SALES ALLOCATION METHOD IMPROVEMENT:
A CASE STUDY IN AUTOMOBILE MANUFACTURING COMPANY

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การวิจัยมีวัตถุประสงค์เพื่อการปรับปรุงวิธีการจัดสรรการขายสำหรับรถยนต์ ของแผนกวางแผนการขายในบริษัทผู้ผลิตรถยนต์ เพื่อเพิ่มยอดขายในส่วนของผู้แทนจำหน่าย การวิจัยเริ่มจากการศึกษาข้อมูลทางวิชาการและระบบการจัดสรรอัตราการขายตามวิธีการที่ใช้อยู่ในปัจจุบันโดยละเอียด ซึ่งประกอบด้วย ขั้นตอนการทำงานโดยรวม, ระบบคอมพิวเตอร์ของการจัดการการขาย, และ การรวบรวมข้อมูลในอดีตของการขาย ระบบการจัดสรรอัตราการขายที่ใช้อยู่ในปัจจุบันได้ถูกนำมาตรวจสอบ, วิเคราะห์และทดสอบประสิทธิภาพ หลังจากนั้นทำการสร้างวิธีการจัดสรรอัตราการขายวิธีการใหม่ซึ่งระบบการตรวจสอบข้อมูลยอดค้างจองได้ถูกนำมาใช้ร่วมกับวิธีการคำนวณยอดจองแบบใหม่ซึ่งใช้วิธีการกรองข้อมูลโดยหาค่าเฉลี่ยแบบเคลื่อนที่และวิเคราะห์การแปรผันตามฤดูกาลของข้อมูลในปีที่ผ่านๆมา วิธีการจัดสรรการขายวิธีการใหม่ได้ถูกนำมาทดสอบและผลการจัดสรรถูกนำมาเปรียบเทียบกันระหว่างการจัดสรรตามวิธีการปัจจุบัน และวิธีการใหม่

วิธีการจัดสรรการขายในบริษัทผู้ผลิตรถยนต์โดยวิธีการใหม่มีความเหมาะสมเป็นอย่างมากกับสภาวะการณ์ในปัจจุบันของอุตสาหกรรมรถยนต์ซึ่งมีการแข่งขันที่สูง เพราะวิธีการใหม่สามารถตอบรับกับความต้องการจริงของตลาด มีระบบการจัดการและประสิทธิภาพที่ดีกว่าการจัดสรรในปัจจุบัน ผลจากการดำเนินงานวิจัยแสดงถึงการปรับปรุงกระบวนการอย่างมีนัยยะ ซึ่งสามารถเพิ่มค่าความสมดุลระหว่างอุปสงค์และอุปทานของตัวแทนจำหน่ายทั่วประเทศ 4.07% ซึ่งส่งผลโดยตรงต่อยอดขายซึ่งเพิ่มขึ้น 4.07% รวมทั้งลดระยะเวลาในการรอรถของลูกค้าอีกครึ่งเดือน นอกเหนือจากนั้นยังสามารถลดค่าคลาดเคลื่อนสมบูรณ์เฉลี่ยโดยรวมของความสมดุลระหว่างอุปสงค์และอุปทานของตัวแทนจำหน่ายทั่วประเทศอีก 15.27% และที่เห็นได้ชัดเจนที่สุดคือการลดค่าคลาดเคลื่อนสมบูรณ์เฉลี่ยโดยรวมของยอดค้างจองคงเหลือของตัวแทนจำหน่ายทั่วประเทศถึง 47.5% โดยภาพรวมแล้วจะสามารถส่งผลถึงการเพิ่มโอกาสในการขายและความพึงพอใจของลูกค้าต่อบริษัท โดยจะนำไปสู่ยอดขายโดยรวมที่ดีขึ้นของผู้แทนจำหน่ายและเพิ่มส่วนแบ่งทางการตลาดทั่วประเทศอีกด้วย

วิธีการจัดสรรอัตราการขายจะถูกส่งเสริมให้มีการนำไปใช้จริงกับรถยนต์รุ่นที่มีความต้องการจากลูกค้า (Demand) มากกว่ากำลังการผลิต (Supply) อันเนื่องมาจากประสิทธิภาพของวิธีการที่มีความเรียบง่ายและเป็นระบบซึ่งจะช่วยให้บริษัทสามารถจัดสรรจำนวนรถยนต์ที่เหมาะสม ไปที่ตัวแทนที่เหมาะสม และในเวลาที่เหมาะสม

ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต
สาขาวิชา การจัดการทางวิศวกรรม
ปีการศึกษา 2552

ลายมือชื่อนิสิต.....
ลายมือชื่ออ.ที่ปรึกษาวิทยานิพนธ์หลัก.....

487 16585 21: MAJOR ENGINEERING MANAGEMENT
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The aim of the research is to manage the sales allocation of vehicle in distribution function in sales planning department in automobile manufacturing company by improve the allocation method to increase the retail sales ratio.

The research started with the study of literatures and the current allocation method in terms of overall process workflow, sales computer system, and data collection of the previous years. Then the current allocation method is examined, analyzed and model implemented. The proposed allocation method is then established with the used of verification system for Back Order data, new booking forecast method by Moving Average methodology with Seasonal index of the past records. The results of the proposed allocation method model will be compared with that of the current allocation method model from the sampling data of actual January 2008 allocation.

Sales allocation according to the proposed allocation model is suitable for the current situation of automotive industry which is highly competitive as it responds to the real market demand more accurately, more systematic and effective than the current allocation method model. The proposed allocation method can improve the average matching ratio of all dealers nationwide by 4.07% which gives the direct improvement impact to retail sales ratio of the company by 4.07% and shorten customer delivery lead time by a half month. Moreover, sum of percentage error of matching ratio of all dealers is improved by 15.27% and the significant improvement in reduction of the sum of percentage error of Back order remaining by a hefty 47.5%. It implies the higher sales opportunity and customer satisfaction to the corporate which better overall retail sales and larger market share nationwide can also be expected.

The recommendation is to implement the proposed allocation method to the model that is in shortage supply situation since this proposed allocation system is very clear, simple and effective which will help the corporate to allocate the right amount of vehicles to the right location of dealers at the right time.

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Student's signature…….
Advisor's signature……...

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CHAPTER I
INTRODUCTION

In this chapter, thesis introduction is described. The corporate information, an overview of what obstacle to succeed is, what kind of tool shall be appropriate and the aim of the thesis are described in section 1.1. In section 1.2, a brief overview of the corporate background is described. The problems occurring in the working process and the objectives of this thesis study are stated in section 1.3 and 1.4, respectively. The scope of study and expected results are given in section 1.5 and 1.6.

1.1 Introduction

In today's automobile business environment, the corporate competitiveness highly depends on its ability to continuously improve cost reduction, customer service and product quality. In this competitive market, customer satisfaction plays the most important role for the success of the company which can be seen in the retail sales ratio and market share percentage. The company should provide quick and efficient service towards the customers. In automobile market, Dealers are an important role in maintaining the uninterrupted flow of vehicles between manufacturer and customers. Then, an effective or balance allocation of vehicles to dealers is needed for improving the performance of the supply chain network and be helpful in a better management of the customer demand. Unbalance or improper vehicle allocation can lead to shortage or oversupply situation of dealers and also can put a negative impact on customer satisfaction which can affect retail sales ratio and company's share in the market. Performance of Dealers can be judged on the basis of its ability to provide the right goods, at the right time and at the right place. The lead time to deliver the vehicle to the customers and the percentage of retail sales are important parameters for the measuring the efficiency and effectiveness of a particular dealer. Therefore efficient allocation of vehicles to Dealers of Distribution function is always important process in developing a flawless and reliable supply network.

