority of customer is set based on order number. The system will prioritise the lower SO numbered first.

[4] Checking stock on hand

This process will check the quantity of inventory to match with the customer demand.

[5] Available stock?

At this stage, customers' demand will be allocated accord to the amount of available stock. When each SKU is fulfilled, the stock will be adjusted according to Equation (8). The output of this option is two solutions as proposed in this thesis; fulfilled order and partial order. They are explained in the following steps respectively.

[6] Fulfilled order

This step is the result from amount of current stock is equal or more than the ordered quantity in every SKU of the order.

[7] Partial order

According to the previous process, the order is uncompleted, but customers are assumed to accept partial orders. Therefore, the order is partially fulfilled and move to next step.

[8] Finish allocation

The allocation plan is create for the considered order.

[9] All orders are considered?

At this stage, the model will search in the customer demand for orders which have not been allocated.

[10] End

Once the system confirmed that all customer order have been finished. The model is completed and presented allocation plan result.

- Simulation

  The pseudo code of the algorithm is shown in Figure 16. The purpose of this algorithm is to sort the order by ascending sequence. As mentioned, the order fulfilment rate is counted only the completed orders. If there is any line missing, that order will be considered as unfilled**.** Therefore, consider order that has lower amount of line per order first has higher tendency to increase order fill rate.

In Heuristic A, the input and output of the program are similar to First-Come, First-Serve. However, the additional process is added in the first part of the coding. The coding will received the "Order_list" file and generate the list of order number with no duplication, naming "SO_list" file. Then the first programing loop will check and record how many times each order number appear in the Order_list. The frequent of appearance is represent the amount of line in the particular orders. Then the order will be sorted in ascending amount of line sequence under the file "Sort_order". This sorted list will be used in the outer most loop of the second section of the program, forcing the allocation to be done in ascending line order. The process is also repeated for the descending sequence for the comparison.

```
Input:  Order_list    %% list of customer orders arranged by time of arrival
Input:  Inv_list      %% actual inventory data at beginning of the day
Output: Allocation_list   %% list of orders together with allocated goods

SO_list = unique order number in Order_list;

for start to end of SO_list
  if order number in SO_list == order number of item
     amount of line in that order number + 1;
  else
    continue
end

Sort_order = sorted Order_list based on ascending of quality;

for start to end of Sort_order     %% allocate the least amount of quality per order first
 for start to the end of Order_list
    for start to end of Inv_list
      if product code in Order_list == product code in Inv_list
       if amount of product in inventory - order amount >= 0
          add allocated goods into Allocation_list;
          remaining inventory = inventory amount- allocated amount;
       else
          "Not enough stock"       %% items are not enough to fill the order
       end
    end
 end
end

for start to end of Allocation_list %% check for the absolute shortage in inventory
    if Allocation result is empty
       "Out of Stock";
    end
end
```

Figure 16 Pseudo code of Heuristic A

5.1.2.3 Heuristic B

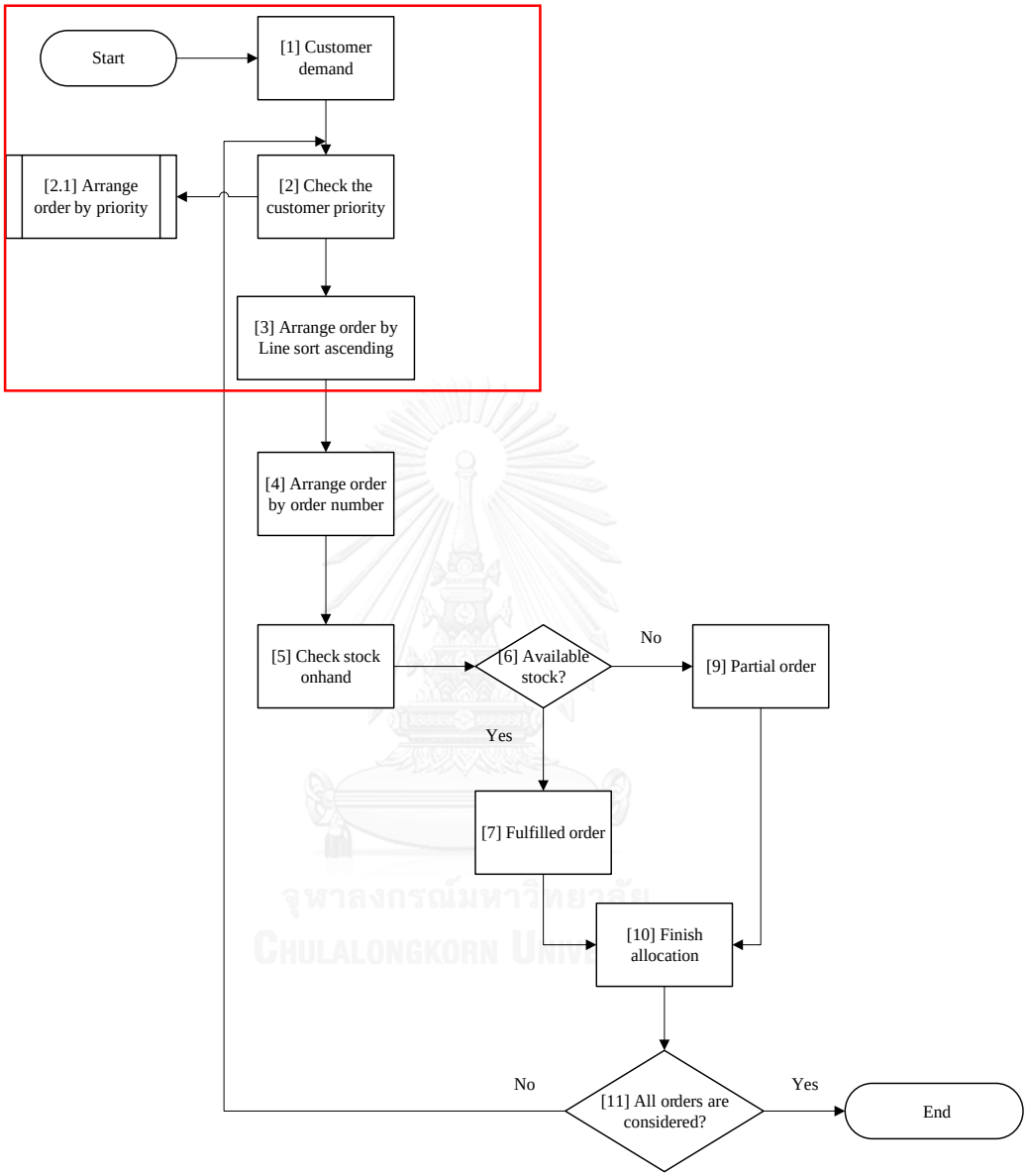

Figure 17 Pseudo diagram of Heuristic B

The concept of Heuristic B was discussed in the previous chapter. The algorithm is based on customer priority constraint. Most processes are the same with Heuristic A but a small step is added at the beginning, shown in red box in the diagram. Implementation detail of the algorithm using heuristic method and the pseudo diagram are shown in Figure 17.

[1] Customer demand

The customer demand is the output from database which consists of 3 sheets in term of excel file. The database is necessary information for using in the system to calculate for the solution.

[2] Checking the customer priority

The priority of customers is refer to the Pareto analysis done in the previous section, classified customers into Grade A, B, and C. Therefore, the prioritized Grade A customer will be focused first and followed by B and C.

[2.1] Checking the order line of each customer

In regards to pervious process, if customer are classified into the same Grade A, their orders will be prioritized from the ascending amount of order line. So, the smallest order of Grade A customer will receive the product first, followed the bigger one in the same grade before moving to the next grade of customers.

[3] – [10] are same as the previous section of Heuristic A

- **Simulation**

The pseudo code of the algorithm is shown in Figure 18. The purpose of this algorithm is to take the priority of customer as the first real industry constraint into account. The program coding will automatically check for the grade of customer based on the calculated value. Customer grade A who has higher credibility and tend to order more goods will received products first. In case that the customer is in the same grade, the program will automatically assign the goods to the lowest amount of line per order first, trying to maximize the order fill rate. When the arranging process is finished, the order will be matched with available stock and goods will be assigned if the stock is enough to fulfil the requested line. If stock is not enough the system will mention as “Not enough stock”. In case that the ordered quality cannot be match with the stock, the system will mention as “Out of stock” Lastly, the process is repeated until all order are considered.

```
Input:  Order_list    %% list of customer orders arranged by time of arrival
Input:  Inv_list      %% actual inventory data at beginning of the day
Input:  Customer_grade %% list of customer with their assigned priority
Output: Allocation_list  %% list of orders together with allocated goods

SO_list = unique order number in order list;

for start to end of SO_list
 if order number in SO_list == order number of item
    amount of line in that order number + 1;
 else
   continue
end

Sort_order = sorted Order_list based on ascending of quality;

for start to end of Sort_order     %% allocate the least amount of quality per order first
 for start to the end of Order_list
  if order number == order number in Sort_order
    check for customer priority based on Customer_grade;
   for start to end of Inv_list
    if product code in Order_list == product code in Inv_list
     if amount of product in inventory - order amount >= 0
         add allocated goods into Allocation_list;
         remaining inventory = inventory amount- allocated amount;
     else
         "Not enough stock"       %% items are not enough to fill the order
     end
   end
  else
   continue
 end
end

for start to end of Allocation_list %% check for the absolute shortage in inventory
   if Allocation result is empty
     "Out of Stock";
   end
end
```

Figure 18 Pseudo code of Heuristic B

In coding of Heuristic B, list of customer grade is required as an additional input when compare to previous models. The sorting of small-to-large order process is the same with previous coding, however, the allocation process is modified. Customer grade is checked in the second loop in programming code, before comparing the product code in order list and inventory. The customers with higher priority will receive the goods in the first run of the loop according to ascending amount of line in their orders. Each continue running loop will reduce the priority of customer by one: First

loop is checking for A, then second for B and third for C. The other process in allocation of goods is similar to previous method.

5.1.2.4 Heuristic C

The Heuristic C will have additional approach of delivery condition on top from the previous methods. It will utilise scarce goods, trying to fulfil the highest amount of orders possible. The input of this module is customer demand including order date, requested delivery date, grade of customer and amount of day required for transportation. Implementation of the algorithm using heuristics in greater detail and pseudo diagram are shown in Figure 19.

[1], [5] – [13] as same as the previous section of Heuristic B

[2] Arrange order by due date

At this step, the priority of customer is created by the delivery date constraint. Orders are arranged based on their requested delivery date, as shown on Table 14. In the example program will automatically arrange delivery date of 17 Aug 2016 as the first priority, while the delivery date on 19 Aug 2016 is the last priority order.

Table 14 Example of arrange order by due date

Customer Code	Order No.	Order Date	Requested Delivery Date	Style	Quantity
E0109	204416	16/8/2016	17/8/2016	11401 02040	30
E0117	204415	16/8/2016	19/8/2016	1G112 176F	24
B0046	204413	16/8/2016	19/8/2016	11207 H6141	12
B0046	204413	16/8/2016	19/8/2016	11207 H6140	12
S0357	204440	16/8/2016	20/8/2016	11405 22043	3

[3**]** Next day delivery?

The selected customers are checked for order date versus the requested delivery date according to Equation (7). The amount of day customer requested will be compare to the standard amount of transportation day required of that customer. Next day delivery condition will be verified based on T_C in Equation (8). If T_C is less than one, the order will need to be fulfill first, otherwise it have to wait in the queue for the evaluation on the next day

$$T_{day}(i) = D_{dev} - D_{order} \quad (7)$$

Where

$T_{day}(i)$ represents the amount of day that customer(i) request for delivery

D_{order} represents order date from customer(i)

D_{dev} represents requested delivery date from customer(i)

[3.1] Checking the number of transport day

In this process, it is the process of arranging order by due date. Some orders have the same evaluated delivery date requested, but they require difference amount of day for transportation. Therefore, the priority will be varied based on location of each customer, accord to the section of grade and location database. Its location is settled based on different region in Thailand. Regarding Equation (7), the delay condition of each customer is checked by concerning the number of transportation day. $T_{required}$ is the standard transportation day required to deliver good to customer location according to example in Table 8. Each customer that has T_C less than or equal to one will be defined as next day delivery order and will be sent to the next process, otherwise it will be marked as “Not reach delivery date”. Table 15 shows the example after checking the transport date. It illustrates that the customer E0117 will received the goods before customer B0046 although they have the same requested

delivery date because the amount of day required for transport of E0117 and B0046 are 3 and 1 day, given the value of T_C equal to 0 and 2 respectively. So, order of customer E0117 will consider as next day delivery order.

$$T_C(i) = T_{day}(i) - T_{required}(i) \quad (8)$$

Where

$T_C(i)$ represents the Transportation condition

$T_{required}(i)$ represents the number of transport day required of customer (i)

Table 15 Example of checking the number of transport day

Customer Code	Order No.	Order Date	Requested Delivery Date	T_{day}	$T_{required}$	T_C	Next day delivery
E0109	204416	16/8/2016	17/8/2016	1	1	0	YES
E0117	204415	16/8/2016	19/8/2016	3	3	0	YES
B0046	204413	16/8/2016	19/8/2016	3	1	2	NO
B0046	204413	16/8/2016	19/8/2016	3	1	2	NO
S0357	204440	16/8/2016	20/8/2016	4	2	2	NO

[4] Waiting for queue

This step is will applied only to the order with “Not reach delivery date mark”. Customer demand will not be considered in the allocation process. Therefore, it will be moved to the status of waiting for queue and carried over as to next day.

[5] – [14] as same as the previous section

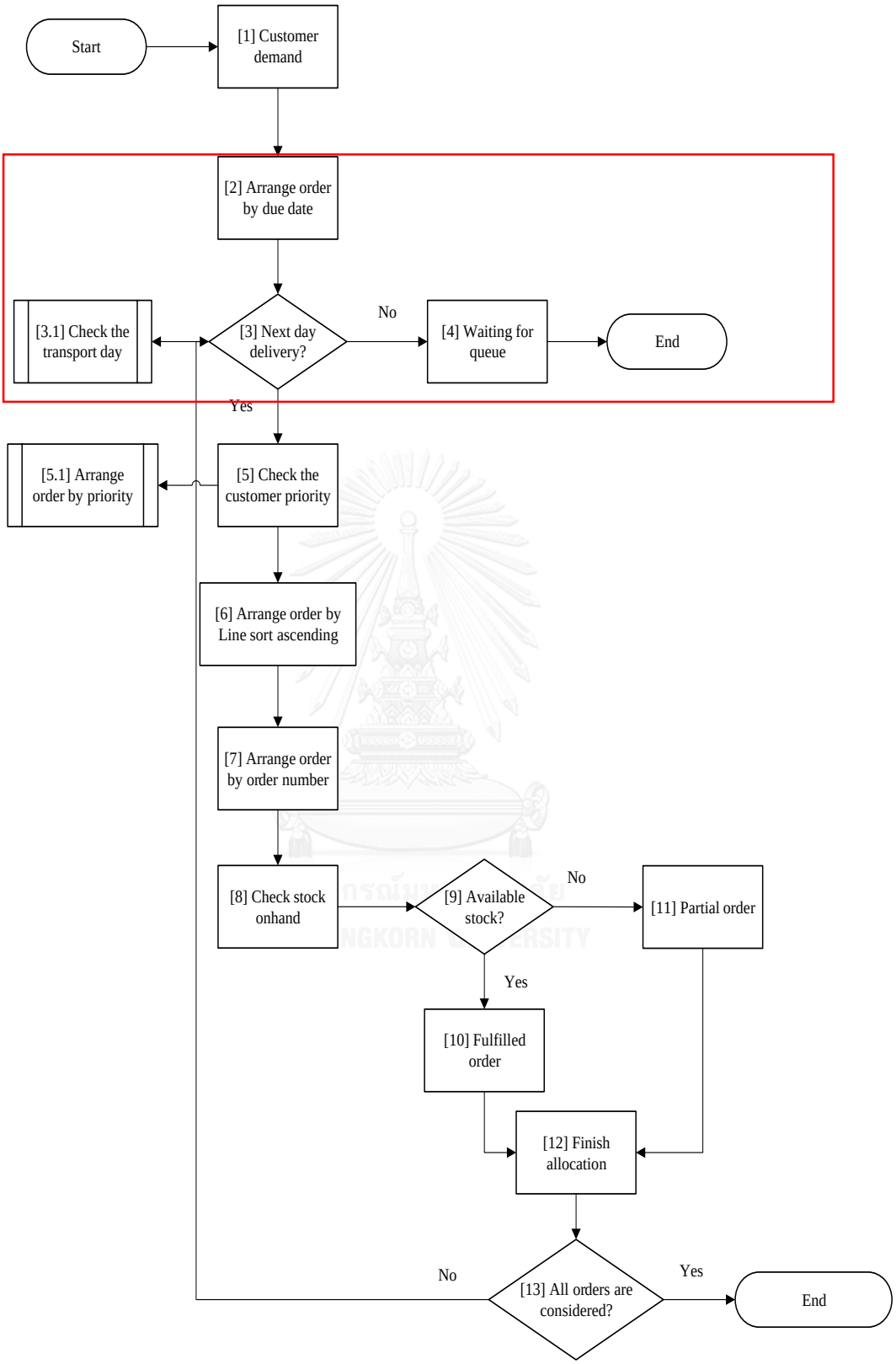

Figure 19 Pseudo diagram of Heuristic C approach

- Simulation

Simulation of this Heuristic starts form considering due date of each customer which match to period of transportation. After the model has already considered the lead time of purchase order, it arrange the processing sequence by customer priority, sorting ascending of line and order number respectively. When the arranging process is finished, the order will be match with available stock. The result can be both fulfil or partial order, depending on the amount of inventory. Lastly, the process is repeated until all order is considered.

In Heuristic C, addition input and programming loops are required to take delivery date condition into account. The first running loop will determine the amount of day between order date and requested delivery date in customer order list. Then, the second programing loop will compare the calculated amount of day with the new input, "Delivery_condition", containing the actual transportation day required to deliver goods to each customer. Then this condition will be added during allocation process to check whether a particular order need to be allocated today or can be postponed to tomorrow.

The process of ascending order sorting, customer grade checking and allocation system remain the same. However, the postponed order need to be manually moved to the order list of the next day before calculation starts.

```
Input:  Order_list                  %% list of customer orders arranged by time of arrival
Input:  Inv_list                    %% actual inventory data at beginning of the day
Input:  Customer_grade              %% list of customer with their assigned priority
Input:  Delivery_condition          %% list including transportation time required
Output: Allocation_list             %% list of orders together with allocated goods

for start to end of Order_list
    Amount_day_requested = requested date - order date;
    Sort Order_list by requested date;
end

for start to end of Order_list
    Delay_condition = Ammount_day_requested - Delivery_condition
end

SO_list = unique order number in order list;

for start to end of SO_list
  if order number in SO_list == order number of item
      amount of line in that order number + 1;
  else
   continue
end

Sort_order = sorted Order_list based on ascending of quality;

for start to end of Sort_order      %% allocate the least amount of quality per order first
 for start to the end of Order_list
  if Delay_condition <=1            %% check for delivery date
   if order number == order number in Sort_order
     check for customer priority based on Customer_grade;
    for start to end of Inv_list
     if product code in Order_list == product code in Inv_list
      if amount of product in inventory - order amount >= 0
          add allocated goods into Allocation_list;
          remaining inventory = inventory amount- allocated amount;
      else
          "Not enough stock"        %% items are not enough to fill the order
     end
    end
   else
    continue
  else
  "NOT REACH DELIVERY DATE";
   Order date + 1;                  %% not reach delivery date orders are moved to next day
 end
end

for start to end of Allocation_list %% check for the absolute shortage in inventory
    if Allocation result is empty
       "Out of Stock";
    end
end
```

Figure 20 Pseudo code of Heuristic C

5.3 Output module

This module is the result form the simulation by using MATLAB program. MATLAB is the program for numerical calculations and high efficiency of visualisation. Working within the MATLAB program based on the Matrix Manipulation and Computation. All the algorithm is created under the MATLAB m-file type (.m) as a function. By using MATLAB, these program codes can be further developed by adding user interface and use as a standalone program for the actual implementation, which is not in the scope of this thesis. Algorithm is created for MATLAB to calculate for the allocation plan. In this thesis, the researcher designs the output as excel file as an example of order allocation plan, according to Table16. The output will show in the column, named Order allocation which show the amount of quantity with the matching available inventory. However, if stock is less than the amount of inventory, it will show "Not enough stock". While, if the customer demand order the item which cannot find in the stock database, it will show "Out of Stock".

Table 16 Example of order allocation plan

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity	Order allocated
E0109	204416	16/8/2016	17/8/2016	11401 02040	30	**30**
E0117	204415	16/8/2016	18/8/2016	1G112 176F	24	**24**
B0046	204413	16/8/2016	18/8/2016	11207 H6141	12	**12**
B0046	204413	16/8/2016	18/8/2016	11207 H6140	12	**12**
S0357	204440	16/8/2016	19/8/2016	11405 22043	3	**3**

5.4 Conclusion

In summarize, this chapter mention about database design, algorithm and simulation from the concept of methodology. First, database is prepared by the staff of the company according to the template file, based from SAP system. The design process considers the three main constraints as discussed in the previous chapter;

priority of order is defined in term of order number sorting order, priority of customer is analysed by Pareto analysis, and due date of customer is defined by location in Thailand. Second, algorithm of four method approaches are explained in term of pseudo diagram and pseudo code. The programming model is simulated in MATLAB program according to set of rules. Third, the output of this methodology is the order allocation plan in term of excel file to ease the implementation in the business.

CHAPTER VI

RESULT AND DISCUSSION

In this chapter, the result of simulation will be demonstrated. The research purpose to improve the efficiency of order allocation process. According to Design and Implementation chapter, it suggested the four approaches to increase the efficiency by simulation via MATLAB program for support decision in allocation planning. Next, discussion is conducted based on related theory and literature review.

6.1 Result

This section represents the four method approaches result which referred as the output of simulation. There are total of 11 operational days in two week period and result of each day is collected at distribution centre of the company. Furthermore, the researcher calculates the output in term of KPIs for performance evaluation. The details were described in the following tables by divided into four method approaches.

6.1.1 First-come, first serve (FCFS)

Regarding Table 17, the result of FCFS approach is shown from output of MATLAB simulation. The researcher collects the data in term of order, quantity, and line for KPIs calculation. Daily amount of order, shown in second column, is fluctuated because there are orders between 13 and 53 per day. The next column represents the uncompleted order which cannot be delivered to customer perfectly. The undelivered quantity is calculated from the different between total quantity-in and total quantity-out. Third, the missed line is came from total lines-in minus total lines-out. This method result in 57 uncompleted orders, more than 5,600 each missed, and 202 missing line of products.

Table 17 The result of First-come, first serve (FCFS)

Day	Order	Uncompleted order	Total quantity-in	Total quantity-out	Total lines-in	Total lines-out
1	35	6	6,575	6,319	797	790
2	53	6	15,026	14,717	1,638	1,620
3	40	9	10,877	9,694	787	761
4	34	4	4,592	4,381	851	835
5	27	4	5,839	5,434	501	491
6	17	3	2,236	2,179	466	442
7	35	6	6,095	5,665	930	918
8	33	8	7,037	6,455	932	914
9	43	7	8,716	8,257	839	808
10	11	2	2,774	1,286	158	137
11	13	2	1,741	1,508	235	216
Total	**341**	**57**	**71,508**	**65,895**	**8,134**	**7,932**

Table 18 Performance measurement of FCFS approach

Day	Order fill rate	Case fill rate	Line fill rate	Back order rate
1	82.9%	96.1%	99.1%	17.1%
2	88.7%	97.9%	98.9%	11.3%
3	77.5%	89.1%	96.7%	22.5%
4	88.2%	95.4%	98.1%	11.8%
5	85.2%	93.1%	98.0%	14.8%
6	82.4%	97.5%	94.8%	17.6%
7	82.9%	92.9%	98.7%	17.1%
8	75.8%	91.7%	98.1%	24.2%
9	83.7%	94.7%	96.3%	16.3%
10	81.8%	46.4%	86.7%	18.2%
11	84.6%	86.6%	91.9%	15.4%
Overall	**83.28%**	**92.15%**	**97.52%**	**16.72%**

Table 18 represents the analysis KPIs of FCFS. The overall order fill rate is 83.3% with related the back order rate, about 17% is unable to deliver to customer. The case fill rate shows 92.15% of goods is delivered. This rate can be more or less, depended on the amount of inventory in that day. Next, the number of missed line items to fulfil order is approximately 2.5**%**.

6.1.2 Heuristic A

Table 19 The result of comparison of completed order between Descending and Ascending

Day	Order	Completed order of Type1-Descending	Completed order of Type2-Ascending
1	35	29	29
2	53	46	47
3	40	30	31
4	34	30	30
5	27	23	23
6	17	17	17
7	35	29	29
8	33	25	25
9	43	37	38
10	11	9	9
11	13	12	12
Total	**341**	**287**	**290**

With regard to Table 19, the results between descending and ascending amount of line in orders are compared. Heuristic A-type 2 can complete order more than type1. Therefore, the researcher selects Heuristic A-type1 as a design baseline for heuristic approaches. The result of Heuristic A method is shown in Table 20. This

method result in 51 uncompleted orders, more than 5,300 quantity missed, and around 150 line item missing.

Table 20 The result of Heuristics A- Type2 (Ascending)

Day	Order	Uncompleted Order	Total quantity-in	Total quantity-out	Total lines-in	Total lines-out
1	35	6	6,575	6,319	797	790
2	53	6	15,026	14,717	1,638	1,620
3	40	9	10,877	9,694	787	761
4	34	4	4,592	4,381	851	835
5	27	4	5,839	5,434	501	491
6	17	0	2,236	2,236	466	466
7	35	6	6,095	5,665	930	918
8	33	8	7,037	6,455	932	914
9	43	5	8,716	8,285	839	826
10	11	2	2,774	1,286	158	137
11	13	1	1,741	1,732	235	226
Total	**341**	**51**	**71,508**	**66,204**	**8,134**	**7,984**

Table 21 represents the KPIs analysis of FCFS as followed. The overall order fill rate is 85% of the total, resulting in about 15% back order rate. The case fill rate shows about 92.6% of ordered goods is delivered. Next, the number of missed line items to fulfil order is approximately 1.8**%** which represent the planned of production in SKUs.

Table 21 Performance measurement of Heuristics A approach - Type2 (Ascending)

Day	Order fill rate	Case fill rate	Line fill rate	Back order rate
1	82.9%	96.1%	99.1%	17.1%
2	88.7%	97.9%	98.9%	11.3%
3	77.5%	89.1%	96.7%	22.5%
4	88.2%	95.4%	98.1%	11.8%
5	85.2%	93.1%	98.0%	14.8%
6	100.0%	100.0%	100.0%	0.0%
7	82.9%	92.9%	98.7%	17.1%
8	75.8%	91.7%	98.1%	24.2%
9	88.4%	95.1%	98.5%	11.6%
10	81.8%	46.4%	86.7%	18.2%
11	92.3%	99.5%	96.2%	7.7%
Overall	**85.04%**	**92.58%**	**98.16%**	**14.96%**

6.1.3 Heuristic B

Heuristics B is the algorithm designed base on customer priority, divided into three classes based on ABC analysis. The simulation result of Heuristic B is shown as the Table 22: It can deliver 287 completed orders and 54 order partially. KPIs of this method is analysed as illustrated in Table 23. Back order rate of this method is account for 15.84%. Case fill rate is 92.6%. Line fill rate of Heuristic B is 98.12%, represented from the completed line in each customer order

Table 22 The result of Heuristics B

Day	Order	Uncompleted Order	Total quantity-in	Total quantity-out	Total lines-in	Total lines-out
1	35	6	6,575	6,319	797	790
2	53	7	15,026	14,732	1,638	1,620
3	40	9	10,877	9,694	787	761
4	34	4	4,592	4,381	851	835
5	27	4	5,839	5,434	501	491
6	17	1	2,236	2,230	466	463
7	35	6	6,095	5,665	930	918
8	33	8	7,037	6,455	932	914
9	43	6	8,716	8,286	839	826
10	11	2	2,774	1,286	158	137
11	13	1	1,741	1,732	235	226
Total	**341**	**54**	**71,508**	**66,214**	**8,134**	**7,981**

Table 23 Performance measurement of Heuristics B approach

Day	Order fill rate	Case fill rate	Line fill rate	Back order rate
1	82.9%	96.1%	99.1%	17.1%
2	86.8%	98.0%	98.9%	13.2%
3	77.5%	89.1%	96.7%	22.5%
4	88.2%	95.4%	98.1%	11.8%
5	85.2%	93.1%	98.0%	14.8%
6	94.1%	99.7%	99.4%	5.9%
7	82.9%	92.9%	98.7%	17.1%
8	75.8%	91.7%	98.1%	24.2%
9	86.0%	95.1%	98.5%	14.0%
10	81.8%	46.4%	86.7%	18.2%
11	92.3%	99.5%	96.2%	7.7%
Overall	**84.16%**	**92.60%**	**98.12%**	**15.84%**

6.1.3 Heuristic C

This approach represent allocation process base on the all concerned constraints of as case study; the priority of order, customer priority, and lead-time of delivery date. After simulation is done, the result is shown in Table 24. It can allocate 287 completed order as well as 54 partially. KPIs of this method is analysed as represented in Table 25. The back order rate of this method is account for 15.84%. However, case fill rate is 92.83% which showed the overall of this KPI seem to be in a high level. However, range of total day is 67.2 to 99.7%, fluctuated volume of this rate due to the amount of inventory. Line fill rate of Heuristic B is about 98%.

Table 24 The result of Heuristics C

Day	Order	Uncompleted order	Total quantity-in	Total quantity-out	Total lines-in	Total lines-out
1	33	5	6,341	6,109	783	777
2	53	7	15,026	14,732	1,638	1,620
3	36	9	10,620	9,437	736	710
4	21	2	3,258	3,148	554	549
5	40	7	5,516	5,088	774	751
6	22	1	4,180	4,072	468	466
7	31	3	5,039	4,937	918	912
8	26	8	5,362	4,794	591	572
9	36	6	7,589	7,155	857	844
10	25	4	5,054	3,397	437	409
11	18	2	3,523	3,512	378	368
Total	**341**	**54**	**71,508**	**66,381**	**8,134**	**7,978**

Table 25 Performance measurement of Heuristics B approach

Day	Order fill rate	Case fill rate	Line fill rate	Back order rate
1	84.8%	96.3%	99.2%	15.2%
2	86.8%	98.0%	98.9%	13.2%
3	75.0%	88.9%	96.5%	25.0%
4	90.5%	96.6%	99.1%	9.5%
5	82.5%	92.2%	97.0%	17.5%
6	95.5%	97.4%	99.6%	4.5%
7	90.3%	98.0%	99.3%	9.7%
8	69.2%	89.4%	96.8%	30.8%
9	83.3%	94.3%	98.5%	16.7%
10	84.0%	67.2%	93.6%	16.0%
11	88.9%	99.7%	97.4%	11.1%
Overall	**84.16%**	**92.83%**	**98.08%**	**15.84%**

Figure 21 shows the overall key performance indexes of four approaches in percentage level of 11 working day based on actual corrected data. The overall result shows the same trend in the high percentage of three KPIs; order, case and line fill rate. While, back order rate is around 15-18%.

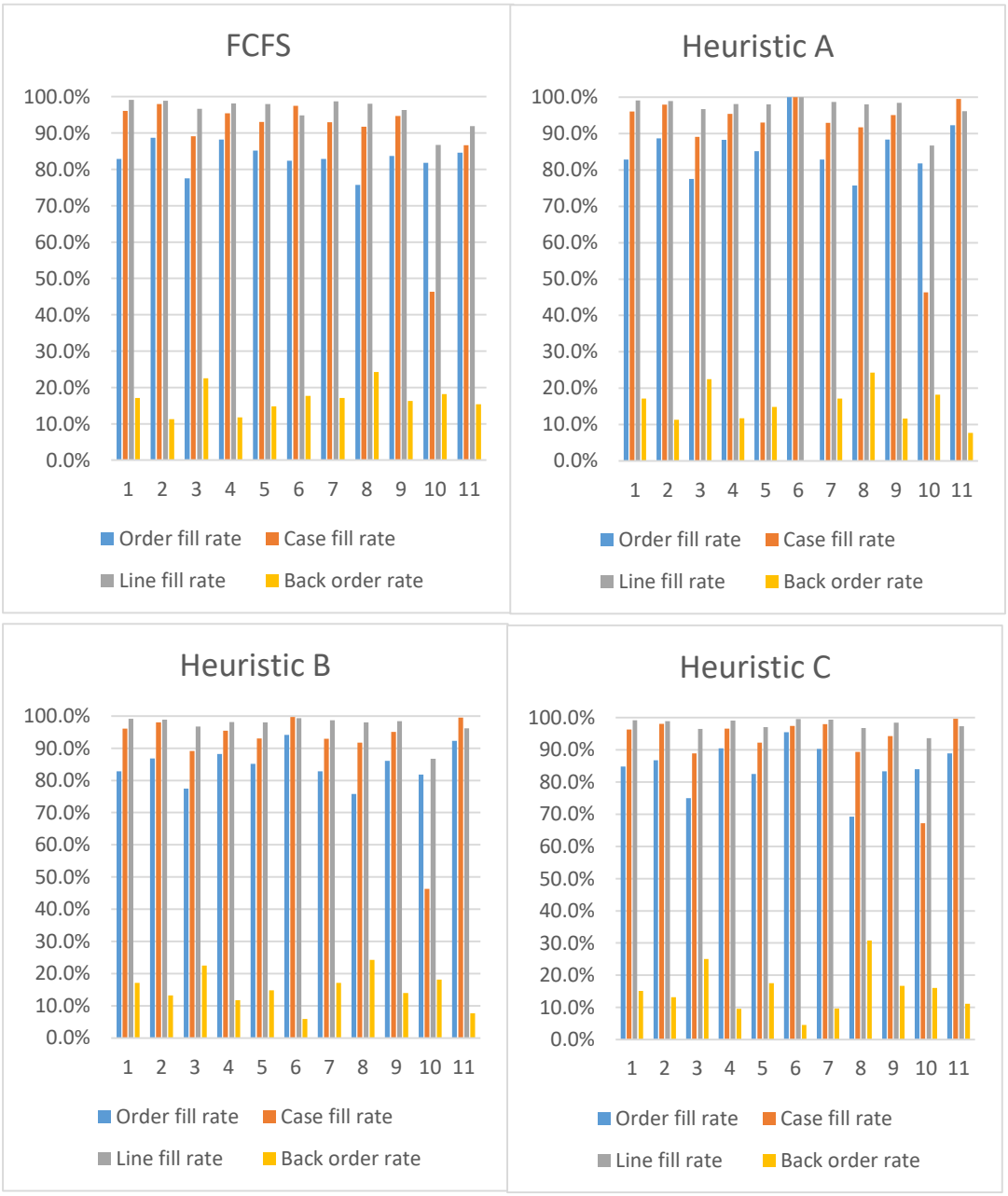

Figure 21 Summary of the result of four methods approach

6.2 Comparison

Regarding Table 25 and 26, the comparison among the four method approaches with the actual performance of the company as case study in all proposed KPIs is illustrated. It represents the improvement in percentage, starting from the order

fill rate and back order rate is better than actual in range of 0.3 – 2.1%. Next, case fill rate is improved in the range of 3.2 – 3.9%, and the line fill rate shows the most improvement at 5.1 – 5.75%. The Figure 22 illustrate the percentage of improvement in term of graph as follows;

- Order fill rate: Heuristic A is the best method approach which can improve 2.05% from the actual performance. While, Heuristic B and C show the same improvement level. FCFS has the lowest rate of improvement.
- Case fill rate: Heuristic C is the best approach which can improve 3.88% from the actual performance. While, Heuristic A and B has about the same improvement rate at 3.65%. In addition, FCFS is still the lowest improvement of all four.
- Line fill rate: Heuristic A is the best method approach which can improve 5.74% from the actual performance. Heuristic B and C shows almost the same level of improvement. Furthermore, FCFS show the worst improvement rate.
- Back order rate: Heuristic A has the best improvement result at about 2% from the actual performance. Heuristic B and C has the same improvement rate. Additionally, FCFS shows the lowest improvement of all approaches.