1.2 Company Background

Company A was established in 1956. The main business was importing passenger cars and commercial vehicles. In 1962 having been awarded BOI investment promotion privilege certification as an automobile assembler, Company A was established on Surawong Road in 1964. The first automobile assembly plant was built at North Samrong. The main role of the plant was importing of completely knockdown part for reassembly. The car model assembled was DYNA JK 170, TIARA, DYNA PUBLICA (UP 10), DA, and STOUT. The second automobile assembly plant was built in 1975 at South Samrong. In 1988, Headquarters was moved from Surawong Road to Samrong Complex and a third automobile assembly plant was built. This new plant has a production output of 100,000 vehicles per year. In 1997, Gateway plant was built at Gateway City in Plangyao District, Chachoengsao. In 2004, the Innovative and International Multi-purpose Vehicle (IMV) project was launched. The target of this project was to setup the multi-purpose vehicle manufacturing center in Thailand. The multi-purpose vehicle is both sell in domestic and exported to Europe, Africa and Asia. The customer demand increase dramatically. The production capacity is insufficient to support the customer demand. In 2007, the new automobile assembly plant was built at Ban Pho in Chachoengsao Province in order to support the increasing demand both domestically and internationally. The plant has the production capacity of 100,000 units per year. The main product of Banpho plant is Multi-purpose vehicle (MPV).

Company A has become one of the leading automobile manufacturers in Thailand with 40% market share. Company A produces variety of products and services. Each series of product are separated into wide range of models. The products are divided into 2 main groups namely Multi-Purpose Vehicle (MPV) and Passenger Car (PC).

All passenger cars are assembled in Thailand. The main concept designs are developed by Company A's mother company in Japan, however, in 2003, the Company A's R&D center called Technical Center Asia Pacific was established in Thailand. The role is to develop the products to satisfy the customer in Asia Pacific by modified and improved some part of the cars.

Company A employs around 120,000 staff. The firm consists of 5 main divisions which are Academy division, Managerial division, Marketing division, Technical division and Manufacturing division as shown in Figure 1.1.

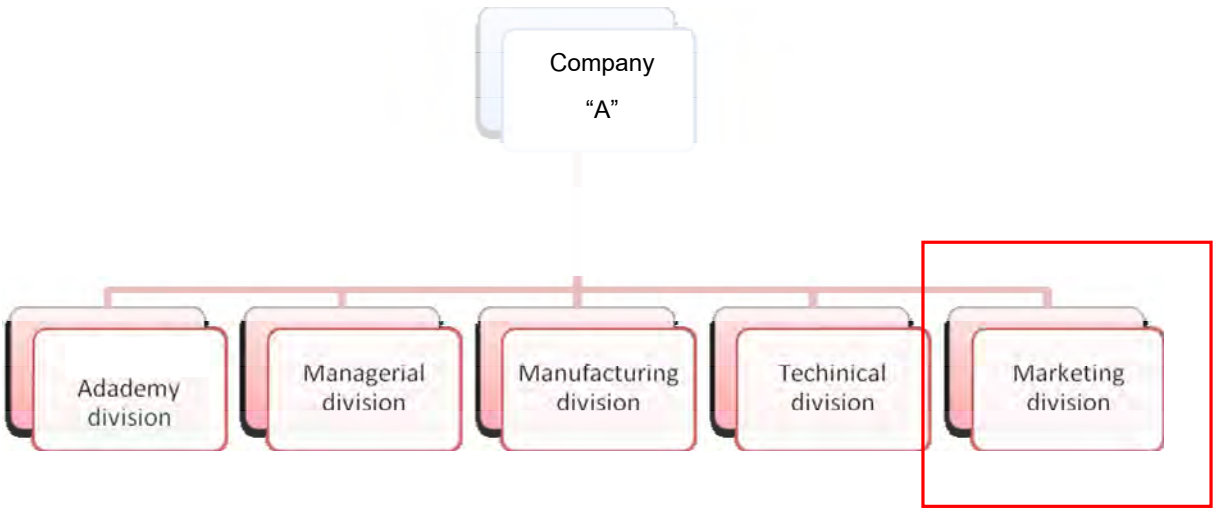


Figure 1.1: Company A Organization's structure

Company A has 4 main workplaces which are Bangkok office, North Samrong automobile assembly plant, Gateway automobile assembly plant and Ban pho automobile assembly plant. Each division located in different workplaces. Company A Academy division is located at North Samrong plant. Managerial Division is located at North Samrong plant and Bangkok office. Marketing division is located at North Samrong plant and Bangkok office. Technical division is located at North Samrong plant. Manufacturing is located at all Company A's automobile assembly plants, except Bangkok office. Figure 3 shows the organization structure of marketing division. Marketing division is separated into three sub-divisions namely national, regional sales, and after sales. Each sub-division consists of departments. Sales planning department is located in national division. Sales planning department is comprises of Sales planning team, Distribution team, and Sales system development team.

Sales planning team is responsible for sales & production planning and local vehicle distribution and allocation to119 dealers in Thailand. Figure 2 shows 33 dealers for Bangkok and suburban region, 29 dealers for Centre Region included Western and

Eastern, 19 dealers for Northern Region, 23 dealers for North-East Region, and 15 dealers for Southern Region. In each Dealer may own more than one showroom. The number of showrooms is depended on the business size of dealer. All around Thailand, there are 303 Showrooms for distributions as shown in Figure 1.2.

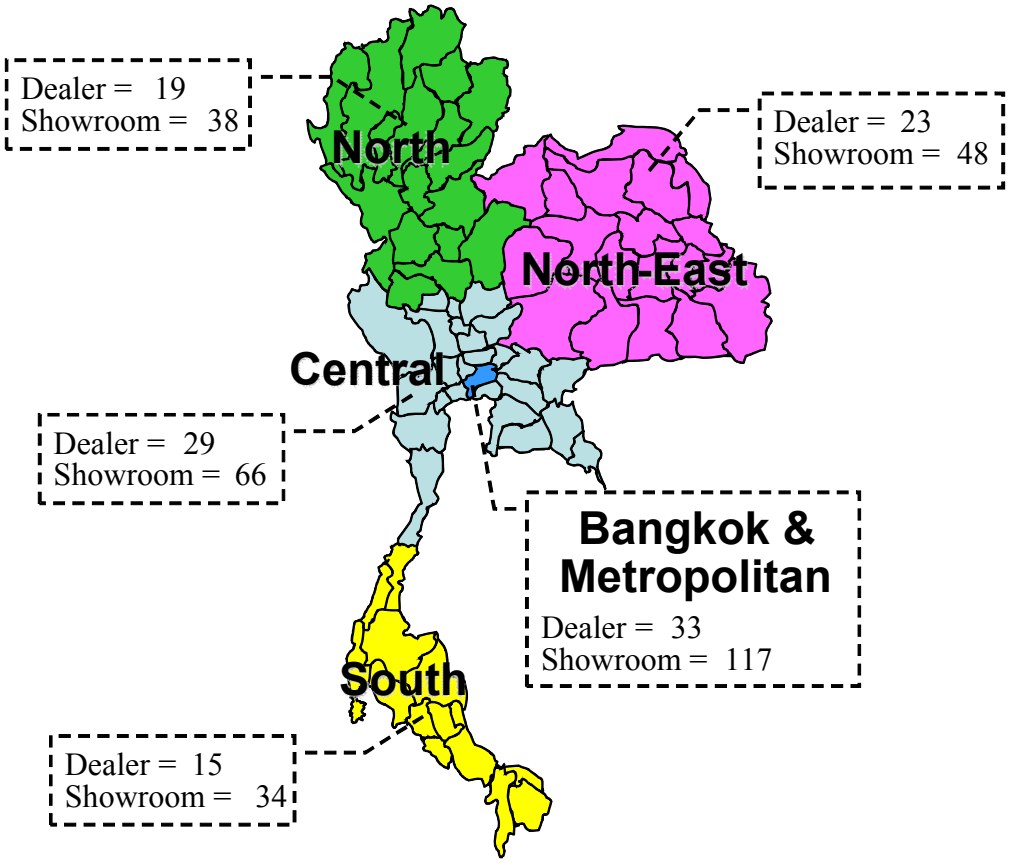


Figure 1.2: Dealers of Company A in Thailand (Update as Dec'08)

The firm consists of both Thai employee and Japanese employee. The employee's level is ranked by grade. The highest position is president. Each division is managed by Vice president, General Manager, Manager, Assistant manager. The employees which are not in managerial level are categorized into 3 groups. The first group is office worker. Employees in this group are Supervisor, Staff and Technician. The second group is Production operator. Group leader, Team leader, Technician and operators are in this group.