Table 26 comparison between four methods approach in four KPIs

KPIs	Method				
	Actual	FCFS	Heuristic-A	Heuristic-B	Heuristic-C
Order fill rate	82.99%	83.28%	85.04%	84.16%	84.16%
Quantity fill rate	88.95%	92.15%	92.58%	92.60%	92.83%
Line fill rate	92.41%	97.52%	98.16%	98.12%	98.08%
Back order rate	17.01%	16.72%	14.96%	15.84%	15.84%

Table 27 The percentage of improvement of all approaches

KPIs	% of Improvement			
	FCFS	Heuristic-A	Heuristic-B	Heuristic-C
Order fill rate	0.29%	2.05%	1.17%	1.17%
Quantity fill rate	3.20%	3.64%	3.65%	3.88%
Line fill rate	5.10%	5.74%	5.71%	5.67%
Back order rate	0.29%	2.05%	1.17%	1.17%

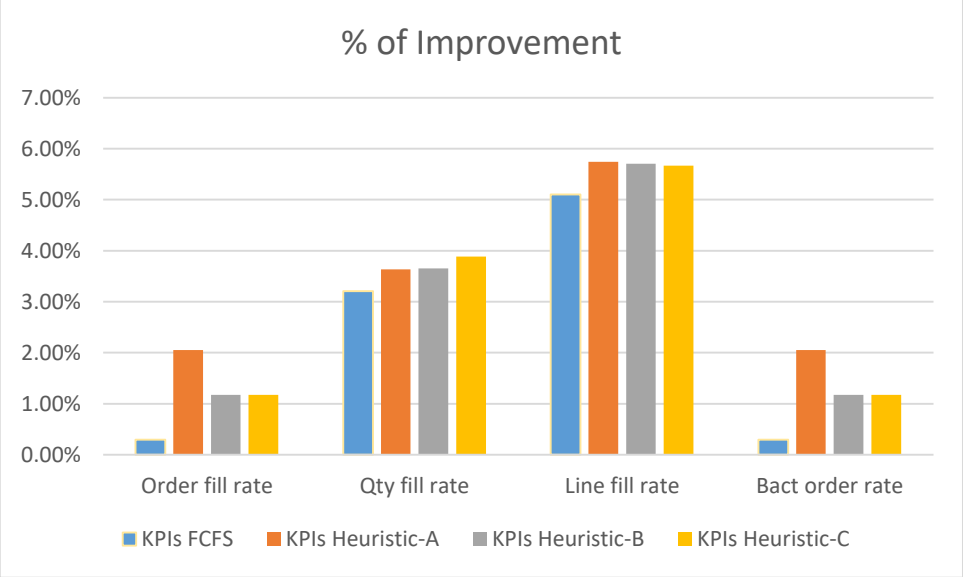

Figure 22 Overview of the percentage of improvement

Since, this thesis is more focus in customer priority, this section will analyse each method to see the result based on customer grade for the insight information and further study.

$$\text{Efficiency} = \frac{Sum\ of\ Partial\ order\ or\ quantity\ or\ line}{Sum\ of\ Total\ order\ or\ quantity\ or\ line} \quad [9]$$

- Order fill rate

It is found that the Heuristic A method shows the most improvement in term of order fill rate. The insight result shows the efficiency of the allocation process based

on the concern in customer priority. Regarding Table28, it represents orders of each customer grade that can be allocated fully or partial. Although Heuristic A has the highest ratio of improvement, but it cannot meet the target of prioritizing grade A customers to firstly received the order. According to Figure23, it shown that the efficiency of fulfilling customer orders ranks from customer Grade C, B, and A, accounted for 93%, 90%, and 74% respectively.

Table 28 Result of order fill rate by Heuristic A approach

Grade of customer	Sum of Fulfilled order	Sum of Partial order
A	86	30
B	94	11
C	112	8

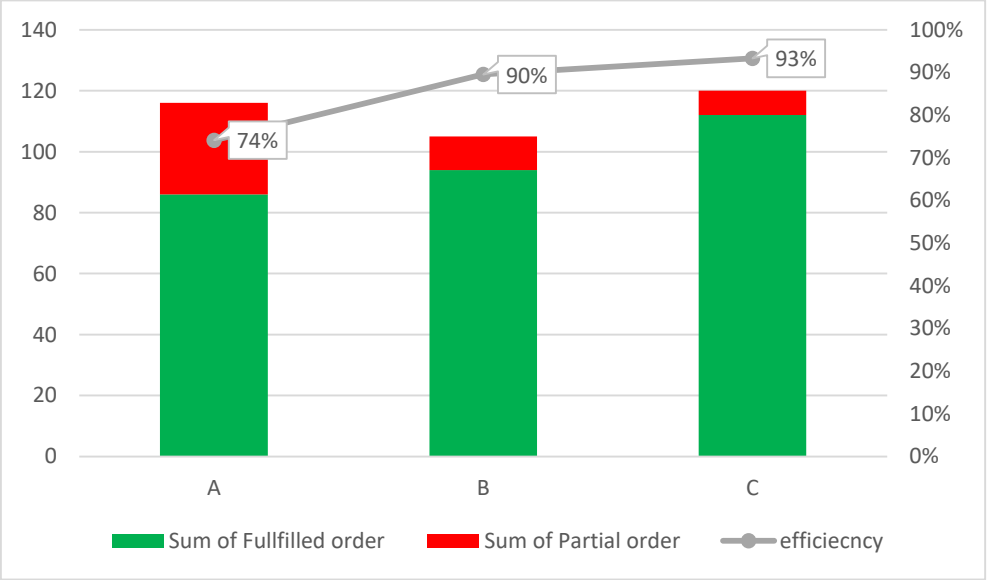

Figure 23 The result and efficiency of each customer grade in order fill rate by Heuristic A approach

- Quantity fill rate

Regarding the result of improvement, Heuristic C approach has the most improvement in term of quantity fill rate. According to the factor of ABC analysis, it divides customer grade based on volume of order, high to low. Therefore grade A

customers are accounted for the biggest volume of ordered quantity as illustrated in Table29. When insufficient inventory happen, grade A customer tend to receive the higher impact due to their order size. One line missing could account for hundred pairs of shoes, while grade B and C customer result in only ten quantity missed. Hence, the efficiency of fulfilled order in term of quantity fill rate for all grades are 92%, 94%, and 96% of Grade A, B, and C respectively as shown in Figure24. This method can improve and commit the goal of the company, more than 90% allocation fulfilment.

Table 29 Result of quantity fill rate by Heuristic C approach

Grade of customer	Sum of Total quantity	Sum of Missed quantity
A	47,752	3,903
B	17,276	1,091
C	6,010	237

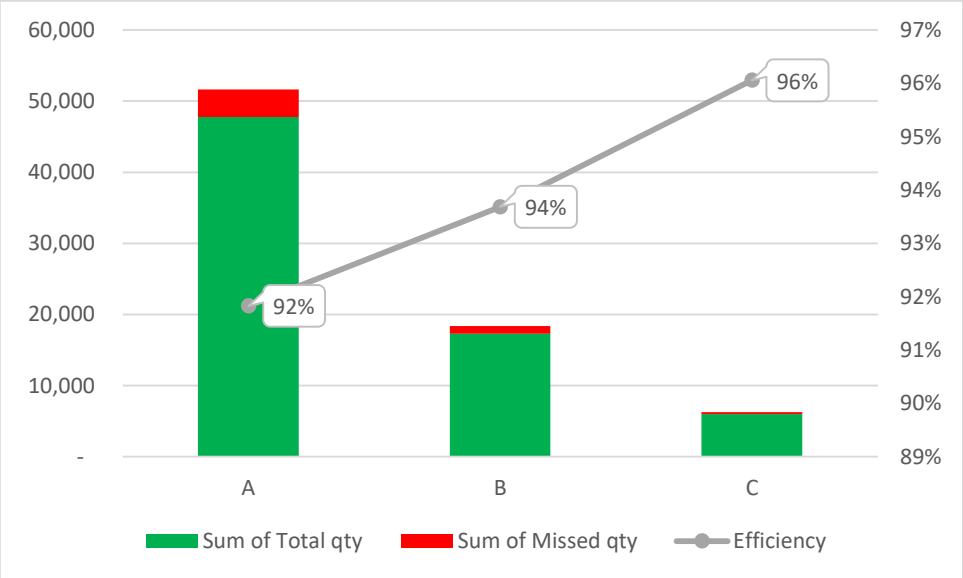

Figure 24 The result and efficiency of each customer grade in quantity fill rate by Heuristic C approach

- Line fill rate

According to Figure22, it shown that the line fill rate is improved almost 6% by Heuristic A approach. This method can help fulfill line items efficiency almost the same for all customers in the range of 97-99%. Customer grade C is better than Grade B, while grade A is the lowest of percentage improvement. Regard to Table30, the number of line items of customers is shows the same trend as order and quantity fill rate which have .the biggest volume in grade A, Grade B is lower volume than grade A, and Grade C is the smallest volume. However, Figure25 shown the effectiveness of each customer is reserve with line volume.

Table 30 Result of line fill rate by Heuristic A approach

Grade of customer	Sum of Fulfilled line	Sum of Missed line
A	3,351	76
B	2,649	47
C	2,134	27

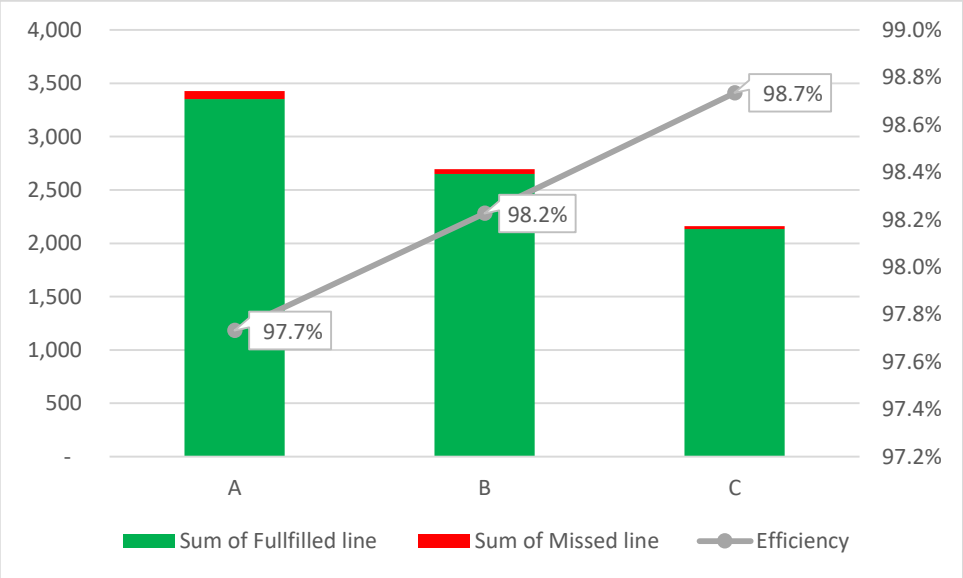

Figure 25 The result and efficiency of each customer grade in line fill rate by Heuristic A approach

- Back order rate

The result of back order rate is directly related to order fill rate because this thesis is assumed that the remained quantity in partial order, is a back order lot. The outcome of Heuristic A approach is shown in Table31.

Table 31 Result of back order rate by Heuristic A approach

Grade of customer	Sum of Fullfilled	Sum of backlot order
A	86	30
B	94	11
C	112	8

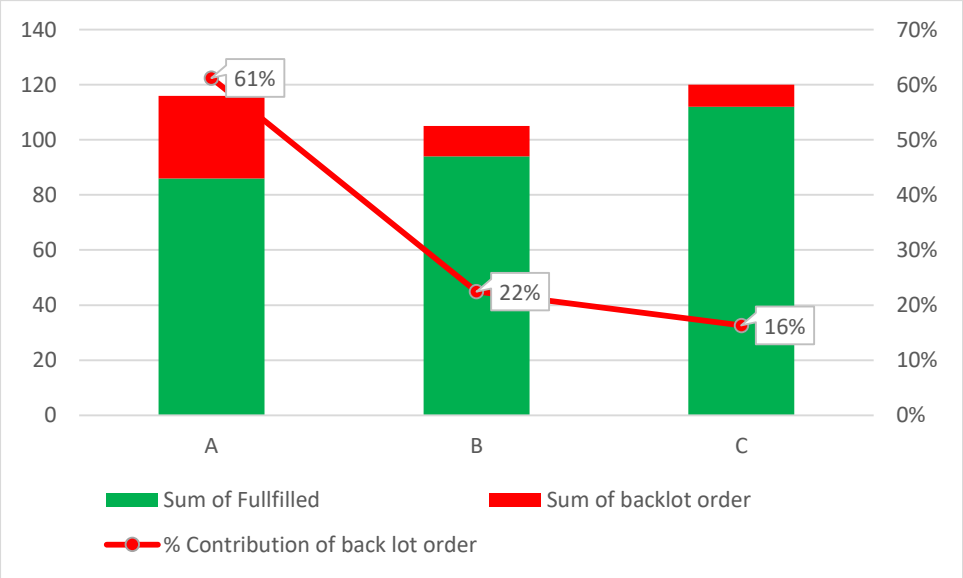

Figure 26 The result and percentage of contribution of each customer grade in back order rate by Heuristic A approach

For this KPI, it is one of the most important factors in efficiency of order management. It can directly impact to customer satisfaction, and loyalty to company. As the Figure26, it represent the contribution of back order rate that effect to customer grade A is the highest, while grade C is the lowest. The analysis of this case is illustrated that although this method has the most improvement, but it is not the best method

because it cannot fulfill demand of the first priority customer as much as possible due to the lacking of inventory and order management.

6.3 Discussion

In this section, the results obtained from each heuristic method will be discussed based on their design constraints and theories. The comparison of methods is made and discussed in detail about the improvement of each KPI compare to the current operation result as well as each other. Some examples are made to explain the possibility that affect the outcome and lead to acquired data.

According to data in section 6.2, the result from all FCFS and Heuristic approaches shows KPIs improvement in all aspect compare to the current operation results. These results confirm that current goods allocating decision is filled with gaps for improvement and constraints that we focus on have noticeable effects. However, the in-depth analysis of each optimizing methods will enable us to clearly understand both positive and negative effect they had before the implementation is made to the real business system.

6.3.1 First-Come, First-Serve (FCFS)

First-Come, First-Serve is the basic concept in goods allocation process. All industrial constraint is eliminated and the allocation is done based on order arrival sequence.

This method should yield the result as a base for comparison and improvement. However, the current allocation system has significantly lower result than FCFS method. The performance indexes show minor increase in order fill rate with considerable increase in quantity and line fulfilment percentage by two and five percent respectively. One of the explanations for this phenomenon is that various constraints are currently concern in the actual allocation system which may limit the

optimizing opportunities. Nonetheless, another aspect can be viewed as the efficiency is dropped from some gaps within the current process such as human miscalculation or poor utilisation of current available products. Hence, the idea of the company to implement First-Come, First-Serve as a first and fast step toward order allocation optimising is supported by this result. The coding program of FCFS will help allocate the goods, minimising the randomness and fluctuation in performance from current human decision based system.

6.3.2 Heuristic A (Fulfil the lowest SKU order first)

The initial attempt to improve goods allocation system is to increase the KPI of order fulfilment rate. With the scarcity of goods, dealing with the less complex orders first should result in increasing of overall order fulfilment rate. This heuristic method will sequence allocation process based on number of SKU per order; the less SKU means less complicated.

The result shows noticeable improvement of KPIs compare to current allocation system. The further investigation is made by comparing the Heuristic A approach with the FCFS method, the no-constraint version of goods allocation. The result shows better improvement in all aspects, especially two more percent in order fill rate which is corresponding to the intended design. This result ensures that order processing sequence is importance and the current non-systemic process can be further improved. Moreover, in term of business aspect, working on the smaller order first can help improve warehouse efficiency as well; the smaller the order is, the better opportunity to improve the order picking and packing in outbound process of the warehouse. Hence, prioritising low SKU per order first could also reduce travel time and travel distance while enable batch or zone picking of many few SKU orders at the same time. The method will help utilise the scarce resources and optimising the

allocation better than FCFS approach. However, this heuristic method still does not account for the actual industrial conditions but can be implement as the upgraded base line of optimisation instead of FCFS.

6.3.3 Heuristic B (Customer priority)

Based on the current business practice, this heuristic approach will take customer priority into account. By applying a restriction on top of the previous method, we expect the KPI result to be better than current company's allocation process but slightly less than the unconditioned one. The result shows improvement in every aspect of KPIs when compare to the current operating allocation plan especially in term of quantity and order fill rate. However, the result turn out as expected when compare to the heuristic method A, slight decline in KPIs is observed except the quantity fill rate that show the opposite trend. After further investigate of this effect, we found that behaviour of customer in different grade is the reason. Since the design of customer grading is based on the quantity ordered, grade A customers tend to order much more SKU per order as well as higher quantity per SKU than the other grade. As we have discussed in the previous method, the more SKU in orders means higher complexity in order fulfilment which results in reduction in order and line fill rate KPIs. However, the unexpected increase in quantity delivered is studied and the example is drawn from a part of actual simulation result author found when compare the result between the two heuristic methods.

Table 32 Example of Order from customer for case study

Item number	Inventory	Customer I order	Customer II order	Customer III order
Item001	20	15	3	3
Item002	14	7	4	-
Item003	32	8	-	-

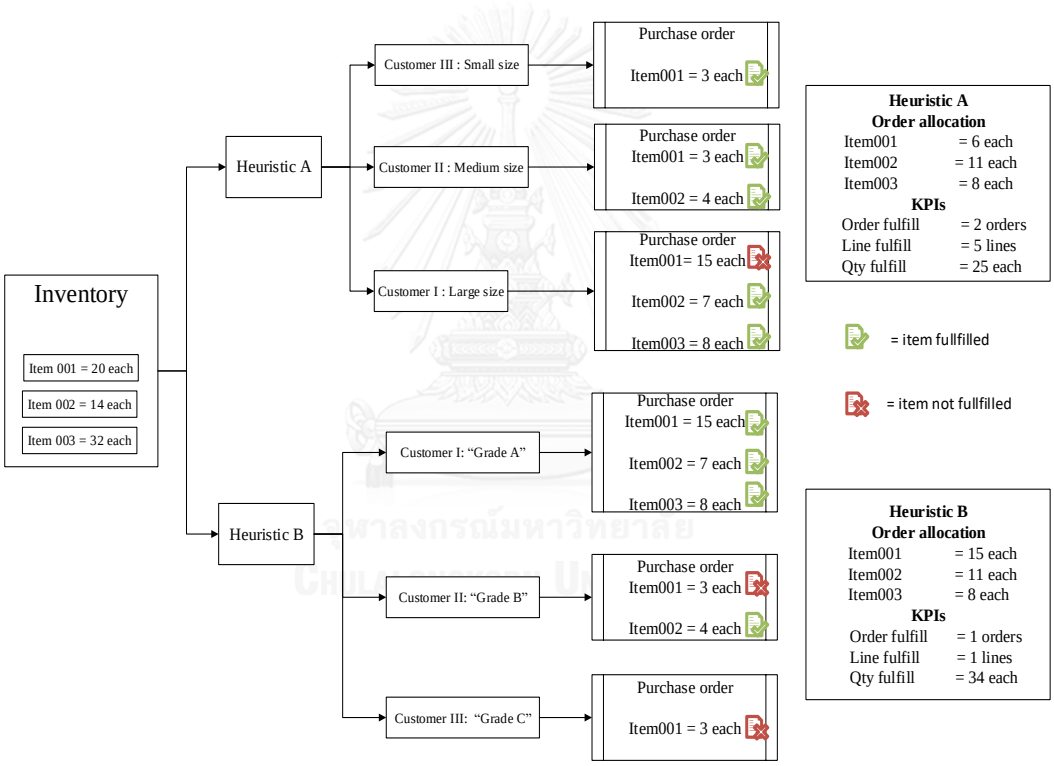

Figure 27 Example of allocation process differences between Heuristic A and B

Table 32 shows the practical example that researcher take out from the real data and the process of allocation through coding of Heuristic A and Heuristic B are illustrated in Figure 27. Three purchase orders are input and waiting for the goods allocation. The quality and quantity list of item from three customers and it respective available inventory is shown in the table. Judged from Heuristic A method, the

sequence of order processing is according to the number of SKU in orders so the sequence is Customer III then Customer II and Customer I. In contrast, Heuristic B approach will yield the opposite sequence, based on customer grade from the amount of line in the orders. According to the basis that we set, if the available quantity of an item in the inventory cannot fulfil the requirement of the same item in order, there will be no goods allocated and that item will be considered as "Not enough stock". The result shows that there is a chance that considering customer grade in Heuristic B can result in the increase in case fill rate while decreasing other KPIs when compare to the Heuristic A.

6.3.4 Heuristic C (Delivery condition)

This heuristic approach tries to solve the order allocation problem in term of maximising quantity delivered. Normally, goods will be allocated to customer without the concern on delivery requirement. This could create a situation where some products may be seen as allocated in the system, removing from the inventory, but need to wait few days before the actual delivery occur. Since the same products may be able to help fulfil another order that require actual delivery, the opportunity to maximise quantity fulfilment is lost. This heuristic approach allocates goods based on the actual requirement by comparing the requested delivery date with the amount of day required in transportation.

The result shows prominent improvement on every KPIs aspect compare to the current allocation process. In addition, Heuristic C methods show distinctively increase in quantity fill rate with about the same order fill rate and slightly decline of line fill rate when compare to Heuristic B. This phenomenon is further investigated and the particular example is illustrated in the Figure 28 from the example of customers' order in Table 33. Author found that there is a case when there is no reservation of undelivered product, the whole amount is accumulated enough to fulfil bigger

quantities requirement while shifting the unfulfilled item to the small-quantity orders. These can result in the reduction of order and line fill rate KPIs. Nonetheless, for this particular study, maintaining level of order fulfilment percentage happens due to after utilising the goods from the small-quantity order to the bigger one, both order still fall under unfulfilled conditions from other products, so this optimization only increase the total quantity allocated while showing no effect on amount of order fulfilled. By working on Heuristic B, the sequence of processing the order is from Customer I to II and II on the first day. However, Heuristic C will work only on the Customer III first since it is the only order that requested delivery date is reach and the other two order will be considered on the next day. Thus, the result show that the overall case fill rate is increase while the order and line fill rate is dropped when compare to Heuristic B.

Table 33 Example of Order from customer for case study

Item number/Date	**Inventory**	**Customer I order**	**Customer II order**	**Customer III order**
Item001	12	5	3	10
Item002	10	15	9	-
Allocation Date		Day 2	Day 2	Day 1

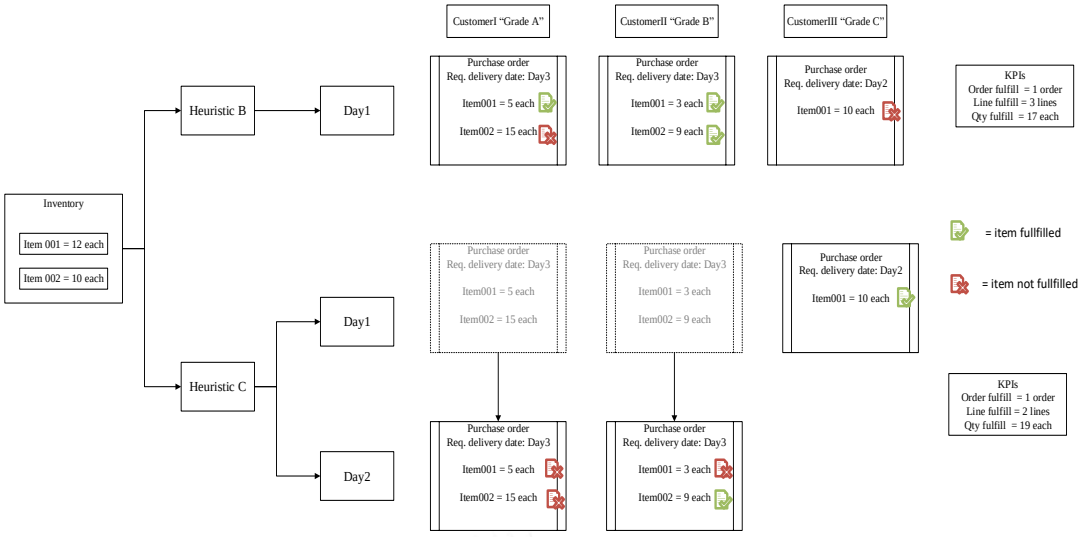

Figure 28 Example of allocation process differences between Heuristic B and C

- **Result comparison between current allocation and Heuristic C simulation**

The simulation of Heuristic C method shows about 1.2% increase in order fill rate, 4% improvement of quantity fill rate, 5.7% additional line fill rate and 1.2% decrease in back order rate when compare to the current allocation result. The improve come from the more efficient way in distributing the goods, based on delivery day condition, as well as the proper orders and customers priority system

In addition, the summary of pros and cons for each optimization is shown in Table 34. For the current situation of the company, First-Come, First-Serve (FCFS) can be implemented as a first step to improve the current operation system. The implement of program coding can start with the Heuristic A, improvement based on the sequence of order size. Further restrictions can be considered by Heuristic B, the improved version that take the customer priority into account. Finally, heuristic C can be used to utilise the available goods to yield higher quantity fill rate. Moreover, this heuristic approach has advantages over other methods in the aspect of further improvement. Proper inventory management can play a major roll to overcome the reduction in KPIs from this method. Since product shortage are known in advance from

the result of heuristic C method, real-time tracking of current inventory and production scheduling for the total requirement on delivery date could help imitate the problem of scarcity and help increase the performance indexes.

Table 34 Comparison advantage and disadvantage of four method approaches

	Advantages	**Disadvantages**
FCFS	- Can be used as a base condition for allocation - Easy to implement and can be done manually	- Do not account the actual business conditions during allocation - There is no attempt on optimisation
Heuristic A	- Easy to apply as a system to help improved the allocation process - Yield the highest order fulfilment rate	- Do not account the actual business condition
Heuristic B	- The improvement is based on the actual restriction in the business. - May help increase the customer satisfaction level of important customer.	- Slight reduction in fulfilment rate occur - Do not help provide insight information of further improvement - Do not account all constrains but can be improved by further study
Heuristic C	- Maximize the quantity delivered, utilising based on the actual shipment required - Provide information for further improvement of warehouse management	- Do not account all constrain in real business but can be improved by further study - Slight reduction of order fulfilment rate happen, can be overcome by materials flow management

CHAPTER VII

CONCLUSION AND RECOMMENDATIONS

This research aims to improve the order allocation process in the footwear company by proposing mathematical models based on various aspect. The thesis consists of four main parts. First, the related theories and literatures are reviewed. Second, the measurement parameters are identified and the current allocation process is studied, including root cause analyst and methods for improvement. Third, the methodology in conducting research is outlined, including the definition of constraints and proposed improvement methods. Finally, the simulation test is done and the results are discussed.

7.1 Research Contribution

The allocation process of finished goods to fulfil the customers' orders can be considered as a part of Available-To-Promise (ATP) model in supply chain system. This research focuses on using mathematical system to improve the allocation process, similar to integer programing approach of Rim and Park (2008). However, the author focuses on applying tailored heuristic models to simulate the allocation result from different methods which response to business constraints of the case study company. The actual allocation data are collected and compared with the results from models based on designed KPIs. The study shows that different Heuristic mathematical models can improve the allocation problem differently, based on the designed structure and business conditions.

7.2 Conclusion

In theories and literature review, warehouse operation concept and related literatures on the attempt to improve them are studied. ABC analysis technique and queuing theory are revisited together with their usage. Two optimisation theories of integer programming and Heuristic approach are discussed based on working methods, its pros and cons and usage in warehouse optimisation. The reviews will be applied to find the gap for improvement as well as design the improvement methods in the company allocation process.

In part two, Key Performance Index (KPI) is studied and four criteria are set to evaluate the allocation performance of the studied company namely Order fill rate, Case fill rate, Line fill rate and Back lot order rate. The current allocation performance of the company is evaluated and result shows about 18% of uncompleted order and 10% of unfulfilled quantity. Researcher has described the current processing methods including the use of support systems. Root cause analysis is conducted to identify the core of problem as well as the gap for improvements. There are four main internal factors, manual processes, labour, inventory and system; and one external factor, customer requirement, contributes to performance of order allocation. Improvement method is proposed by setting up inventory and warehouse management policy.

In the third part, the methodology in conducting this thesis is outlined. From the studied literatures and collected data from site visiting, constraints are analysed and set as a basis for the design of proposed improvement methods. The constraints are identified as three main factors: Order processing sequence, Priority of customers and Delivery date, which will be used as a basis for algorithmic design. First-Come, First-Serve is used for comparison with the current process. Three heuristic methods are discussed regarding their design concept and proposed based on the analysed constraints. Heuristic A will allocate goods from the least amount of SKU per order

first, reducing the complexity and increase a chance of order fulfilment. Heuristic B will be designed on top of the first one to account for the real company constrains of different customer priority. By applying ABC analysis method, customers are assigned into group according to their order quantity; the higher amount will be prioritised to receive the product first. The final Heuristic C approach is designed to exploit the use of delivery requirement from customer, trying to maximise the quantity fill rate. Products are only allocated to the order that delivery request date is arrive, no reservation of goods is allowed.

In the fourth phase, the program coding of FCFS and Heuristic methods are designed and pseudo codes are presented with their corresponding diagram. The related theories are applied to calculate the required information. The programs are then implemented using the collected actual industrial data from site visiting. The result from simulation shows noticeable improvement on all KPI from every method, approximately one and a half to five and a half percent. The result from FCFS ensures that the current allocation methods is inefficient and the company idea about applying FCFS as an initial step in improvement should yield the positive result. The Heuristic A method shows the improved allocation result without regarding industrial constraints. All KPIs increase about one to two percent from FCFS methods, so it could be used as a based decision making instead of FCFS. The Heuristic B method shows a small increase in quantity fill rate but small decline of order and line fill rate when compare to the first heuristic due to the limitation in allocation process is applied. The final Heuristic C approach shows significant improvement in case fill rate while small decline in line few rate is observed. The investigation is made and conclude that the with the aim to utilised goods in a stock by restricting goods reservation, there is a possibility that the bigger quantity order will be fulfilled by taking goods from small orders, resulting in decline in two KPI value. Nonetheless, the approximately four percent increase of case fulfilment shows the potential of this Heuristic method to be applied

in the real industrial scale and enable proper production and warehouse planning to further improve the order fulfilment rate of the company.

7.3 Limitation

The limitation of working in this thesis mostly comes from the fact that it is a real business based thesis. Inventory data is only available based on daily basis without the record and the only way to acquire the data is to conduct site survey. However, due to restriction in business aspect, researcher was allowed to collect data at site for only two-week period (11 working days). For further evaluation of optimization method, proper inventory data is required in both past record and real-time tracking. This is one of the most important data to keep track the flow of goods and information across the warehouse process.

As the current allocation process is subjective and there is no proper guideline and detailed list of customer condition. One of the criteria that the researcher needs to eliminate is the receiving condition of each customer when the ordered goods is not fully allocated. Currently, this condition relied on the expertise of operator and negotiation. However, the list of every customer standard procedure should be form for constraints analysis in order to implement into the optimization consideration and cover for the future use.

7.4 Further study

Heuristic method can be designed to response actual business conditions in many ways. The study on different structure can be done for comparison between methods. Other constraints such as goods receiving condition of each customer, products hierarchy and transportation frequency can be taken into account for further improvement

Linear programing is another possible mathematical model that can be applied to help improve the allocation process of the case study company. Base on the reviewed theories, Linear programming could yield more improved result than Heuristic method, however, the formulation of linear mathematical system of real business parameter is arduous. Due to various constraints in this business, the concept of hybrid system between Heuristic and Linear programming is also interesting for further research and adaptation

7.5 Recommendation

As the result of Heuristic C shows that there is an opportunity to increase total delivered quantity. The company can start tracking the flow of product in stock and forecasting for proper production. The optimisation on the inbound boundary of warehouse is also important and will help the outbound in term of increasing the flow of materials. Another possible optimisation area is the warehouse layout and picking procedure which researcher has reviewed related literatures in chapter II. Nonetheless, based on the current result, the company can start working toward FCFS approach as intended and record the change for further implementation of other proposed methods.