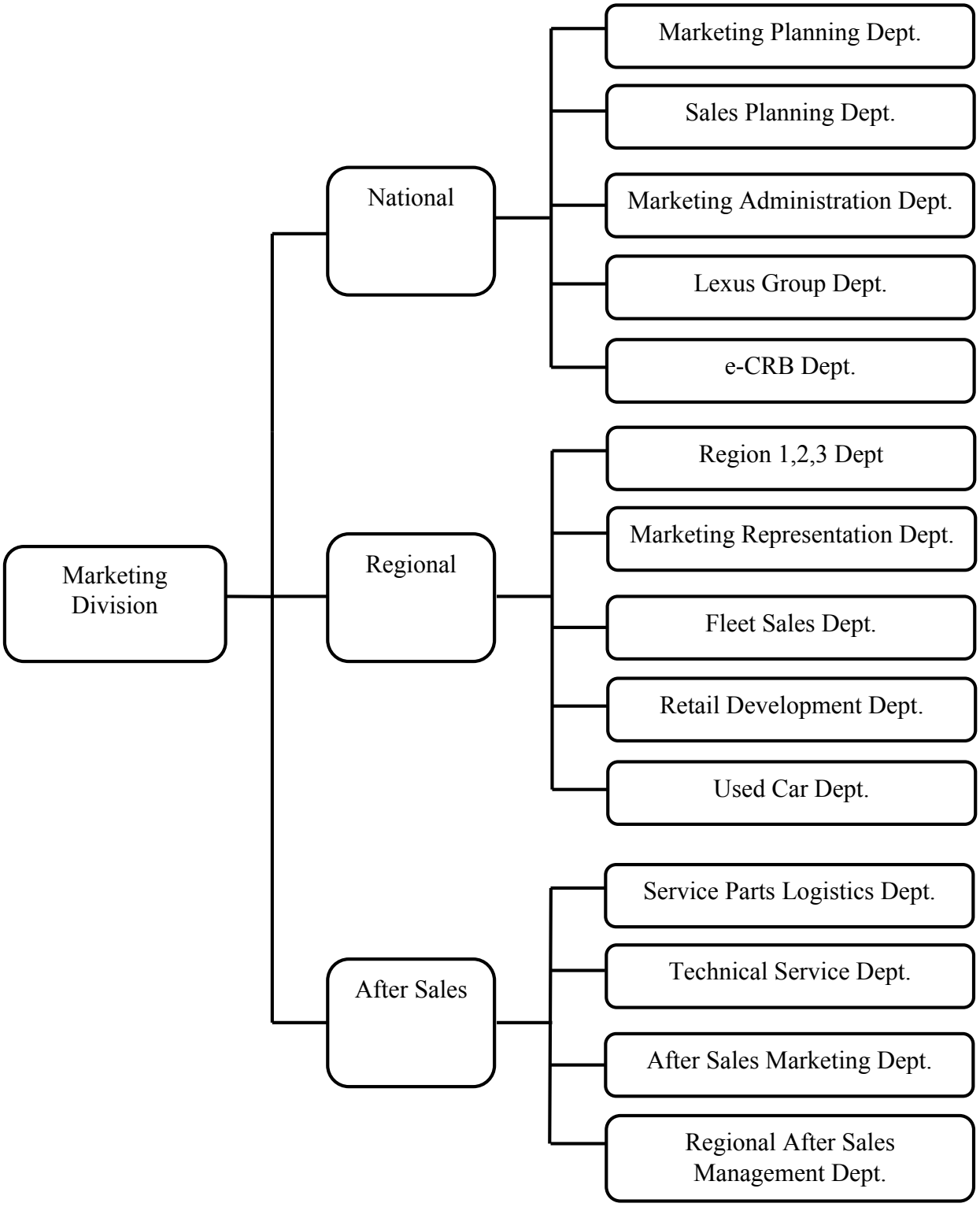


Figure 1.3: Organization Chart of Marketing Division

1.3 Problem Statement

After launching new products, the demand increases marginally. As a result, the demand exceeds the production capacity. Sales planning department cannot allocate vehicles as dealer orders which reflects to customer demand called “Back order”. Back order is the number of customer bookings which car has to be waited for a certain amount of time in delivery. Most dealers face the situation of shortage. Nowadays, Model A is among the new products facing this circumstance. The production of Model A can serve only around 40% of Back order. The company receives lots of complaint from customers for long car delivery time and less delivery at the promised time reflecting poor customer satisfaction and lost in sales opportunity to other competitors. The major problem faced in sales planning department is the management of vehicle distribution and allocation to 119 dealers nationwide. Example can be seen in Table 1.1 showing that the total retail sales are only 65% of the total supplies.

Table 1.1 shows that although numbers of Back orders are usually high but actually the retail sales of many dealers are quite low which are lower than the Average of 65.6% shown in Column B. Some dealers hold large stocks; see in column C while some dealers need to make sales. This lessens the sales opportunity of dealers who awaiting cars to be delivered. And this problem can also reflect some supplies are not in the real demand which may well be the cause of retail sales target cannot be achieved as plan and long delivery lead time. Column D is Back order at the end of the month and Column E is Back Order Remaining Month which is the number of month which Remaining of Back order is expected to be cleared or in another meaning of how long next coming customer has to wait for their booking. For example as shown in Table 1.1 for Dealer 1 who has Back Order Remaining Month of 2.23 reflecting around 2 and a half months which dealer will clear their existing Back orders and also can imply that next coming customer booking will have to wait for 2 and a half months for the vehicle while Nationwide average of Back Order Remaining Month is at 2.92. But, many dealers have the Back Order Remaining Month above Nationwide average which explains the problem of customer awaiting cars longer than the necessity.

	A	B	C	D	E
DEALER	RS Jan'07	RS Ratio	Stock End Month	Back Order Remaining End Month	Back Order Remainning Month
Dealer 1	51	71.8%	20	116	2.23
Dealer 2	31	70.5%	13	48	1.66
Dealer 3	18	62.1%	11	32	2.46
Dealer 4	14	63.6%	8	21	1.50
Dealer 5	19	67.9%	9	84	3.11
Dealer 6	22	64.7%	12	86	5.38
Dealer 7	104	89.7%	12	363	2.33
Dealer 8	36	87.8%	5	230	4.11
Dealer 9	64	85.3%	11	171	2.90
Dealer 10	21	75.0%	7	99	2.83
Dealer 11	9	81.8%	2	18	3.00
Dealer 12	30	62.5%	18	69	3.29
Dealer 13	3	75.0%	1	43	3.91
Dealer 14	9	52.9%	8	16	2.00
Dealer 15	54	81.8%	12	73	2.43
Dealer 16	8	88.9%	1	25	2.50
Dealer 17	24	85.7%	4	48	2.09
Dealer 18	4	50.0%	4	20	2.50
Dealer 19	14	73.7%	5	17	1.89
Dealer 20	6	66.7%	3	20	4.00
Dealer 21	38	88.4%	5	65	3.82
Dealer 22	11	68.8%	5	30	3.33
Dealer 23	14	73.7%	5	8	1.14
Dealer 24	12	85.7%	2	46	2.42
Dealer 25	9	81.8%	2	22	2.20
Dealer 26	20	66.7%	10	100	3.70
Dealer 27	8	80.0%	2	23	3.29
Dealer 28	12	75.0%	4	32	2.91
Dealer 29	7	58.3%	5	16	2.00
Dealer 30	7	77.8%	2	8	0.89
Dealer 31	7	70.0%	3	28	2.80
Dealer 32	15	83.3%	3	15	1.88
Dealer 33	12	92.3%	1	50	5.56
Dealer 34	5	83.3%	1	7	1.75
Dealer 35	2	66.7%	1	6	2.00
Dealer 36	2	50.0%	2	2	1.00
Dealer 37	9	60.0%	6	13	1.86
Dealer 38	3	75.0%	1	10	5.00
Dealer 39	3	60.0%	2	7	3.50
Dealer 40	1	33.3%	2	3	1.50
Dealer 41	2	50.0%	2	2	2.00
Dealer 42	10	66.7%	5	13	2.17
Dealer 43	4	80.0%	1	12	4.00
Dealer 44	9	81.8%	2	42	5.25
Dealer 45	7	87.5%	1	12	4.00
Dealer 46	3	75.0%	1	15	3.75
Dealer 47	1	25.0%	3	22	5.50
Dealer 48	1	50.0%	1	6	2.00
Dealer 49	2	66.7%	1	1	0.33
Dealer 50	4	80.0%	1	17	5.67
Dealer 51	1	50.0%	1	5	1.67
Dealer 52	2	66.7%	1	10	2.50
Dealer 53	2	50.0%	2	4	4.00
Dealer 54	3	75.0%	1	12	2.40
Dealer 55	6	75.0%	2	43	4.78
Dealer 56	12	100.0%	0	55	6.11
Dealer 57	9	81.8%	2	52	5.78
Dealer 58	1	50.0%	1	18	6.00
Dealer 59	0	0.0%	0	4	2.00
Dealer 60	4	66.7%	2	16	5.33
Dealer 61	4	66.7%	2	3	1.00
Dealer 62	4	80.0%	1	2	1.00
Dealer 63	3	75.0%	1	7	1.75
Dealer 64	1	25.0%	3	7	2.33
Dealer 65	1	100.0%	0	7	3.50
Dealer 66	6	75.0%	2	14	7.00
Dealer 67	3	75.0%	1	8	4.00
Dealer 68	0	0.0%	1	5	5.00
Dealer 69	1	100.0%	0	3	3.00
Dealer 70	3	60.0%	2	27	5.40
Dealer 71	0	0.0%	1	2	2.00
Dealer 72	5	100.0%	0	4	2.00
Dealer 73	1	50.0%	1	3	3.00
Dealer 74	2	50.0%	2	3	3.00
Dealer 75	1	50.0%	1	3	1.50
Dealer 76	4	50.0%	4	18	2.57
Dealer 77	3	60.0%	2	9	2.25
Dealer 78	5	83.3%	1	5	1.25
Dealer 79	0	0.0%	1	1	1.00
Dealer 80	3	60.0%	2	11	2.75
Dealer 81	8	80.0%	2	27	3.86
Dealer 82	5	100.0%	0	9	1.80
Dealer 83	1	33.3%	2	3	1.50
Dealer 84	1	100.0%	0	1	1.00
Dealer 85	1	100.0%	0	2	1.00
Dealer 86	4	57.1%	3	27	6.75
Dealer 87	2	66.7%	1	1	1.00
Dealer 88	2	66.7%	1	8	2.00
Dealer 89	0	0.0%	0	0	-
Dealer 90	1	100.0%	0	4	4.00
Dealer 91	1	100.0%	0	1	1.00
Dealer 92	5	55.6%	4	12	1.50
Dealer 93	4	66.7%	2	6	1.50
Dealer 94	1	50.0%	1	6	2.00
Dealer 95	3	60.0%	2	10	2.50
Dealer 96	1	50.0%	1	1	1.00
Dealer 97	2	66.7%	1	2	1.00
Dealer 98	1	25.0%	3	2	2.00
Dealer 99	0	0.0%	3	1	0.50
Dealer 100	0	0.0%	1	1	1.00
Dealer 101	1	50.0%	1	4	4.00
Dealer 102	0	0.0%	1	3	3.00
Dealer 103	4	80.0%	1	10	5.00
Dealer 104	9	90.0%	1	7	1.40
Dealer 105	2	66.7%	1	3	3.00
Dealer 106	13	86.7%	2	43	6.14
Dealer 107	1	50.0%	1	6	6.00
Dealer 108	1	100.0%	0	7	3.50
Dealer 109	3	75.0%	1	6	2.00
Dealer 110	2	100.0%	0	11	3.67
Dealer 111	1	33.3%	2	6	3.00
Dealer 112	6	85.7%	1	18	3.00
Dealer 113	3	60.0%	2	18	3.60
Dealer 114	1	100.0%	0	7	7.00
Dealer 115	2	66.7%	1	3	3.00
Dealer 116	0	0.0%	0	2	2.00
Grand Total	**964**	**65.6%**	**330**	**2873**	**2.92**

Table 1.1: Retail Sales and Stock of Model A in January 2007

1.4 Objective of the thesis

To improve vehicle allocation method for an automobile manufacturer to increase the retail sales ratio.

1.5 Scope of the thesis

The thesis will study and focus on the sales allocation method for Model A in Distribution function in Sales planning department in automobile manufacturer, i.e. Company A.

1.6 Expected Results

This study will benefit the corporate in the sense of:

1.6.1 To control the appropriate stock of all dealers.
When the vehicles are allocated to the dealers which have real demand, dealers have no need to keep the stock in the long term. This can improve the stock turn over.

1.6.2 To increase the total retail sales ratio.
The opportunities to sales are increased when the vehicles are in the right place at the right time.

1.6.3 To be the standard method of allocation in case of Demand over Supply.

CHAPTER II
THEORETICAL BACKGROUND AND LITERATURE REVIEWS

The theoretical background used in this thesis including definitions, basic concepts and objectives of Just In Time (JIT) which is one of the main pillars of famous Toyota Production System (TPS), Sales Management Computer Database System for manufacturer and dealer (SMCDS), Cause- Effect diagram, Independent demand and Dependent demand, Inventory – Related costs, FIFO System, Data Verification and Validation methods, Modular Arithmetic, Moving Average, Seasonal Variation and Index, and Mean absolute percentage error are described in section 2.1 respectively. In section 2.2, a brief review of the literatures relevant to the using of allocation methods in automotive industry from various manufactures.

2.1 Theoretical Background

2.1.1 Definition, Basic concept and Objectives of JIT

Just in Time production and services (JIT) originally emanating from Henry Ford and was perfected by Toyota and has been applied in practice since the early1970s as a means of meeting consumer demands with minimum delays.