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APPENDIX

APPENDIX I: ABC Analysis

Rank	Customer code	Sum of Order number	Sum of Order Quantity	% Cumulative	Grade
1	S0119	326	4124	3.45%	A
2	S0013	203	4032	6.83%	A
3	E0218	177	3240	9.54%	A
4	E0109	64	2760	11.85%	A
5	N0012	100	2676	14.10%	A
6	N0171	389	2304	16.02%	A
7	N0019	128	2280	17.93%	A
8	B0513	67	2208	19.78%	A
9	X0299	597	2097	21.54%	A
10	B0584	123	2052	23.26%	A
11	S0325	91	2008	24.94%	A
12	B0297	31	1992	26.61%	A
13	N0037	86	1980	28.26%	A
14	E0085	44	1956	29.90%	A
15	C0341	139	1896	31.49%	A
16	S0307	80	1884	33.07%	A
17	N0071	4	1680	34.47%	A
18	X0715	466	1676	35.88%	A
19	X0739	356	1606	37.22%	A
20	B0046	101	1572	38.54%	A
21	X0298	878	1519	39.81%	A
22	N0117	204	1500	41.07%	A
23	B0163	366	1480	42.31%	A

24	S0302	174	1439	43.51%	A
25	B8029	90	1422	44.70%	A
26	N0025	199	1404	45.88%	A
27	N0179	2	1200	46.88%	A
28	S0337	92	1170	47.86%	A
29	B0417	21	1140	48.82%	A
30	C0098	112	1046	49.69%	A
31	X0727	221	996	50.53%	A
32	C0269	49	995	51.36%	A
33	S0360	99	969	52.17%	A
34	S0151	11	966	52.98%	A
35	C0089	65	948	53.77%	A
36	C0163	200	936	54.56%	A
37	C0345	20	924	55.33%	A
38	B0270	12	900	56.09%	A
39	S0334	19	900	56.84%	A
40	B0502	28	888	57.58%	A
41	N0142	2	864	58.31%	A
42	S0090	30	864	59.03%	A
43	C0233	53	816	59.71%	A
44	E0117	116	780	60.37%	A
45	E0100	93	779	61.02%	A
46	E0165	60	768	61.66%	A
47	N0107	30	720	62.27%	A
48	B0444	45	714	62.86%	A
49	E0213	186	708	63.46%	A
50	C0223	97	691	64.03%	A
51	E0007	55	660	64.59%	A
52	N0175	38	660	65.14%	A
53	S0356	55	660	65.69%	A

Rank	Customer code	Sum of Order number	Sum of Order Quantity	% Cumulative	Grade
54	B0447	14	636	66.23%	A
55	B5819	7	631	66.75%	A
56	E0075	27	624	67.28%	A
57	N0111	40	613	67.79%	A
58	C0268	51	612	68.30%	A
59	N0010	28	612	68.81%	A
60	B0344	13	600	69.32%	A
61	E0133	81	600	69.82%	B
62	N0115	2	600	70.32%	B
63	B0618	144	597	70.82%	B
64	C0034	6	576	71.30%	B
65	N0050	13	576	71.79%	B
66	N0070	192	576	72.27%	B
67	S0093	75	576	72.75%	B
68	S0037	86	564	73.22%	B
69	N0023	145	540	73.68%	B
70	N0062	9	540	74.13%	B
71	E0193	41	528	74.57%	B
72	S0050	27	528	75.01%	B
73	C0080	11	504	75.43%	B
74	C0339	9	504	75.86%	B
75	S0024	85	504	76.28%	B
76	C0236	25	501	76.70%	B
77	N0083	25	468	77.09%	B
78	B0484	33	456	77.47%	B
79	S0243	74	427	77.83%	B
80	S0120	132	405	78.17%	B
81	N0022	80	396	78.50%	B

Rank	Customer code	Sum of Order number	Sum of Order Quantity	% Cumulative	Grade
82	B0048	23	372	78.81%	B
83	E0207	35	360	79.11%	B
84	N0064	8	360	79.41%	B
85	S0290	2	360	79.72%	B
86	E0028	36	348	80.01%	B
87	E0095	101	348	80.30%	B
88	E0069	34	336	80.58%	B
89	N0060	47	336	80.86%	B
90	B0575	59	326	81.13%	B
91	C0317	24	324	81.41%	B
92	S0187	31	324	81.68%	B
93	C0060	28	312	81.94%	B
94	E0062	37	312	82.20%	B
95	S0022	70	306	82.46%	B
96	C0032	153	302	82.71%	B
97	B8028	13	300	82.96%	B
98	B0147	127	291	83.20%	B
99	C0280	13	288	83.44%	B
100	S0297	12	288	83.69%	B
101	S0275	6	287	83.93%	B
102	C0331	7	276	84.16%	B
103	B0075	14	264	84.38%	B
104	B5658	10	264	84.60%	B
105	C0252	20	264	84.82%	B
106	N0073	34	264	85.04%	B
107	S0077	81	262	85.26%	B
108	B0055	21	252	85.47%	B
109	N0005	30	252	85.68%	B

Rank	Customer code	Sum of Order number	Sum of Order Quantity	% Cumulative	Grade
110	S0167	31	252	85.89%	B
111	E0195	30	240	86.10%	B
112	N0020	20	240	86.30%	B
113	S0236	3	240	86.50%	B
114	S0284	3	240	86.70%	B
115	C0157	153	235	86.89%	B
116	B0074	30	226	87.08%	B
117	S0291	48	216	87.26%	B
118	S0312	82	216	87.45%	B
119	E0212	87	204	87.62%	B
120	N0058	40	204	87.79%	B
121	S0064	43	204	87.96%	B
122	E0079	116	198	88.12%	B
123	B0325	13	192	88.28%	B
124	E0105	4	192	88.45%	B
125	B0330	113	180	88.60%	B
126	E0078	3	180	88.75%	B
127	E0132	10	180	88.90%	B
128	S0287	1	180	89.05%	B
129	B5700	12	178	89.20%	B
130	S0027	38	178	89.35%	B
131	N0089	34	174	89.49%	B
132	S0053	37	173	89.64%	B
133	C0025	17	168	89.78%	B
134	C0298	29	168	89.92%	B
135	C0362	19	168	90.06%	B
136	B5467	21	165	90.20%	B
137	S0114	83	160	90.33%	B

Rank	Customer code	Sum of Order number	Sum of Order Quantity	% Cumulative	Grade
138	S0349	19	159	90.46%	B
139	B5473	9	156	90.60%	B
140	C0367	34	156	90.73%	B
141	E0091	5	156	90.86%	B
142	E0115	38	156	90.99%	B
143	N0036	3	156	91.12%	B
144	N0186	26	156	91.25%	B
145	B0579	16	150	91.37%	B
146	S0234	24	148	91.50%	B
147	E0073	56	145	91.62%	B
148	C0235	13	144	91.74%	B
149	E0108	10	144	91.86%	B
150	E0215	20	144	91.98%	B
151	N0084	3	144	92.10%	C
152	N0126	9	144	92.22%	C
153	S0198	4	144	92.34%	C
154	E0006	18	142	92.46%	C
155	N0004	31	141	92.58%	C
156	C0247	68	140	92.70%	C
157	N0063	20	134	92.81%	C
158	B0310	64	130	92.92%	C
159	S0115	101	130	93.03%	C
160	N0081	39	128	93.13%	C
161	C0256	29	126	93.24%	C
162	S0317	67	125	93.34%	C
163	N0046	39	124	93.45%	C
164	S0268	54	121	93.55%	C
165	B5417	6	120	93.65%	C

Rank	Customer code	Sum of Order number	Sum of Order Quantity	% Cumulative	Grade
166	C0248	20	120	93.75%	C
167	E0082	10	120	93.85%	C
168	N0099	18	120	93.95%	C
169	S0054	67	120	94.05%	C
170	B0603	59	117	94.15%	C
171	B0461	40	116	94.25%	C
172	B0531	29	116	94.34%	C
173	S0036	47	116	94.44%	C
174	B0600	70	114	94.54%	C
175	E0222	42	114	94.63%	C
176	C0046	18	110	94.72%	C
177	C0210	30	109	94.82%	C
178	N0007	17	108	94.91%	C
179	S0339	58	108	95.00%	C
180	C0365	83	104	95.08%	C
181	B8013	25	102	95.17%	C
182	S0057	43	102	95.25%	C
183	E0103	51	100	95.34%	C
184	B8021	20	96	95.42%	C
185	C0156	16	96	95.50%	C
186	E0200	6	96	95.58%	C
187	N0080	17	96	95.66%	C
188	N0153	3	96	95.74%	C
189	S0014	11	96	95.82%	C
190	S0039	47	96	95.90%	C
191	S0238	6	96	95.98%	C
192	S0344	8	96	96.06%	C
193	S0345	36	96	96.14%	C

Rank	Customer code	Sum of Order number	Sum of Order Quantity	% Cumulative	Grade
194	S0311	16	93	96.22%	C
195	B5448	5	90	96.30%	C
196	B5805	17	90	96.37%	C
197	B0568	88	88	96.44%	C
198	C0119	48	85	96.52%	C
199	E0057	30	84	96.59%	C
200	S0056	54	84	96.66%	C
201	S0282	40	84	96.73%	C
202	S0376	64	84	96.80%	C
203	E0101	68	83	96.87%	C
204	B5708	5	78	96.93%	C
205	B5363	11	73	96.99%	C
206	B0336	2	72	97.05%	C
207	B0616	6	72	97.11%	C
208	B5687	4	72	97.17%	C
209	C0083	12	72	97.23%	C
210	C0251	8	72	97.29%	C
211	C0277	9	72	97.35%	C
212	E0116	18	72	97.41%	C
213	N0112	18	72	97.48%	C
214	N0181	6	72	97.54%	C
215	S0116	7	72	97.60%	C
216	B0259	45	71	97.66%	C
217	C0075	29	71	97.71%	C
218	C0206	39	70	97.77%	C
219	C0230	56	70	97.83%	C
220	B0193	29	62	97.88%	C
221	B5412	13	60	97.93%	C

Rank	Customer code	Sum of Order number	Sum of Order Quantity	% Cumulative	Grade
222	C0188	21	60	97.98%	C
223	E0077	57	60	98.03%	C
224	S0255	17	60	98.08%	C
225	S0274	9	60	98.14%	C
226	S0296	10	60	98.19%	C
227	C0078	40	59	98.23%	C
228	B0222	37	56	98.28%	C
229	C0029	41	55	98.33%	C
230	E0205	13	54	98.37%	C
231	X2702	5	54	98.42%	C
232	B0332	22	53	98.46%	C
233	B0114	24	52	98.51%	C
234	E0001	38	52	98.55%	C
235	E0188	43	51	98.59%	C
236	C0105	39	50	98.63%	C
237	B8017	13	48	98.67%	C
238	E0035	48	48	98.71%	C
239	N0125	4	48	98.75%	C
240	S0029	12	48	98.79%	C
241	S0289	4	48	98.84%	C
242	S0320	1	48	98.88%	C
243	S0348	6	48	98.92%	C
244	S0355	1	48	98.96%	C
245	S0359	48	48	99.00%	C
246	C0232	29	43	99.03%	C
247	B0068	9	36	99.06%	C
248	C0286	13	36	99.09%	C
249	E0198	29	36	99.12%	C

Rank	Customer code	Sum of Order number	Sum of Order Quantity	% Cumulative	Grade
250	E0209	3	36	99.15%	C
251	N0018	7	36	99.18%	C
252	N0131	3	36	99.21%	C
253	N0189	2	36	99.24%	C
254	S0286	25	36	99.27%	C
255	S0318	19	36	99.30%	C
256	S0089	4	31	99.33%	C
257	S0386	31	31	99.36%	C
258	B0083	30	30	99.38%	C
259	S0350	11	30	99.41%	C
260	B0561	13	29	99.43%	C
261	C0006	29	29	99.45%	C
262	B0215	3	24	99.47%	C
263	B0450	17	24	99.49%	C
264	B5515	2	24	99.51%	C
265	C0167	9	24	99.53%	C
266	C0173	13	24	99.55%	C
267	C0319	24	24	99.57%	C
268	E0020	20	24	99.59%	C
269	E0043	24	24	99.61%	C
270	E0124	18	24	99.63%	C
271	E0201	21	24	99.65%	C
272	N0056	24	24	99.68%	C
273	N0066	9	24	99.70%	C
274	S0136	16	24	99.72%	C
275	S0295	12	24	99.74%	C
276	S0357	8	24	99.76%	C
277	B5333	7	21	99.77%	C

Rank	Customer code	Sum of Order number	Sum of Order Quantity	% Cumulative	Grade
278	C0086	11	20	99.79%	C
279	S0157	19	19	99.81%	C
280	B0011	12	18	99.82%	C
281	B0482	17	17	99.84%	C
282	B0386	10	16	99.85%	C
283	S0100	16	16	99.86%	C
284	C0019	12	15	99.87%	C
285	B0506	7	14	99.89%	C
286	B0364	12	12	99.90%	C
287	B0486	3	12	99.91%	C
288	C0081	1	12	99.92%	C
289	C0106	4	12	99.93%	C
290	C0288	6	12	99.94%	C
291	E0051	5	12	99.95%	C
292	N0024	1	12	99.96%	C
293	S0035	10	12	99.97%	C
294	S0377	3	12	99.98%	C
296	N0172	2	9	99.99%	C
297	W0007	2	2	100.00%	C
298	W0009	2	2	100.00%	C
299	W0006	1	1	100.00%	C
300	W0008	1	1	100.00%	C
301	W0010	1	1	100.00%	C

APPENDIX II: Example of Customer order

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B0046	204413	16/8/2016	18/8/2016	11207 H6140	12
B0046	204413	16/8/2016	18/8/2016	11207 H6141	12
B0046	204413	16/8/2016	18/8/2016	11207 H6142	12
B0046	204413	16/8/2016	18/8/2016	11207 H6143	12
B0046	204413	16/8/2016	18/8/2016	11207 07040	12
B0046	204413	16/8/2016	18/8/2016	11207 07041	12
B0046	204413	16/8/2016	18/8/2016	11207 07042	12
B0046	204413	16/8/2016	18/8/2016	11207 07043	12
B0046	204413	16/8/2016	18/8/2016	11207 11639	6
B0046	204413	16/8/2016	18/8/2016	11207 11642	6
B0046	204413	16/8/2016	18/8/2016	11207 12041	12
B0046	204413	16/8/2016	18/8/2016	11207 12042	12
B0046	204413	16/8/2016	18/8/2016	11207 12043	12
B0046	204413	16/8/2016	18/8/2016	11207 12044	12
B0046	204413	16/8/2016	18/8/2016	11207 13437	12
B0046	204413	16/8/2016	18/8/2016	11207 13438	12
B0046	204413	16/8/2016	18/8/2016	11207 13439	12
B0046	204413	16/8/2016	18/8/2016	11207 13440	24
B0046	204413	16/8/2016	18/8/2016	11207 13441	24
B0046	204413	16/8/2016	18/8/2016	11207 13442	24
B0046	204413	16/8/2016	18/8/2016	11207 13443	12
B0046	204413	16/8/2016	18/8/2016	11207 22038	12
B0046	204413	16/8/2016	18/8/2016	11207 22039	12
B0046	204413	16/8/2016	18/8/2016	11207 22040	24

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B0046	204413	16/8/2016	18/8/2016	11207 22041	24
B0046	204413	16/8/2016	18/8/2016	11207 22042	24
B0046	204413	16/8/2016	18/8/2016	11207 22043	24
B0046	204413	16/8/2016	18/8/2016	11207 22044	12
B0046	204413	16/8/2016	18/8/2016	11207 22045	12
B0046	204413	16/8/2016	18/8/2016	11207 52139	12
B0046	204413	16/8/2016	18/8/2016	11207 52140	12
B0046	204413	16/8/2016	18/8/2016	11207 52141	12
B0046	204413	16/8/2016	18/8/2016	11207 52142	12
B0046	204413	16/8/2016	18/8/2016	11207 52143	12
B0046	204413	16/8/2016	18/8/2016	11207 52144	12
B0046	204413	16/8/2016	18/8/2016	11207 52145	12
B0046	204413	16/8/2016	18/8/2016	11207 52240	12
B0046	204413	16/8/2016	18/8/2016	11207 52241	12
B0046	204413	16/8/2016	18/8/2016	11207 52242	12
B0046	204413	16/8/2016	18/8/2016	11207 52243	12
B0046	204413	16/8/2016	18/8/2016	11207 54739	12
B0046	204413	16/8/2016	18/8/2016	11207 54740	12
B0046	204413	16/8/2016	18/8/2016	11207 54741	12
B0046	204413	16/8/2016	18/8/2016	11207 54742	12
B0046	204413	16/8/2016	18/8/2016	11207 54743	12
B0046	204413	16/8/2016	18/8/2016	11255 30841	12
B0046	204413	16/8/2016	18/8/2016	11255 32240	12
B0046	204413	16/8/2016	18/8/2016	11255 32241	12
B0046	204413	16/8/2016	18/8/2016	11255 32242	12
B0046	204413	16/8/2016	18/8/2016	11255 32243	12

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B0046	204413	16/8/2016	18/8/2016	11255 36340	12
B0046	204413	16/8/2016	18/8/2016	11255 36341	12
B0046	204413	16/8/2016	18/8/2016	11255 36342	12
B0046	204413	16/8/2016	18/8/2016	11255 36343	12
B0046	204413	16/8/2016	18/8/2016	11255 36344	12
B0046	204413	16/8/2016	18/8/2016	11255 42338	12
B0046	204413	16/8/2016	18/8/2016	11255 43540	12
B0046	204413	16/8/2016	18/8/2016	11255 43541	12
B0046	204413	16/8/2016	18/8/2016	11255 43542	12
B0046	204413	16/8/2016	18/8/2016	11255 43543	12
B0046	204413	16/8/2016	18/8/2016	11255 54237	6
B0046	204413	16/8/2016	18/8/2016	11255 54238	6
B0046	204413	16/8/2016	18/8/2016	11255 54241	12
B0046	204413	16/8/2016	18/8/2016	11255 54642	12
B0046	204413	16/8/2016	18/8/2016	11255 60039	12
B0046	204413	16/8/2016	18/8/2016	11255 60040	12
B0046	204413	16/8/2016	18/8/2016	11255 60041	12
B0046	204413	16/8/2016	18/8/2016	11255 60042	12
B0046	204413	16/8/2016	18/8/2016	11255 60043	12
B0046	204413	16/8/2016	18/8/2016	11255 60044	12
B0046	204413	16/8/2016	18/8/2016	11255 60045	12
B0046	204413	16/8/2016	18/8/2016	11268 Y1041	12
B0046	204413	16/8/2016	18/8/2016	11268 3F539	12
B0046	204413	16/8/2016	18/8/2016	11268 3F540	12
B0046	204413	16/8/2016	18/8/2016	11268 3F541	12
B0046	204413	16/8/2016	18/8/2016	11268 3F542	12

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B0046	204413	16/8/2016	18/8/2016	11268 3F543	12
B0046	204413	16/8/2016	18/8/2016	11268 3F544	12
B0046	204413	16/8/2016	18/8/2016	11268 32237	12
B0046	204413	16/8/2016	18/8/2016	11268 32238	12
B0046	204413	16/8/2016	18/8/2016	11268 32239	12
B0046	204413	16/8/2016	18/8/2016	11268 32240	12
B0046	204413	16/8/2016	18/8/2016	11268 32241	12
B0046	204413	16/8/2016	18/8/2016	11268 32242	12
B0046	204413	16/8/2016	18/8/2016	11268 32243	12
B0046	204413	16/8/2016	18/8/2016	11268 37U41	12
B0046	204413	16/8/2016	18/8/2016	11268 37U42	12
B0046	204413	16/8/2016	18/8/2016	11268 37V39	12
B0046	204413	16/8/2016	18/8/2016	11268 38442	12
B0046	204413	16/8/2016	18/8/2016	11268 42342	12
B0046	204413	16/8/2016	18/8/2016	11268 52144	12
B0046	204413	16/8/2016	18/8/2016	11268 52145	12
B0046	204413	16/8/2016	18/8/2016	11268 52741	12
B0046	204413	16/8/2016	18/8/2016	11268 52742	12
B0046	204413	16/8/2016	18/8/2016	11268 52743	12
B0046	204413	16/8/2016	18/8/2016	11268 52744	12
B5473	204414	16/8/2016	23/8/2016	1G305 02037	24
B5473	204414	16/8/2016	23/8/2016	1G305 02038	18
B5473	204414	16/8/2016	23/8/2016	1G305 02039	18
B5473	204414	16/8/2016	23/8/2016	1G305 02040	12
B5473	204414	16/8/2016	23/8/2016	1G305 02041	24
B5473	204414	16/8/2016	23/8/2016	1G305 02042	12

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B5473	204414	16/8/2016	23/8/2016	1G305 02043	24
B5473	204414	16/8/2016	23/8/2016	1G305 02044	12
B5473	204414	16/8/2016	23/8/2016	1G305 02045	12
E0117	204415	16/8/2016	18/8/2016	1G112 176F	24
E0117	204415	16/8/2016	18/8/2016	1G112 220F	24
E0117	204415	16/8/2016	18/8/2016	1G152 176F01	48
E0117	204415	16/8/2016	18/8/2016	1G172 220F01	36
E0117	204415	16/8/2016	18/8/2016	1G173 176F01	18
E0117	204415	16/8/2016	18/8/2016	1G173 220F01	6
E0117	204415	16/8/2016	18/8/2016	1G174 176F01	24
E0117	204415	16/8/2016	18/8/2016	1G174 220F01	12
E0117	204415	16/8/2016	18/8/2016	1G182 176F01	24
E0117	204415	16/8/2016	18/8/2016	1G182 220F01	24
E0117	204415	16/8/2016	18/8/2016	1G220 06039	2
E0117	204415	16/8/2016	18/8/2016	1G220 06040	2
E0117	204415	16/8/2016	18/8/2016	1G220 06041	3
E0117	204415	16/8/2016	18/8/2016	1G220 06042	3
E0117	204415	16/8/2016	18/8/2016	1G220 06043	2
E0117	204415	16/8/2016	18/8/2016	1G220 07039	2
E0117	204415	16/8/2016	18/8/2016	1G220 07040	2
E0117	204415	16/8/2016	18/8/2016	1G220 07041	3
E0117	204415	16/8/2016	18/8/2016	1G220 07042	3
E0117	204415	16/8/2016	18/8/2016	1G220 07043	2
E0117	204415	16/8/2016	18/8/2016	1G220 10039	2
E0117	204415	16/8/2016	18/8/2016	1G220 10040	2
E0117	204415	16/8/2016	18/8/2016	1G220 10041	3

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
E0117	204415	16/8/2016	18/8/2016	1G220 10042	3
E0117	204415	16/8/2016	18/8/2016	1G220 10043	2
E0117	204415	16/8/2016	18/8/2016	1G220 12039	2
E0117	204415	16/8/2016	18/8/2016	1G220 12040	2
E0117	204415	16/8/2016	18/8/2016	1G220 12041	3
E0117	204415	16/8/2016	18/8/2016	1G220 12042	3
E0117	204415	16/8/2016	18/8/2016	1G220 12043	2
E0117	204415	16/8/2016	18/8/2016	1G244 17639	2
E0117	204415	16/8/2016	18/8/2016	1G244 17640	2
E0117	204415	16/8/2016	18/8/2016	1G244 17641	3
E0117	204415	16/8/2016	18/8/2016	1G244 17642	3
E0117	204415	16/8/2016	18/8/2016	1G244 17643	2
E0117	204415	16/8/2016	18/8/2016	1G244 22039	2
E0117	204415	16/8/2016	18/8/2016	1G244 22040	2
E0117	204415	16/8/2016	18/8/2016	1G244 22041	3
E0117	204415	16/8/2016	18/8/2016	1G244 22042	3
E0117	204415	16/8/2016	18/8/2016	1G244 22043	2
E0117	204415	16/8/2016	18/8/2016	1G245 17639	2
E0117	204415	16/8/2016	18/8/2016	1G245 17640	2
E0117	204415	16/8/2016	18/8/2016	1G245 17641	3
E0117	204415	16/8/2016	18/8/2016	1G245 17642	3
E0117	204415	16/8/2016	18/8/2016	1G245 17643	2
E0117	204415	16/8/2016	18/8/2016	1G245 22039	2
E0117	204415	16/8/2016	18/8/2016	1G245 22040	2
E0117	204415	16/8/2016	18/8/2016	1G245 22041	3
E0117	204415	16/8/2016	18/8/2016	1G245 22042	3

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
E0117	204415	16/8/2016	18/8/2016	1G245 22043	2
E0117	204415	16/8/2016	18/8/2016	11268 38440	4
E0117	204415	16/8/2016	18/8/2016	11268 38441	4
E0117	204415	16/8/2016	18/8/2016	11268 38442	4
E0117	204415	16/8/2016	18/8/2016	11268 43640	4
E0117	204415	16/8/2016	18/8/2016	11268 43641	4
E0117	204415	16/8/2016	18/8/2016	11268 43642	4
E0117	204415	16/8/2016	18/8/2016	11268 52740	6
E0117	204415	16/8/2016	18/8/2016	11268 52741	6
E0117	204415	16/8/2016	18/8/2016	11268 52742	6
E0117	204415	16/8/2016	18/8/2016	11268 52743	6
E0117	204415	16/8/2016	18/8/2016	11271 08C38	2
E0117	204415	16/8/2016	18/8/2016	11271 08C39	2
E0117	204415	16/8/2016	18/8/2016	11271 08C40	3
E0117	204415	16/8/2016	18/8/2016	11271 08C41	3
E0117	204415	16/8/2016	18/8/2016	11271 08C42	2
E0117	204415	16/8/2016	18/8/2016	11271 13138	2
E0117	204415	16/8/2016	18/8/2016	11271 13139	2
E0117	204415	16/8/2016	18/8/2016	11271 13140	3
E0117	204415	16/8/2016	18/8/2016	11271 13141	3
E0117	204415	16/8/2016	18/8/2016	11271 13142	2
E0117	204415	16/8/2016	18/8/2016	11271 13438	2
E0117	204415	16/8/2016	18/8/2016	11271 13439	2
E0117	204415	16/8/2016	18/8/2016	11271 13440	2
E0117	204415	16/8/2016	18/8/2016	11271 13441	2
E0117	204415	16/8/2016	18/8/2016	11271 13442	2

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
E0117	204415	16/8/2016	18/8/2016	11271 13443	2
E0117	204415	16/8/2016	18/8/2016	11272 38838	2
E0117	204415	16/8/2016	18/8/2016	11272 38839	2
E0117	204415	16/8/2016	18/8/2016	11272 38840	2
E0117	204415	16/8/2016	18/8/2016	11272 38841	2
E0117	204415	16/8/2016	18/8/2016	11272 38842	2
E0117	204415	16/8/2016	18/8/2016	11272 38843	2
E0117	204415	16/8/2016	18/8/2016	11272 44338	2
E0117	204415	16/8/2016	18/8/2016	11272 44339	2
E0117	204415	16/8/2016	18/8/2016	11272 44340	2
E0117	204415	16/8/2016	18/8/2016	11272 44341	2
E0117	204415	16/8/2016	18/8/2016	11272 44342	2
E0117	204415	16/8/2016	18/8/2016	11272 44343	2
E0117	204415	16/8/2016	18/8/2016	11272 52138	2
E0117	204415	16/8/2016	18/8/2016	11272 52139	2
E0117	204415	16/8/2016	18/8/2016	11272 52140	2
E0117	204415	16/8/2016	18/8/2016	11272 52141	2
E0117	204415	16/8/2016	18/8/2016	11272 52142	2
E0117	204415	16/8/2016	18/8/2016	11272 52143	2
E0117	204415	16/8/2016	18/8/2016	11272 52238	2
E0117	204415	16/8/2016	18/8/2016	11272 52239	2
E0117	204415	16/8/2016	18/8/2016	11272 52240	2
E0117	204415	16/8/2016	18/8/2016	11272 52241	2
E0117	204415	16/8/2016	18/8/2016	11272 52242	2
E0117	204415	16/8/2016	18/8/2016	11272 52243	2
E0109	204416	16/8/2016	17/8/2016	11401 02031	20

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
E0109	204416	16/8/2016	17/8/2016	11401 02032	20
E0109	204416	16/8/2016	17/8/2016	11401 02033	20
E0109	204416	16/8/2016	17/8/2016	11401 02034	20
E0109	204416	16/8/2016	17/8/2016	11401 02035	20
E0109	204416	16/8/2016	17/8/2016	11401 02036	20
E0109	204416	16/8/2016	17/8/2016	11401 02037	30
E0109	204416	16/8/2016	17/8/2016	11401 02038	30
E0109	204416	16/8/2016	17/8/2016	11401 02039	30
E0109	204416	16/8/2016	17/8/2016	11401 02040	30
B0055	204417	16/8/2016	18/8/2016	1205S 17630	48
B0055	204417	16/8/2016	18/8/2016	1205S 17635	48
B0055	204417	16/8/2016	18/8/2016	1205S 17636	48
B0055	204418	16/8/2016	18/8/2016	11272 32239	3
B0055	204418	16/8/2016	18/8/2016	11272 32240	4
B0055	204418	16/8/2016	18/8/2016	11272 32241	8
B0055	204418	16/8/2016	18/8/2016	11272 32242	8
B0055	204418	16/8/2016	18/8/2016	11272 32243	8
B0055	204418	16/8/2016	18/8/2016	11272 32244	5
B0055	204418	16/8/2016	18/8/2016	11272 44339	3
B0055	204418	16/8/2016	18/8/2016	11272 44340	4
B0055	204418	16/8/2016	18/8/2016	11272 44341	8
B0055	204418	16/8/2016	18/8/2016	11272 44342	8
B0055	204418	16/8/2016	18/8/2016	11272 44343	8
B0055	204418	16/8/2016	18/8/2016	11272 44344	5
B0055	204418	16/8/2016	18/8/2016	11272 52139	3
B0055	204418	16/8/2016	18/8/2016	11272 52140	4

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B0055	204418	16/8/2016	18/8/2016	11272 52141	8
B0055	204418	16/8/2016	18/8/2016	11272 52142	8
B0055	204418	16/8/2016	18/8/2016	11272 52143	8
B0055	204418	16/8/2016	18/8/2016	11272 52144	5
B0083	204419	16/8/2016	18/8/2016	1G311 13139	1
B0083	204419	16/8/2016	18/8/2016	1G311 13140	1
B0083	204419	16/8/2016	18/8/2016	1G311 13141	1
B0083	204419	16/8/2016	18/8/2016	1G311 13142	1
B0083	204419	16/8/2016	18/8/2016	1G311 13143	1
B0083	204419	16/8/2016	18/8/2016	1G311 13144	1
B0083	204419	16/8/2016	18/8/2016	1G311 22039	1
B0083	204419	16/8/2016	18/8/2016	1G311 22040	1
B0083	204419	16/8/2016	18/8/2016	1G311 22041	1
B0083	204419	16/8/2016	18/8/2016	1G311 22042	1
B0083	204419	16/8/2016	18/8/2016	1G311 22043	1
B0083	204419	16/8/2016	18/8/2016	1G311 22044	1
B0083	204419	16/8/2016	18/8/2016	1G312 04039	1
B0083	204419	16/8/2016	18/8/2016	1G312 04040	1
B0083	204419	16/8/2016	18/8/2016	1G312 04041	1
B0083	204419	16/8/2016	18/8/2016	1G312 04042	1
B0083	204419	16/8/2016	18/8/2016	1G312 04043	1
B0083	204419	16/8/2016	18/8/2016	1G312 04044	1
B0083	204419	16/8/2016	18/8/2016	1G312 10039	1
B0083	204419	16/8/2016	18/8/2016	1G312 10040	1
B0083	204419	16/8/2016	18/8/2016	1G312 10041	1
B0083	204419	16/8/2016	18/8/2016	1G312 10042	1

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B0083	204419	16/8/2016	18/8/2016	1G312 10043	1
B0083	204419	16/8/2016	18/8/2016	1G312 10044	1
B0083	204419	16/8/2016	18/8/2016	1G312 17639	1
B0083	204419	16/8/2016	18/8/2016	1G312 17640	1
B0083	204419	16/8/2016	18/8/2016	1G312 17641	1
B0083	204419	16/8/2016	18/8/2016	1G312 17642	1
B0083	204419	16/8/2016	18/8/2016	1G312 17643	1
B0083	204419	16/8/2016	18/8/2016	1G312 17644	1
B0618	204420	16/8/2016	18/8/2016	1C012 22036	2
B0618	204420	16/8/2016	18/8/2016	1C012 22037	2
B0618	204420	16/8/2016	18/8/2016	1C012 22038	2
B0618	204421	16/8/2016	18/8/2016	1D414 997F01	60
B0618	204421	16/8/2016	18/8/2016	1D415 997F01	60
B0618	204421	16/8/2016	18/8/2016	1D416 997F01	120
B0618	204421	16/8/2016	18/8/2016	1D417 997F01	120
B0618	204421	16/8/2016	18/8/2016	1G311 08C37	1
B0618	204421	16/8/2016	18/8/2016	1G311 08C38	2
B0618	204421	16/8/2016	18/8/2016	1G311 08C39	2
B0618	204421	16/8/2016	18/8/2016	1G311 08C40	2
B0618	204421	16/8/2016	18/8/2016	1G311 08C41	2
B0618	204421	16/8/2016	18/8/2016	1G311 08C42	1
B0618	204421	16/8/2016	18/8/2016	1G311 08C43	1
B0618	204421	16/8/2016	18/8/2016	1G311 08C44	1
B0618	204421	16/8/2016	18/8/2016	1G311 13137	1
B0618	204421	16/8/2016	18/8/2016	1G311 13138	2
B0618	204421	16/8/2016	18/8/2016	1G311 13139	2

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B0618	204421	16/8/2016	18/8/2016	1G311 13140	2
B0618	204421	16/8/2016	18/8/2016	1G311 13141	2
B0618	204421	16/8/2016	18/8/2016	1G311 13142	1
B0618	204421	16/8/2016	18/8/2016	1G311 13143	1
B0618	204421	16/8/2016	18/8/2016	1G311 13144	1
B0618	204421	16/8/2016	18/8/2016	1G311 22037	1
B0618	204421	16/8/2016	18/8/2016	1G311 22038	2
B0618	204421	16/8/2016	18/8/2016	1G311 22039	2
B0618	204421	16/8/2016	18/8/2016	1G311 22040	2
B0618	204421	16/8/2016	18/8/2016	1G311 22041	2
B0618	204421	16/8/2016	18/8/2016	1G311 22042	1
B0618	204421	16/8/2016	18/8/2016	1G311 22043	1
B0618	204421	16/8/2016	18/8/2016	1G311 22044	1
B0618	204421	16/8/2016	18/8/2016	1G312 04037	1
B0618	204421	16/8/2016	18/8/2016	1G312 04038	2
B0618	204421	16/8/2016	18/8/2016	1G312 04039	2
B0618	204421	16/8/2016	18/8/2016	1G312 04040	2
B0618	204421	16/8/2016	18/8/2016	1G312 04041	2
B0618	204421	16/8/2016	18/8/2016	1G312 04042	1
B0618	204421	16/8/2016	18/8/2016	1G312 04043	1
B0618	204421	16/8/2016	18/8/2016	1G312 04044	1
B0618	204421	16/8/2016	18/8/2016	1G312 10037	1
B0618	204421	16/8/2016	18/8/2016	1G312 10038	2
B0618	204421	16/8/2016	18/8/2016	1G312 10039	2
B0618	204421	16/8/2016	18/8/2016	1G312 10040	2
B0618	204421	16/8/2016	18/8/2016	1G312 10041	2