Just In Time (JIT) is a management system of producing only what is required, in the exact quantity required, exactly when it is required and delivered exactly where it is required on time. Often we confuse JIT as just an inventory strategy, when it is very much a continuous improvement (Kaizen) program that addresses process flow issues, significantly reducing lead time, improving quality, freeing up space and significantly reducing costs and response time to changing demands of customers. When implemented JIT is driven by a series of signals, or Kanbans, that trigger production and service processes when to carry out the next part of the process, Kanban uses an array of simple visual signals, such as the presence or absence of a part on a shelf, color coded bins, cards, flags and even golf balls. When implemented correctly, JIT generally leads to dramatic improvement in organizations with major return on

investment in quality, efficiency and inventory costs. New stock is triggered using visual signals when downstream processes require items or activity to happen saving warehouse space and costs.

2.1.2 Sales Management Computer Database System for manufacturer and dealer (SMCDS) Definition and Objectives

SMCDS, Sales Management Computer Database System is a computerized sales system developed in 1999 which integrates company sales information to make one set of data for the company, plan the sales activities in a company and streamline process for better, faster and more effective with all concerned parties including dealers, Toyota sales concerned departments such as sales planning and production planning, and customer. SMCDS has been a set of sales techniques which enables all concerned parties to operate in a streamline environment resulting in more efficient operations in term of real time communication control.

2.1.3 Cause – Effect Diagram

The cause & effect diagram is the brainchild of Kaoru Ishikawa, who pioneered quality management processes in the Kawasaki shipyards and in the process, became one of the founding fathers of modern management. The cause and effect diagram is used to explore all the potential or real causes (or inputs) that result in a single effect (or output). Causes are arranged according to their level of importance or detail, resulting in a depiction of relationships and hierarchy of events. This can help you search for root causes, identify areas where there may be problems, and compare the relative importance of different causes.

Causes in a cause & effect diagram are frequently arranged into four major categories. While these categories can be anything, it will be often seen as:

- Manpower, Methods, Materials, and Machinery (recommended for manufacturing)
- Equipment, Policies, Procedures, and People (recommended for administration and service).

The C&E diagram is also known as the fishbone diagram because it was drawn to resemble the skeleton of a fish, with the main causal categories drawn as "bones" attached to the spine of the fish, as shown below.

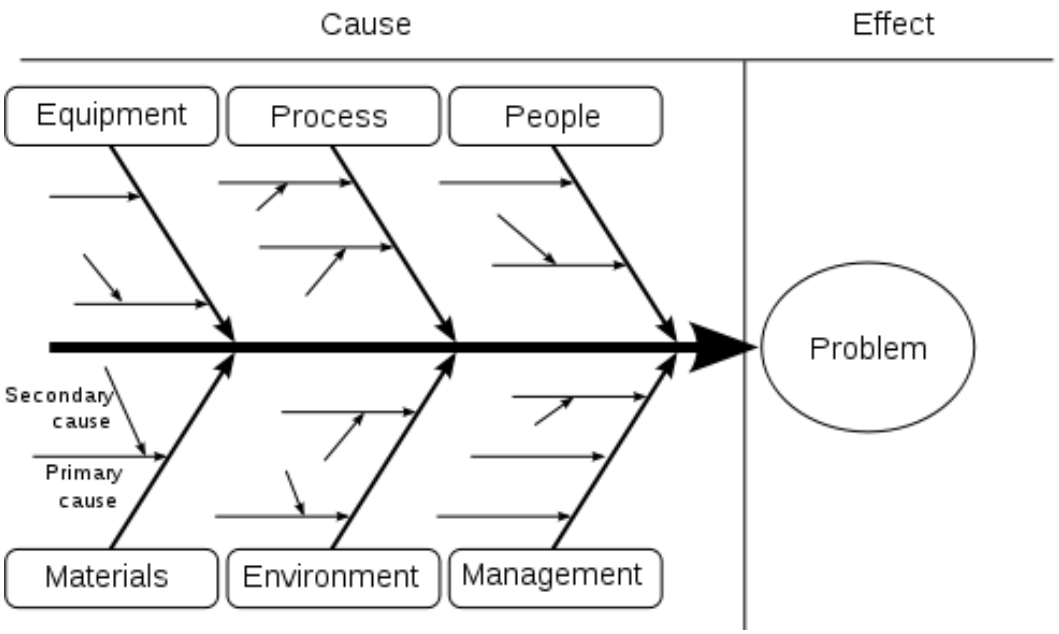


Figure 2.1: Sample of Cause & Effect Diagram

Cause & Effect diagrams can also be drawn as tree diagrams, resembling a tree turned on its side. From a single outcome or trunk, branches extend that represent major categories of inputs or causes that create that single outcome. These large branches then lead to smaller and smaller branches of causes all the way down to twigs at the ends. The tree structure has an advantage over the fishbone-style diagram. As a fishbone diagram becomes more and more complex, it becomes difficult to find and compare items that are the same distance from the effect because they are dispersed over the diagram. With the tree structure, all items on the same causal level are aligned vertically.

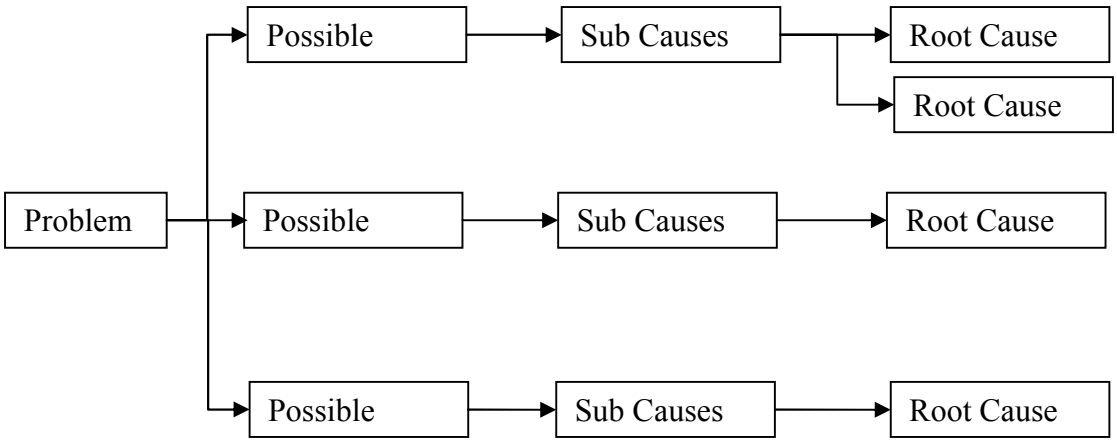


Figure 2.2: Sample of Tree Cause & Effect Diagram

2.1.4 Independent Demand and Dependent Demand

Independent Demand is any demand that has no cause within the business-system context (although it may have a cause in a larger context). For example, to an automobile dealer, a customer order for a new car is an independent demand (although to the customer, it might have been dependent on the unreliability of the customer's old car).

Dependent Demand is any demand that is caused by an independent demand, or is necessary to the satisfaction of the independent demand. For example, an independent demand for a new car causes dependent demands for all of the components which make up the car.

2.1.5 Inventory- Related costs

Cost related to inventory is not only cost associated with managing inventory which is most visible. There are three costs which most widely known in the context of inventory management: cost of preparing an order, cost for keeping inventory and cost incurred when there is a shortage.

- **Ordering cost**

Ordering cost means the cost necessary for time-consumed and extra cost required for order placing for an item, receive it, and pay for it (Hohenstein C. L., 1982). This cost associates with issuing paperwork, order preparation, maintaining files, and controlling quality, verifying accurate receipts, and other hidden costs.

- **Holding cost**

Holding cost is the cost incurred when holding goods in stock for certain period of time. This cost associates with investment on security, the cost of capital which is incurred on the inventory investment and the return on investment which could not be undertaken because funds must be committed to inventory. This cost could be taxes and insurance on inventory, costs of inventory obsolescence and costs for storing and operating inventory such as electricity, water and labor.