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B0618	204421	16/8/2016	18/8/2016	1G312 10042	1
B0618	204421	16/8/2016	18/8/2016	1G312 10043	1
B0618	204421	16/8/2016	18/8/2016	1G312 10044	1
B0618	204421	16/8/2016	18/8/2016	1G312 17637	1
B0618	204421	16/8/2016	18/8/2016	1G312 17638	2
B0618	204421	16/8/2016	18/8/2016	1G312 17639	2
B0618	204421	16/8/2016	18/8/2016	1G312 17640	2
B0618	204421	16/8/2016	18/8/2016	1G312 17641	2
B0618	204421	16/8/2016	18/8/2016	1G312 17642	1
B0618	204421	16/8/2016	18/8/2016	1G312 17643	1
B0618	204421	16/8/2016	18/8/2016	1G312 17644	1
B0618	204422	16/8/2016	18/8/2016	1205S 02031	2
B0618	204422	16/8/2016	18/8/2016	1205S 02032	2
B0618	204422	16/8/2016	18/8/2016	1205S 02033	2
B0618	204422	16/8/2016	18/8/2016	1205S 02034	2
B0618	204422	16/8/2016	18/8/2016	1205S 02035	2
B0618	204422	16/8/2016	18/8/2016	1205S 02036	2
B0618	204422	16/8/2016	18/8/2016	1205S 02037	2
B0618	204422	16/8/2016	18/8/2016	1205S 02038	2
B0618	204422	16/8/2016	18/8/2016	1205S 02039	2
B0618	204422	16/8/2016	18/8/2016	1205S 02040	2
B0618	204422	16/8/2016	18/8/2016	1205S 02041	2
B0618	204422	16/8/2016	18/8/2016	1205S 02042	2
B0618	204422	16/8/2016	18/8/2016	1205S 02043	2
B0618	204422	16/8/2016	18/8/2016	1205S 17631	2
B0618	204422	16/8/2016	18/8/2016	1205S 17632	2

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B0618	204422	16/8/2016	18/8/2016	1205S 17633	2
B0618	204422	16/8/2016	18/8/2016	1205S 17634	2
B0618	204422	16/8/2016	18/8/2016	1205S 17635	2
B0618	204422	16/8/2016	18/8/2016	1205S 17636	2
B0618	204422	16/8/2016	18/8/2016	1205S 17637	2
B0618	204422	16/8/2016	18/8/2016	1205S 17638	2
B0618	204422	16/8/2016	18/8/2016	1205S 17639	2
B0618	204422	16/8/2016	18/8/2016	1205S 17640	2
B0618	204422	16/8/2016	18/8/2016	1205S 17641	2
B0618	204422	16/8/2016	18/8/2016	1205S 17642	2
B0618	204422	16/8/2016	18/8/2016	1205S 17643	2
B0618	204422	16/8/2016	18/8/2016	1205S 22031	2
B0618	204422	16/8/2016	18/8/2016	1205S 22032	2
B0618	204422	16/8/2016	18/8/2016	1205S 22033	2
B0618	204422	16/8/2016	18/8/2016	1205S 22034	2
B0618	204422	16/8/2016	18/8/2016	1205S 22035	2
B0618	204422	16/8/2016	18/8/2016	1205S 22036	2
B0618	204422	16/8/2016	18/8/2016	1205S 22037	2
B0618	204422	16/8/2016	18/8/2016	1205S 22038	2
B0618	204422	16/8/2016	18/8/2016	1205S 22039	2
B0618	204422	16/8/2016	18/8/2016	1205S 22040	2
B0618	204422	16/8/2016	18/8/2016	1205S 22041	2
B0618	204422	16/8/2016	18/8/2016	1205S 22042	2
B0618	204422	16/8/2016	18/8/2016	1205S 22043	2
B5708	204423	16/8/2016	22/8/2016	1MT02 22040	18

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
B5708	204423	16/8/2016	22/8/2016	1MT02 22041	6
B5708	204423	16/8/2016	22/8/2016	1MT02 22042	18
B5708	204423	16/8/2016	22/8/2016	1MT02 22043	18
B5708	204423	16/8/2016	22/8/2016	1MT02 22044	18
C0269	204425	16/8/2016	19/8/2016	1D409 32110	48
C0269	204425	16/8/2016	19/8/2016	1D409 32110T	48
C0269	204425	16/8/2016	19/8/2016	1D409 32111	48
C0269	204425	16/8/2016	19/8/2016	1D409 3219	12
C0269	204425	16/8/2016	19/8/2016	1D409 3219.5	24
C0280	204426	16/8/2016	19/8/2016	1G184 220F01	24
C0280	204426	16/8/2016	19/8/2016	1G185 220F01	24
C0280	204426	16/8/2016	19/8/2016	1G186 220F01	24
C0280	204426	16/8/2016	19/8/2016	1G187 220F01	24
C0280	204426	16/8/2016	19/8/2016	1G190 220F01	24
C0280	204426	16/8/2016	19/8/2016	1G191 220F01	24
C0280	204426	16/8/2016	19/8/2016	1G192 220F01	24
C0280	204426	16/8/2016	19/8/2016	1G193 220F01	24
C0280	204427	16/8/2016	19/8/2016	1G166 220F01	24
C0280	204427	16/8/2016	19/8/2016	1G167 220F01	24
C0280	204427	16/8/2016	19/8/2016	1G168 220F01	12
C0280	204427	16/8/2016	19/8/2016	1G175 058F01	24
C0280	204427	16/8/2016	19/8/2016	1G176 058F01	12
S0013	204428	16/8/2016	19/8/2016	1G152 176F01	48
S0013	204428	16/8/2016	19/8/2016	1G152 220F01	48
S0013	204428	16/8/2016	19/8/2016	1G155 220F01	48
S0022	204429	16/8/2016	19/8/2016	1G209 22038	6

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
S0022	204429	16/8/2016	19/8/2016	1G209 22039	6
S0022	204429	16/8/2016	19/8/2016	1G209 22040	6
S0022	204429	16/8/2016	19/8/2016	1G209 22041	6
S0022	204429	16/8/2016	19/8/2016	1G209 22042	6
S0022	204429	16/8/2016	19/8/2016	1G209 22043	6
S0024	204430	16/8/2016	19/8/2016	1G201 22040	36
S0024	204430	16/8/2016	19/8/2016	1G201 22041	24
S0024	204430	16/8/2016	19/8/2016	1G201 22043	24
S0057	204431	16/8/2016	19/8/2016	1F186 13133	2
S0057	204431	16/8/2016	19/8/2016	1F186 13134	1
S0057	204431	16/8/2016	19/8/2016	1F186 13135	2
S0057	204431	16/8/2016	19/8/2016	1F186 13136	2
S0057	204431	16/8/2016	19/8/2016	1F186 13137	1
S0057	204431	16/8/2016	19/8/2016	1F186 13138	2
S0057	204431	16/8/2016	19/8/2016	1F186 13139	1
S0057	204431	16/8/2016	19/8/2016	1F186 13144	1
S0057	204431	16/8/2016	19/8/2016	1F186 22033	2
S0057	204431	16/8/2016	19/8/2016	1F186 22034	2
S0057	204431	16/8/2016	19/8/2016	1F186 22035	2
S0057	204431	16/8/2016	19/8/2016	1F186 22036	2
S0057	204431	16/8/2016	19/8/2016	1F186 22037	2
S0057	204431	16/8/2016	19/8/2016	1F186 22038	2
S0057	204431	16/8/2016	19/8/2016	1F186 22039	2
S0057	204431	16/8/2016	19/8/2016	1F186 22044	2
S0057	204431	16/8/2016	19/8/2016	1F196 22033	3
S0057	204431	16/8/2016	19/8/2016	1R017 32737	1

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
S0057	204431	16/8/2016	19/8/2016	1R017 32738	1
S0057	204431	16/8/2016	19/8/2016	1R017 32739	1
S0057	204431	16/8/2016	19/8/2016	1R017 32740	1
S0057	204431	16/8/2016	19/8/2016	1R017 38437	1
S0057	204431	16/8/2016	19/8/2016	1R017 38438	1
S0057	204431	16/8/2016	19/8/2016	1R017 38439	1
S0057	204431	16/8/2016	19/8/2016	1R017 38440	1
S0057	204431	16/8/2016	19/8/2016	1R020 13140	1
S0057	204431	16/8/2016	19/8/2016	1R020 13141	1
S0057	204431	16/8/2016	19/8/2016	1R023 04039	1
S0057	204431	16/8/2016	19/8/2016	1R023 04040	1
S0057	204431	16/8/2016	19/8/2016	1R023 04041	1
S0057	204431	16/8/2016	19/8/2016	1R023 04042	1
S0057	204431	16/8/2016	19/8/2016	1R023 04043	1
S0057	204431	16/8/2016	19/8/2016	1R023 04044	1
S0057	204431	16/8/2016	19/8/2016	1R023 22039	1
S0057	204431	16/8/2016	19/8/2016	1R023 22040	1
S0057	204431	16/8/2016	19/8/2016	1R023 22041	1
S0057	204431	16/8/2016	19/8/2016	1R023 22042	1
S0057	204431	16/8/2016	19/8/2016	1R023 22043	1
S0057	204431	16/8/2016	19/8/2016	1R023 22044	1
S0057	204431	16/8/2016	19/8/2016	1R024 16037	1
S0057	204431	16/8/2016	19/8/2016	1SO72 220002	12
S0057	204431	16/8/2016	19/8/2016	1SO72 220003	12
S0057	204431	16/8/2016	19/8/2016	1SO74 220F	24
S0077	204432	16/8/2016	19/8/2016	11207 22039	9

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
S0077	204432	16/8/2016	19/8/2016	11255 54240	3
S0077	204432	16/8/2016	19/8/2016	11255 54241	3
S0077	204432	16/8/2016	19/8/2016	11255 54242	3
S0077	204432	16/8/2016	19/8/2016	11255 54244	3
S0077	204432	16/8/2016	19/8/2016	11255 54245	3
S0090	204433	16/8/2016	19/8/2016	1205S 02034	24
S0090	204433	16/8/2016	19/8/2016	1205S 02037	24
S0090	204433	16/8/2016	19/8/2016	1205S 02038	48
S0090	204433	16/8/2016	19/8/2016	1205S 02039	60
S0090	204433	16/8/2016	19/8/2016	1205S 02040	48
S0090	204433	16/8/2016	19/8/2016	1205S 02041	60
S0090	204433	16/8/2016	19/8/2016	1205S 02042	48
S0090	204433	16/8/2016	19/8/2016	1205S 02043	96
S0090	204433	16/8/2016	19/8/2016	1205S 02045	12
S0090	204433	16/8/2016	19/8/2016	1205S 17629	12
S0090	204433	16/8/2016	19/8/2016	1205S 17630	24
S0090	204433	16/8/2016	19/8/2016	1205S 17631	12
S0090	204433	16/8/2016	19/8/2016	1205S 17632	24
S0090	204433	16/8/2016	19/8/2016	1205S 17633	24
S0090	204433	16/8/2016	19/8/2016	1205S 17634	24
S0090	204433	16/8/2016	19/8/2016	1205S 17635	12
S0090	204433	16/8/2016	19/8/2016	1205S 17636	12
S0090	204433	16/8/2016	19/8/2016	1205S 17637	12
S0090	204433	16/8/2016	19/8/2016	1205S 17638	12
S0090	204433	16/8/2016	19/8/2016	1205S 17639	12
S0090	204433	16/8/2016	19/8/2016	1205S 17640	12

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
S0090	204433	16/8/2016	19/8/2016	1205S 17642	12
S0090	204433	16/8/2016	19/8/2016	1205S 17643	24
S0090	204433	16/8/2016	19/8/2016	1205S 17644	12
S0090	204433	16/8/2016	19/8/2016	1205S 22037	36
S0090	204433	16/8/2016	19/8/2016	1205S 22038	12
S0090	204433	16/8/2016	19/8/2016	1205S 22040	48
S0090	204433	16/8/2016	19/8/2016	1205S 22042	60
S0090	204433	16/8/2016	19/8/2016	1205S 22044	24
S0120	204434	16/8/2016	19/8/2016	1G234 05838	2
S0120	204434	16/8/2016	19/8/2016	1G234 05839	2
S0120	204434	16/8/2016	19/8/2016	1G234 05840	2
S0120	204434	16/8/2016	19/8/2016	1G234 05841	2
S0120	204434	16/8/2016	19/8/2016	1G234 05842	2
S0120	204434	16/8/2016	19/8/2016	1G234 05843	2
S0120	204434	16/8/2016	19/8/2016	1G234 17639	2
S0120	204434	16/8/2016	19/8/2016	1G234 17640	3
S0120	204434	16/8/2016	19/8/2016	1G234 17641	3
S0120	204434	16/8/2016	19/8/2016	1G234 17642	2
S0120	204434	16/8/2016	19/8/2016	1G234 17643	2
S0120	204435	16/8/2016	19/8/2016	1F136 10432	1
S0120	204435	16/8/2016	19/8/2016	1F136 10433	1
S0120	204435	16/8/2016	19/8/2016	1F136 10434	1
S0120	204435	16/8/2016	19/8/2016	1F136 10435	1
S0120	204435	16/8/2016	19/8/2016	1F136 10436	1
S0120	204435	16/8/2016	19/8/2016	1F136 10437	1
S0120	204435	16/8/2016	19/8/2016	1F136 10438	1

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
S0120	204435	16/8/2016	19/8/2016	1F136 10439	1
S0120	204435	16/8/2016	19/8/2016	1F136 13132	1
S0120	204435	16/8/2016	19/8/2016	1F136 13133	1
S0120	204435	16/8/2016	19/8/2016	1F136 13134	1
S0120	204435	16/8/2016	19/8/2016	1F136 13135	1
S0120	204435	16/8/2016	19/8/2016	1F136 13136	1
S0120	204435	16/8/2016	19/8/2016	1F136 13137	1
S0120	204435	16/8/2016	19/8/2016	1F136 13138	1
S0120	204435	16/8/2016	19/8/2016	1F136 13139	1
S0120	204435	16/8/2016	19/8/2016	1F136 22032	1
S0120	204435	16/8/2016	19/8/2016	1F136 22033	1
S0120	204435	16/8/2016	19/8/2016	1F136 22034	1
S0120	204435	16/8/2016	19/8/2016	1F136 22035	1
S0120	204435	16/8/2016	19/8/2016	1F136 22036	1
S0120	204435	16/8/2016	19/8/2016	1F136 22037	1
S0120	204435	16/8/2016	19/8/2016	1F136 22038	1
S0120	204435	16/8/2016	19/8/2016	1F136 22039	1
S0187	204436	16/8/2016	19/8/2016	11271 13439	2
S0187	204436	16/8/2016	19/8/2016	11271 13440	2
S0187	204436	16/8/2016	19/8/2016	11271 13441	2
S0187	204436	16/8/2016	19/8/2016	11271 13442	2
S0187	204436	16/8/2016	19/8/2016	11271 13443	2
S0187	204436	16/8/2016	19/8/2016	11271 13444	2
S0187	204436	16/8/2016	19/8/2016	11271 22039	2
S0187	204436	16/8/2016	19/8/2016	11271 22040	2
S0187	204436	16/8/2016	19/8/2016	11271 22041	2

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
S0187	204436	16/8/2016	19/8/2016	11271 22042	2
S0187	204436	16/8/2016	19/8/2016	11271 22043	2
S0187	204436	16/8/2016	19/8/2016	11271 22044	2
S0187	204437	16/8/2016	19/8/2016	1G201 22039	36
S0187	204437	16/8/2016	19/8/2016	1G201 22042	36
S0187	204437	16/8/2016	19/8/2016	1G238 22038	12
S0187	204437	16/8/2016	19/8/2016	1G238 22039	12
S0187	204437	16/8/2016	19/8/2016	1G238 22040	12
S0187	204437	16/8/2016	19/8/2016	1G238 22041	12
S0187	204437	16/8/2016	19/8/2016	1G238 22042	12
S0187	204437	16/8/2016	19/8/2016	1G238 22043	12
S0312	204438	16/8/2016	19/8/2016	1GW08 08CF01	12
S0312	204438	16/8/2016	19/8/2016	1GW08 176F01	12
S0312	204438	16/8/2016	19/8/2016	1GW08 220F01	12
S0312	204438	16/8/2016	19/8/2016	1GW10 176F01	12
S0320	204439	16/8/2016	19/8/2016	1G194 220F01	48
S0357	204440	16/8/2016	19/8/2016	11405 02040	3
S0357	204440	16/8/2016	19/8/2016	11405 02041	3
S0357	204440	16/8/2016	19/8/2016	11405 02042	3
S0357	204440	16/8/2016	19/8/2016	11405 02043	3
S0357	204440	16/8/2016	19/8/2016	11405 22040	3
S0357	204440	16/8/2016	19/8/2016	11405 22041	3
S0357	204440	16/8/2016	19/8/2016	11405 22042	3
S0357	204440	16/8/2016	19/8/2016	11405 22043	3
E0109	204441	16/8/2016	19/8/2016	11401 02033	60
E0109	204441	16/8/2016	19/8/2016	11401 02034	60

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
E0109	204441	16/8/2016	19/8/2016	11401 02035	60
E0109	204441	16/8/2016	19/8/2016	11401 02036	60
E0109	204441	16/8/2016	19/8/2016	11401 02037	40
E0109	204441	16/8/2016	19/8/2016	11401 02038	40
E0109	204441	16/8/2016	19/8/2016	11401 02039	40
E0109	204441	16/8/2016	19/8/2016	11401 02040	40
E0109	204441	16/8/2016	19/8/2016	11401 02041	40
E0109	204441	16/8/2016	19/8/2016	11401 02042	40
E0109	204441	16/8/2016	19/8/2016	11401 22033	60
E0109	204441	16/8/2016	19/8/2016	11401 22034	60
E0109	204441	16/8/2016	19/8/2016	11401 22035	60
E0109	204441	16/8/2016	19/8/2016	11401 22036	60
E0115	204442	16/8/2016	19/8/2016	1F186 10031	2
E0115	204442	16/8/2016	19/8/2016	1F186 10032	3
E0115	204442	16/8/2016	19/8/2016	1F186 10033	3
E0115	204442	16/8/2016	19/8/2016	1F186 10034	4
E0115	204442	16/8/2016	19/8/2016	1F186 10035	4
E0115	204442	16/8/2016	19/8/2016	1F186 10036	5
E0115	204442	16/8/2016	19/8/2016	1F186 10037	5
E0115	204442	16/8/2016	19/8/2016	1F186 10038	5
E0115	204442	16/8/2016	19/8/2016	1F186 10039	4
E0115	204442	16/8/2016	19/8/2016	1F186 10040	4
E0115	204442	16/8/2016	19/8/2016	1F186 10041	4
E0115	204442	16/8/2016	19/8/2016	1F186 10042	4
E0115	204442	16/8/2016	19/8/2016	1F186 10043	2
E0115	204442	16/8/2016	19/8/2016	1F186 13131	1

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
E0115	204442	16/8/2016	19/8/2016	1F186 13132	2
E0115	204442	16/8/2016	19/8/2016	1F186 13133	2
E0115	204442	16/8/2016	19/8/2016	1F186 13134	2
E0115	204442	16/8/2016	19/8/2016	1F186 13135	4
E0115	204442	16/8/2016	19/8/2016	1F186 13136	4
E0115	204442	16/8/2016	19/8/2016	1F186 13137	5
E0115	204442	16/8/2016	19/8/2016	1F186 13138	5
E0115	204442	16/8/2016	19/8/2016	1F186 13139	5
E0115	204442	16/8/2016	19/8/2016	1F186 13140	5
E0115	204442	16/8/2016	19/8/2016	1F186 13141	6
E0115	204442	16/8/2016	19/8/2016	1F186 13142	6
E0115	204442	16/8/2016	19/8/2016	11272 32037	2
E0115	204442	16/8/2016	19/8/2016	11272 32038	4
E0115	204442	16/8/2016	19/8/2016	11272 32039	4
E0115	204442	16/8/2016	19/8/2016	11272 32040	4
E0115	204442	16/8/2016	19/8/2016	11272 32041	4
E0115	204442	16/8/2016	19/8/2016	11272 32042	4
E0115	204442	16/8/2016	19/8/2016	11272 32043	2
E0115	204442	16/8/2016	19/8/2016	11272 52138	4
E0115	204442	16/8/2016	19/8/2016	11272 52139	5
E0115	204442	16/8/2016	19/8/2016	11272 52140	6
E0115	204442	16/8/2016	19/8/2016	11272 52141	7
E0115	204442	16/8/2016	19/8/2016	11272 52142	8
E0115	204442	16/8/2016	19/8/2016	11272 52143	6
E0116	204443	16/8/2016	19/8/2016	11268 38438	4
E0116	204443	16/8/2016	19/8/2016	11268 38439	4

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
E0116	204443	16/8/2016	19/8/2016	11268 38440	4
E0116	204443	16/8/2016	19/8/2016	11268 38441	4
E0116	204443	16/8/2016	19/8/2016	11268 38442	4
E0116	204443	16/8/2016	19/8/2016	11268 38443	4
E0116	204443	16/8/2016	19/8/2016	11268 43638	4
E0116	204443	16/8/2016	19/8/2016	11268 43639	4
E0116	204443	16/8/2016	19/8/2016	11268 43640	4
E0116	204443	16/8/2016	19/8/2016	11268 43641	4
E0116	204443	16/8/2016	19/8/2016	11268 43642	4
E0116	204443	16/8/2016	19/8/2016	11268 43643	4
E0116	204443	16/8/2016	19/8/2016	11268 52738	4
E0116	204443	16/8/2016	19/8/2016	11268 52739	4
E0116	204443	16/8/2016	19/8/2016	11268 52740	4
E0116	204443	16/8/2016	19/8/2016	11268 52741	4
E0116	204443	16/8/2016	19/8/2016	11268 52742	4
E0116	204443	16/8/2016	19/8/2016	11268 52743	4
E0117	204444	16/8/2016	19/8/2016	1D416 997F01	60
E0117	204444	16/8/2016	19/8/2016	1D417 997F01	120
C0019	204445	16/8/2016	18/8/2016	1F166 02041	1
C0019	204445	16/8/2016	18/8/2016	1F166 02042	1
C0019	204445	16/8/2016	18/8/2016	1F166 02044	1
C0019	204445	16/8/2016	18/8/2016	1F166 13141	2
C0019	204445	16/8/2016	18/8/2016	1F166 13142	1
C0019	204445	16/8/2016	18/8/2016	1F166 13143	1
C0019	204445	16/8/2016	18/8/2016	1F166 13144	1
C0019	204445	16/8/2016	18/8/2016	1F166 22038	1

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
C0019	204445	16/8/2016	18/8/2016	1F166 22039	1
C0019	204445	16/8/2016	18/8/2016	1F166 22042	1
C0019	204445	16/8/2016	18/8/2016	1F166 22043	2
C0019	204445	16/8/2016	18/8/2016	1F166 22044	2
C0029	204446	16/8/2016	18/8/2016	1F166 02031	1
C0029	204446	16/8/2016	18/8/2016	1F166 02032	1
C0029	204446	16/8/2016	18/8/2016	1F166 13131	1
C0029	204446	16/8/2016	18/8/2016	1F166 13132	1
C0029	204446	16/8/2016	18/8/2016	1F166 13134	1
C0029	204446	16/8/2016	18/8/2016	1F166 13140	1
C0029	204446	16/8/2016	18/8/2016	1F166 13141	1
C0029	204446	16/8/2016	18/8/2016	1F166 13144	1
C0029	204446	16/8/2016	18/8/2016	1F166 22031	1
C0029	204446	16/8/2016	18/8/2016	1F166 22032	1
C0029	204446	16/8/2016	18/8/2016	1F166 22038	1
C0029	204446	16/8/2016	18/8/2016	1F166 22039	1
C0032	204447	16/8/2016	18/8/2016	1F147 02033	2
C0032	204447	16/8/2016	18/8/2016	1F147 02036	2
C0032	204447	16/8/2016	18/8/2016	1F147 02037	2
C0032	204447	16/8/2016	18/8/2016	1F147 02038	1
C0032	204447	16/8/2016	18/8/2016	1F147 07033	2
C0032	204447	16/8/2016	18/8/2016	1F147 07034	2
C0032	204447	16/8/2016	18/8/2016	1F147 07035	2
C0032	204447	16/8/2016	18/8/2016	1F147 07036	2
C0032	204447	16/8/2016	18/8/2016	1F147 07037	2
C0032	204447	16/8/2016	18/8/2016	1F147 07038	2

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
C0032	204447	16/8/2016	18/8/2016	1F147 07039	1
C0032	204447	16/8/2016	18/8/2016	1F147 07043	1
C0032	204447	16/8/2016	18/8/2016	1F159 06036	1
C0032	204447	16/8/2016	18/8/2016	1F159 06037	2
C0032	204447	16/8/2016	18/8/2016	1F159 06039	2
C0032	204447	16/8/2016	18/8/2016	1F159 06040	2
C0032	204447	16/8/2016	18/8/2016	1F159 06041	1
C0032	204447	16/8/2016	18/8/2016	1F159 06042	2
C0032	204447	16/8/2016	18/8/2016	1F159 22033	1
C0032	204447	16/8/2016	18/8/2016	1F159 22035	2
C0032	204447	16/8/2016	18/8/2016	1F159 22036	1
C0032	204447	16/8/2016	18/8/2016	1F159 22039	1
C0032	204447	16/8/2016	18/8/2016	1F166 13131	2
C0032	204447	16/8/2016	18/8/2016	1F166 13132	1
C0032	204447	16/8/2016	18/8/2016	1F166 13133	2
C0032	204447	16/8/2016	18/8/2016	1F166 13134	2
C0032	204447	16/8/2016	18/8/2016	1F166 13135	2
C0032	204447	16/8/2016	18/8/2016	1F166 13136	1
C0032	204447	16/8/2016	18/8/2016	1F166 13139	2
C0032	204447	16/8/2016	18/8/2016	1F166 13140	2
C0032	204447	16/8/2016	18/8/2016	1F166 13142	1
C0032	204447	16/8/2016	18/8/2016	1F166 13143	1
C0032	204447	16/8/2016	18/8/2016	1F166 22031	2
C0032	204447	16/8/2016	18/8/2016	1F166 22032	1
C0032	204447	16/8/2016	18/8/2016	1F166 22033	2
C0032	204447	16/8/2016	18/8/2016	1F166 22034	2

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
C0032	204447	16/8/2016	18/8/2016	1F166 22037	1
C0032	204447	16/8/2016	18/8/2016	1F166 22039	2
C0032	204447	16/8/2016	18/8/2016	1F166 22040	2
C0032	204447	16/8/2016	18/8/2016	1F166 22042	2
C0032	204447	16/8/2016	18/8/2016	1F176 37H39	1
C0032	204447	16/8/2016	18/8/2016	1F176 37H40	1
C0032	204447	16/8/2016	18/8/2016	1F176 37H41	1
C0032	204447	16/8/2016	18/8/2016	1F176 37H42	1
C0032	204447	16/8/2016	18/8/2016	1F176 37H43	1
C0032	204447	16/8/2016	18/8/2016	1F176 37H44	1
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C0032	204447	16/8/2016	18/8/2016	1F176 37V40	1
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C0032	204447	16/8/2016	18/8/2016	1F196 10036	1
C0032	204447	16/8/2016	18/8/2016	1F196 10037	1
C0032	204447	16/8/2016	18/8/2016	1F196 10038	1
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C0032	204447	16/8/2016	18/8/2016	1F196 12033	1

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
C0032	204447	16/8/2016	18/8/2016	1F196 12036	1
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C0032	204447	16/8/2016	18/8/2016	1F196 22033	1
C0032	204447	16/8/2016	18/8/2016	1F196 22034	1
C0032	204447	16/8/2016	18/8/2016	1F196 22035	1
C0032	204447	16/8/2016	18/8/2016	1F196 22036	1
C0032	204447	16/8/2016	18/8/2016	1F196 22037	1
C0032	204447	16/8/2016	18/8/2016	1F196 22038	1
C0032	204447	16/8/2016	18/8/2016	1F198 06031	1
C0032	204447	16/8/2016	18/8/2016	1F198 06032	1
C0032	204447	16/8/2016	18/8/2016	1F198 06035	1
C0032	204447	16/8/2016	18/8/2016	1F198 06036	1
C0032	204447	16/8/2016	18/8/2016	1F198 06037	1
C0032	204447	16/8/2016	18/8/2016	1F198 06038	1
C0032	204447	16/8/2016	18/8/2016	1F198 07033	1
C0032	204447	16/8/2016	18/8/2016	1F198 07035	1
C0032	204447	16/8/2016	18/8/2016	1F198 07036	1
C0032	204447	16/8/2016	18/8/2016	1F198 07037	1
C0032	204447	16/8/2016	18/8/2016	1F198 07038	1
C0032	204447	16/8/2016	18/8/2016	1G306 02038	4
C0032	204447	16/8/2016	18/8/2016	1G306 02040	2
C0032	204447	16/8/2016	18/8/2016	1G311 13137	1
C0032	204447	16/8/2016	18/8/2016	1G311 13138	1
C0032	204447	16/8/2016	18/8/2016	1G311 13139	1
C0032	204447	16/8/2016	18/8/2016	1G311 13140	1

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
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C0032	204447	16/8/2016	18/8/2016	1G311 13144	1
C0032	204447	16/8/2016	18/8/2016	1G311 22037	1
C0032	204447	16/8/2016	18/8/2016	1G311 22038	1
C0032	204447	16/8/2016	18/8/2016	1G311 22039	1
C0032	204447	16/8/2016	18/8/2016	1G311 22040	1
C0032	204447	16/8/2016	18/8/2016	1G311 22041	1
C0032	204447	16/8/2016	18/8/2016	1G311 22042	1
C0032	204447	16/8/2016	18/8/2016	1G311 22043	1
C0032	204447	16/8/2016	18/8/2016	1G311 22044	1
C0032	204447	16/8/2016	18/8/2016	11207 03043	2
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C0032	204447	16/8/2016	18/8/2016	11207 22045	2
C0032	204447	16/8/2016	18/8/2016	11272 32237	1
C0032	204447	16/8/2016	18/8/2016	11272 32238	1
C0032	204447	16/8/2016	18/8/2016	11272 32239	1
C0032	204447	16/8/2016	18/8/2016	11272 32240	1
C0032	204447	16/8/2016	18/8/2016	11272 32241	1
C0032	204447	16/8/2016	18/8/2016	11272 32242	1
C0032	204447	16/8/2016	18/8/2016	11272 32243	1
C0032	204447	16/8/2016	18/8/2016	11272 32244	1
C0032	204447	16/8/2016	18/8/2016	11272 32245	1
C0032	204447	16/8/2016	18/8/2016	11272 38837	1
C0032	204447	16/8/2016	18/8/2016	11272 38838	1

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
C0032	204447	16/8/2016	18/8/2016	11272 38839	1
C0032	204447	16/8/2016	18/8/2016	11272 38840	1
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C0032	204447	16/8/2016	18/8/2016	11272 38842	1
C0032	204447	16/8/2016	18/8/2016	11272 38843	1
C0032	204447	16/8/2016	18/8/2016	11272 38844	1
C0032	204447	16/8/2016	18/8/2016	11272 38845	1
C0032	204447	16/8/2016	18/8/2016	11272 52137	1
C0032	204447	16/8/2016	18/8/2016	11272 52138	1
C0032	204447	16/8/2016	18/8/2016	11272 52139	1
C0032	204447	16/8/2016	18/8/2016	11272 52140	1
C0032	204447	16/8/2016	18/8/2016	11272 52141	1
C0032	204447	16/8/2016	18/8/2016	11272 52142	1
C0032	204447	16/8/2016	18/8/2016	11272 52143	1
C0032	204447	16/8/2016	18/8/2016	11272 52144	1
C0032	204447	16/8/2016	18/8/2016	11272 52145	1
C0032	204447	16/8/2016	18/8/2016	11272 52237	1
C0032	204447	16/8/2016	18/8/2016	11272 52238	1
C0032	204447	16/8/2016	18/8/2016	11272 52239	1
C0032	204447	16/8/2016	18/8/2016	11272 52240	1
C0032	204447	16/8/2016	18/8/2016	11272 52241	1
C0032	204447	16/8/2016	18/8/2016	11272 52242	1
C0032	204447	16/8/2016	18/8/2016	11272 52243	1
C0032	204447	16/8/2016	18/8/2016	11272 52244	1
C0032	204447	16/8/2016	18/8/2016	11272 52245	1
C0032	204447	16/8/2016	18/8/2016	11405 02029	2

Customer Code	Order No.	Order Date	Delivery Date	Style	Quantity
C0032	204447	16/8/2016	18/8/2016	11405 02030	2
C0032	204447	16/8/2016	18/8/2016	11405 02040	12
C0032	204447	16/8/2016	18/8/2016	11405 17635	12
C0032	204447	16/8/2016	18/8/2016	11405 17639	12
C0032	204447	16/8/2016	18/8/2016	11405 17640	12
C0032	204447	16/8/2016	18/8/2016	11405 17641	12
C0032	204447	16/8/2016	18/8/2016	11405 17643	12
C0032	204447	16/8/2016	18/8/2016	11405 22039	12
C0032	204447	16/8/2016	18/8/2016	11405 22040	12
C0032	204447	16/8/2016	18/8/2016	11405 22041	12
C0032	204447	16/8/2016	18/8/2016	11405 22042	12
C0032	204447	16/8/2016	18/8/2016	1205S 02049	2
C0032	204447	16/8/2016	18/8/2016	1205S 22043	3
C0298	204448	16/8/2016	18/8/2016	1205S 02041	36
C0298	204448	16/8/2016	18/8/2016	1205S 02042	24
C0298	204448	16/8/2016	18/8/2016	1205S 02043	24
C0298	204448	16/8/2016	18/8/2016	1205S 02044	12
C0298	204448	16/8/2016	18/8/2016	1205S 02045	12
C0298	204448	16/8/2016	18/8/2016	1205S 17637	12
C0298	204448	16/8/2016	18/8/2016	1205S 17640	12

VITA