- **Shortage cost**

Shortage cost incurs when demand exceeds the available supply on hand. It includes cost for keeping track of a back-order and income lost when the customer purchases the product from the competitors. Moreover, the shortage cost could not be measured when the customer goodwill is lost.

2.1.6 First-In First-Out System (FIFO)

FIFO is an acronym for First In, First Out, an abstraction in ways of organizing and manipulation of data relative to time and prioritization. This expression describes the principle of a queue processing technique or servicing conflicting demands by ordering process by first-come, first-served (FCFS) behavior: what comes in first is handled first, what comes in next waits until the first is finished, etc.

Thus it is analogous to the behavior of persons queuing (or "standing in line", in common American parlance), where the persons leave the queue in the order they arrive, or waiting one's turn at a traffic control signal. FCFS is also the shorthand name (see Jargon and acronym) for the FIFO operating system scheduling algorithm, which gives every process CPU time in the order they come. In the broader sense, the abstraction LIFO, or Last-In-First-Out is the opposite of the abstraction FIFO organization, the difference perhaps is clearest with considering the less commonly used synonym of LIFO, FILO—meaning First-In-Last-Out. In essence, both are specific cases of a more generalized list (which could be accessed anywhere). The difference is not in the list (data), but in the rules for accessing the content. One sub-type adds to one end, and takes off from the other; its opposite takes and puts things only on one end.

A priority queue is a variation on the queue which does not qualify for the name FIFO, because it is not accurately descriptive of that data structure's behavior. Queuing theory encompasses the more general concept of queue, as well as interactions between strict-FIFO queues.

2.1.7 Data Verification and Validation Methods

Verification and validation is the process of checking that a product, service, or system meets specifications and that it fulfills its intended purpose. These are critical components of a quality management system such as ISO 9000. Sometimes proceeded with "Independent" (or IV&V) to ensure the validation is performed by a disinterested third party.

Verification is a Quality control process that is used to evaluate whether or not a product, service, or system complies with regulations, specifications, or conditions imposed at the start of a development phase. Verification can be in development, scale-up, or production. This is often an internal process.

Validation is Quality assurance process of establishing evidence that provides a high degree of assurance that a product, service, or system accomplishes its intended

requirements. This often involves acceptance of fitness for purpose with end users and other product stakeholders.

It is sometimes said that validation can be expressed by the query "Are you building the right thing?" and verification by "Are you building the thing right?", "Building the right thing" refers back to the user's needs, while "building it right" checks that the specifications be correctly implemented by the system. In some contexts, it is required to have written requirements for both as well as formal procedures or protocols for determining compliance.

Validation work can generally be categorized by the following functions:

- Prospective validation - the missions conducted before new items are released to make sure the characteristics of the interests which are functional properly and which meet the safety standards. Some examples could be legislative rules, guidelines or proposals, methods, theories/hypothesis/models, products and services.
- Retrospective validation - a process for items that are already in use and distribution or production. The validation is performed against the written specifications or predetermined expectations, based upon their historical data/evidences that are documented / recorded. If any critical data is missing, then the work cannot be processed or can only be completed partially. The tasks are considered necessary if
    - Prospective validation is missing, inadequate or flawed.
    - The change of legislative regulations or standards affects the compliance of the items being released to the public or market.
    - reviving of out-of-use items

Some of the examples could be validating of

    - ancient scriptures that remain controversies
    - clinical decision rules
    - data systems

- Full scale validation

- Partial validation - often used for research and pilot studies if time is constrained. The most important and significant effects are tested. From an analytical chemistry perspective, those effects are selectivity, accuracy, repeatability, linearity and its range.
- Cross-validation
- Re-validation/Locational or Periodical validation - carried out, for the item of interest that is dismissed, repaired, integrated/coupled, relocated, or after a specified time laps. Examples of this category could be relicensing/renewing driver's license, recertifying an analytical balance that has been expired or relocated, and even revalidating professionals. Re-validation may also be conducted when/where a change occurs during the courses of activities, such as scientific researches or phases of clinical trial transitions. Examples of these changes could be
    - sample matrices
    - production scales
    - population profiles and sizes
    - out-of-specification (OOS) investigations, due to the contamination of testing reagents, glasswares, the aging of equipment/devices, or the depreciation of associated assets etc

In GLP accredited laboratories, verification/revalidation will even be conducted very often against the monographs of USP and BP to cater for domestic needs.

- Concurrent validation - conducted during a routine processing of services, manufacturing or engineering etc. Examples of these could be
    - duplicated sample analysis for a chemical assay
    - triplicated sample analysis for trace impurities at the marginalized levels of detection limit, or/and quantification limit
    - single sample analysis for an chemical assay by a skilled operator with multiplicated online system suitability testing

2.1.8 Modular Arithmetic

In mathematics, modular arithmetic (sometimes called clock arithmetic) is a system of arithmetic for integers, where numbers "wrap around" after they reach a certain value—the modulus. Modular arithmetic was introduced by Carl Friedrich Gauss in his book Disquisitiones Arithmeticae, published in 1801.

Figure 2.3: Time-Keeping on a Clock; Example of Modular Arithmetic.

A familiar use of modular arithmetic is its use in the 12-hour clock, in which the day is divided into two 12 hour periods. If the time is 7:00 now, then 8 hours later it will be 3:00. Usual addition would suggest that the later time should be 7 + 8 = 15, but this is not the answer because clock time "wraps around" every 12 hours; there is no "15 o'clock". Likewise, if the clock starts at 12:00 (noon) and 21 hours elapse, then the time will be 9:00 the next day, rather than 33:00. Since the hour number starts over when it reaches 12, this is arithmetic *modulo* 12.

Modular arithmetic can be handled mathematically by introducing a congruence relation on the integers that is compatible with the operations of the ring of integers: addition, subtraction, and multiplication. For a fixed modulus *n*, it is defined as follows.

> Two integers *a* and *b* are said to be congruent modulo *n*, if their difference $a - b$ is an integer multiple of *n*. An equivalent definition is that both numbers have the same remainder when divided by n. If this is the case, it is expressed as:
>
> $$a \equiv b \pmod{n}.$$
>
> The above mathematical statement is read: "*a* is congruent to *b* modulo *n*".

For example,

$$38 \equiv 14 \pmod{12}$$

because 38 − 14 = 24, which is a multiple of 12. For positive n and non-negative a and b, congruence of a and b can also be thought of as asserting that these two numbers have the same remainder after dividing by the modulus n. So,

$$38 \equiv 2 \pmod{12}$$

because both numbers, when divided by 12, have the same remainder (2). Equivalently, the fractional parts of doing a full division of each of the numbers by 12 are the same: 0.1666... (38/12 = 3.166..., 2/12 = 0.1666...). From the prior definition we also see that their difference, $a - b$ = 36, is a whole number (integer) multiple of 12 (n = 12, 36/12 = 3).

The same rule holds for negative values of a:

$$-3 \equiv 2 \pmod{5}.$$

A remark on the notation: Because it is common to consider several congruence relations for different module at the same time, the modulus is incorporated in the notation. In spite of the ternary notation, the congruence relation for a given modulus is binary. This would have been clearer if the notation $a \equiv_n b$ had been used, instead of the common traditional notation.

The properties that make this relation a congruence relation (respecting addition, subtraction, and multiplication) are the following.

If $a_1 \equiv b_1 \pmod{n}$ and $a_2 \equiv b_2 \pmod{n}$, then:

- $(a_1 + a_2) \equiv (b_1 + b_2) \pmod{n}$
- $(a_1 - a_2) \equiv (b_1 - b_2) \pmod{n}$
- $(a_1 a_2) \equiv (b_1 b_2) \pmod{n}$.

Like any congruence relation, congruence modulo *n* is an equivalence relation, and the equivalence class of the integer *a*, denoted by $\overline{a}_n$, is the set $\{\ldots, a-2n, a-n, a, a+n, a+2n, \ldots\}$. This set, consisting of the integers congruent to *a* modulo *n*, is called the congruence class or residue class of *a* modulo *n*. Another notation for this congruence class, which requires that in the context the modulus is known, is $[a]$.

Modular arithmetic is referenced in number theory, group theory, ring theory, knot theory, abstract algebra, cryptography, computer science, chemistry and the visual and musical arts.

It is one of the foundations of number theory, touching on almost every aspect of its study, and provides key examples for group theory, ring theory and abstract algebra.

In cryptography, modular arithmetic directly underpins public key systems such as RSA and Diffie-Hellman, as well as providing finite fields which underlie elliptic curves, and is used in a variety of symmetric key algorithms including AES, IDEA, and RC4.

In computer science, modular arithmetic is often applied in bitwise operations and other operations involving fixed-width, cyclic data structures. The module operation, as implemented in many programming languages and calculators, is an application of modular arithmetic that is often used in this context.

In chemistry, the last digit of the CAS registry number (a number which is unique for each chemical compound) is a check digit, which is calculated by taking the last digit of the first two parts of the CAS registry number times 1, the next digit times 2, the next digit times 3 etc., adding all these up and computing the sum modulo 10.

In music, arithmetic modulo 12 is used in the consideration of the system of twelve-tone equal temperament, where octave and enharmonic equivalency occurs (that is, pitches in a 1;2 or 2;1 ratio are equivalent, and C-sharp is considered the same as D-flat).

The method of casting out nines offers a quick check of decimal arithmetic computations performed by hand. It is based on modular arithmetic modulo 9, and specifically on the crucial property that $10 \equiv 1 \pmod 9$.

More generally, modular arithmetic also has application in disciplines such as law (see e.g., apportionment), economics, (see e.g., game theory) and other areas of the social sciences, where proportional division and allocation of resources plays a central part of the analysis.

Since modular arithmetic has such a wide range of applications, it is important to know how hard it is to solve a system of congruence. A linear system of congruence can be solved in polynomial time with a form of Gaussian elimination, for details see Linear congruence theorem. Algorithms, such as Montgomery reduction, also exist to allow simple arithmetic operations, such as multiplication and exponentiation modulo *n*, to be performed efficiently on large numbers.

2.1.9 Moving Average

Moving average is considered as one of the time series forecasting methods are based on analysis of historical data (time series: a set of observations measured at successive times or over successive periods). It makes the assumption that past patterns in data can be used to forecast future data points.

Moving averages (simple moving average, weighted moving average): forecast is based on arithmetic average of a given number of past data points.

Component of time series demand which in this case is the Moving average methodology:

- average: the mean of the observations over time
- trend: a gradual increase or decrease in the average over time
- Seasonal Influence: predictable short-term cycling behavior due to time of day, week, month, season, year, etc.

- Cyclical Movement: unpredictable long-term cycling behavior due to business cycle or product/service life cycle
- Random Error: remaining variation that cannot be explained by the other four components

Moving average techniques forecast demand by calculating an average of actual demands from a specified number of prior periods. Each new forecast drops the demand in the oldest period and replaces it with the demand in the most recent period; thus, the data in the calculation "moves" over time

Simple Moving Average: $A_t = \frac{D_t + D_{t-1} + D_{t-2} + \ldots + D_{t-N+1}}{N}$

where N = total number of periods in the average

Forecast for period t+1: $F_{t+1} = A_t$

Key Decision**:** N - How many periods should be considered in the forecast

Tradeoff: Higher value of N - greater smoothing, lower responsiveness

Lower value of N - less smoothing, more responsiveness

- The more periods (N) over which the moving average is calculated, the less susceptible the forecast is to random variations, but the less responsive it is to changes.
- A large value of N is appropriate if the underlying pattern of demand is stable
- A smaller value of N is appropriate if the underlying pattern is changing or if it is important to identify short-term fluctuations

2.1.10 Seasonal Variation and Index

Seasonal Variation is a component of a time series which is defined as the repetitive and predictable movement around the trend line in one year or less. It is detected by measuring time intervals in small units, such as days, weeks months or quarters.

Organizations facing seasonal variations, like the motor vehicle industry is often interested in knowing their relative performance to the normal seasonal variation. Same is with the ministry of employment which expects unemployment to increase in June because recent graduates are just arriving into the market and also schools have also been given a vacation for the summer. The moot point is whether the increase is more or less than expected.

Organizations affected by seasonal variation need to identify and measure this seasonality to help with planning for temporary increases or decreases in labor requirements, inventory, training, periodic maintenance, and so forth. Apart from these the organizations need to know if the seasonal variation they experience at more or less than the average rate.

There are three main reasons for studying seasonal variation.

1. The description of the seasonal effect provides a better understanding of the impact this component has upon a particular series.

2. After establishing the seasonal pattern methods can be implemented to eliminate it from the time-series to study the effect of other components such as cyclical and irregular variations. This elimination of the seasonal effect is referred to as deseasonalizing or seasonal adjustment of data.

3. To project the past patterns into the future knowledge of the seasonal variations is a must.

4. Prediction of the future trend

A decision maker or analyst must select one of the following assumptions when treating the seasonal component:

- The impact of the seasonal component is constant from year to year.
- The seasonal effect is changing slightly from year to year.
- The impact of the seasonal influence is changing dramatically.

Seasonal variation is measured in terms of an index, called seasonal index. It is an average that indicates the percentage of an actual observation relative to what it would be if no seasonal variation in a particular period is present. It is attached to each period of the time series within a year. This implies that if monthly data are considered there are 12 separate seasonal; indexes, one for each month and 4 separate indexes for quarterly data. The following methods are used to calculate seasonal indices to measure seasonal variations of a time-series data.

1. Method of Simple Averages

2. Ratio to Trend Method

3. Ratio-to-Moving Average Method

4. Link Relatives Method

2.1.11 Mean Absolute Percentage Error

Mean absolute percentage error (also known as MAPE) is measure of accuracy in a fitted time series value in statistics, specifically trending. It usually expresses accuracy as a percentage.

$$\mathrm{MAPE} = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{A_t - F_t}{A_t}\right|$$

The difference between actual value A_t and the forecast value F_t, is divided by the actual value A_t again. The absolute value of this calculation is summed for every fitted or forecast point in time and divided again by the number of fitted points n. This makes it a percentage error so one can compare the error of fitted time series that differ in level.

Although the concept of MAPE sounds very simple and convincing it has two major drawbacks in practical application:

- If there are zero values (sometimes happens for example in demand series) there will be a division by zero
- When having a perfect fit, MAPE is zero. But in regard to its upper level the MAPE has no restriction. When calculating the average MAPE for a number of time series there might be a problem: a few numbers of series that have a very high MAPE might distort a comparison between the average MAPE of time series fitted with one method compared to the average MAPE when using another method. In order to avoid this problem other measures have been defined, for example the sMAPE (symmetrical MAPE) or a relative measure of accuracy.

2.2 Literature Review

The 'industry of industries', as Peter Drucker (1946) referred to the automotive industry more than half a century ago, has been a frequent subject of academic studies.

With intense global competition, manufacturers strive to provide their customers with highly valued products and services. Demanding customers expected these manufacturers to integrate complex sets of requirements in terms of outstanding quality, competitive prices, reliable delivery and innovative features (Tomino, Park, Hong, and Roh, 2008). In the current competitive economy, manufacturers are not competing with manufacturers, the supply chain compete with each other (Christopher, 1992). Supply chain in this case means manufacturers, suppliers, and nationwide dealers and this thesis will mainly focus on the relation between manufacturers and dealers in terms of handling market demand and supply in the industry.

Despite the efficiency gains at the manufacturing level however, overall vehicle supply systems shows poor performance in responding to customer needs, and

increasingly rely on incentives and rebates to sell their vehicles (Ramcharran, 2001, Holweg and Pil, 2004). A key reason for this dichotomy has to be seen in the fact that – while manufacturing practices were reengineered – allocation systems largely remained unchanged. The large majority of cars are still produced to forecast, and sold from dealer inventory. In a capital-intensive industry such as automotive, this approach renders the manufacturer less vulnerable to swings in demand in the marketplace.

While inventory levels inside the manufacturing operation have been reduced from the entire advance controlling systems which have been developed so far such as Just-In-Time (JIT), Lean Manufacturing, First- In First- Out (FIFO) and etc., the average new vehicle stock level has consistently been stable without improvement in the past. Recently, automobile business or automotive industry has been boomed with the demand with quite a number of competitors aim to gain it. Therefore

From the view point of stable production and dealer management in Just-In-Time (JIT), it is not easy and smooth as almost all researches about JIT explained. There are several problems in my viewpoint which can be conventionally explained as followed:

- **Lead-Time and Risk**

For the parts manufacturers, a lead time of 30-60 days is required therefore demand must be predicted 30-60 days in advance. However, if a prediction is inaccurate, it will cause surplus stock or shortages.

- **Flexibility and Efficiency**

JIT will face the problem of how to bridge the gap of the production capacity fixed to a medium or a long period of time, and the changing demand in the short term. Inventory-related costs are also concerned from this problem.

- **A Part Supplier and Dealer's Role**

Risk is shifted to the parts supplier and dealers and parts suppliers and dealers are "burdened" by Toyota (Risk Shifting Hypothesis: RSH) (Asanuma, 1997). The parts

supplier and dealer must contend with some of the very same conditions as the assembler. Accordingly, how can the supplier solve problems that Toyota itself cannot solve? No research has been done to explain this point.

From the above problems explanation, the main party to take the risk and responsibility should be the vehicle manufacturer to figure out how to manage and improve their process and system in order to get rid of these obstacles.

Few academic studies, such as (Kiff, 1997; Blumenfeld et al., 1999; Karabakal et al., 2000), directly analyze the drivers behind inventory in the retail and distribution end of the supply chain, although the role of and reasons for excess inventory has conceptually been well described within the wider field of supply chain dynamics (Forrester, 1958; Sterman, 1989; Lee and Billington, 1992). Of particular interest to the underlying study is the paper by Blumenfeld et al. (1999), which shows that, analytically, the inventory level at the retailer is driven by the stock replenishment lead time, and how shorter order lead times could reduce the finished goods inventory.
From my view point, this paper by Blumenfeld et al. (1999) is out of date and does not match with the current situation happening in automobile retail business these days since not only excess inventory must be focused but the shortage is around to be fixed as well therefore old style of allocation or distribution must be improved to match with the current situation of the market.

In the past decade until now, automobile business or automotive industry has been boomed with the huge and fluctuating demand with quite a number of competitors aiming to gain it. Therefore, effective allocation system must be in place to proper foresee the real demand of the market enabling the manufacturer to be able to allocate the vehicles to the right location, at the right amount and at the right time.

CHAPTER III
CURRENT VEHICLE ALLOCATION METHOD ANALYSIS

In chapter 3, the organization structure and the objectives of sales planning department are described. The overall current process of supply chain management, the current computer system using in sales planning department, the current vehicle allocation method and the current daily assignment schedule are discussed in section 3.1, 3.2, 3.3, and 3.4 respectively.

From the marketing division organization chart in Figure 1.3 shows the organization structure of marketing division, the Sales planning department is located in national division. Sales planning department comprises of Sales planning team, distribution team and sales system development. The organization of this department is shown in Figure 3.1

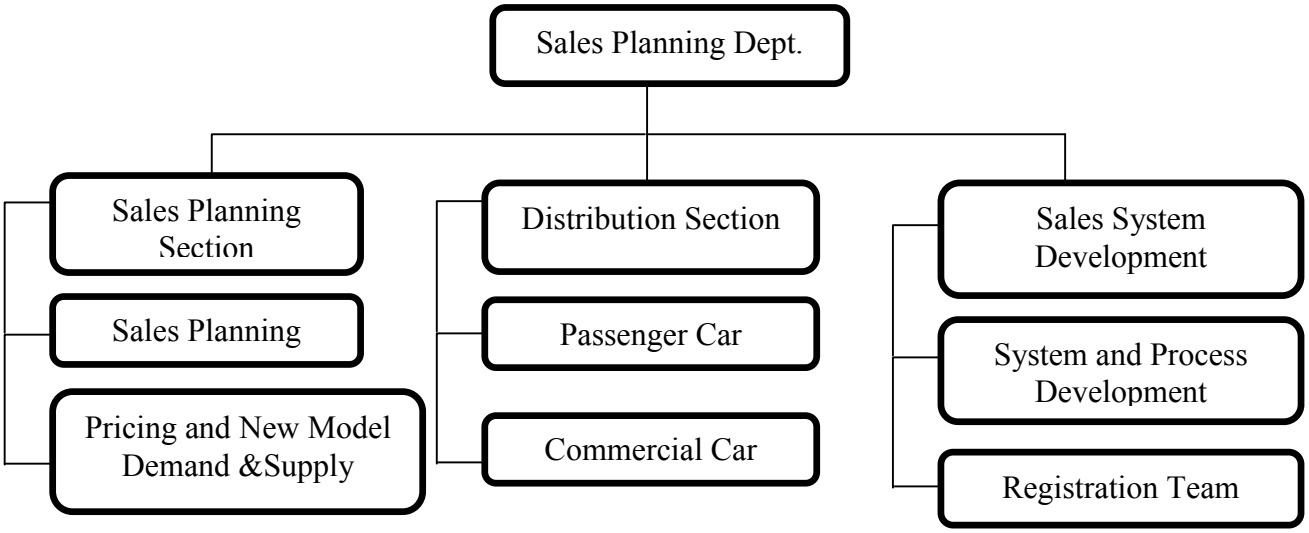


Figure 3.1: Sales Planning Department Structure

Sales planning section consists of 2 sub-sections which are sales planning team who is responsible for sales & production planning and pricing and new model demand & supply team who is in charge of set pricing and monitor & manage new model demand & supply. Next, distribution section is responsible for local passenger and commercial car distribution and allocation to 119 dealers in Thailand. Finally, sales system development team consists of 2 sub-sections which are registration team who

is responsible for manage and operate local & export vehicle Department of Land Transportation (DLT), customers, Thai Industrial Standard Institute (TISI), Royal Thai Police and concerns for vehicle type approval and vehicle information required. Next, system process development team who is responsible for development and maintain of Sales Management Computer Database System for manufacturer and dealer (Referred to SMCDS in this thesis).

Sales management computer database system is the system which is commonly used for communication between dealers, sales planning department and production department. Sales planning department acts as a middleman on this basis.

The objective of the sales planning department is to distribute and allocate the right product in the right amount at the right place at the right time and at the right cost.

3.1 The Current and Overall Process of Supply Chain Management

Figure 3.2 illustrates current workflow of the overall process of modern supply chain management which is basically monitored, controlled and managed by Sales planning department. The core processes can be classified into 5 steps:

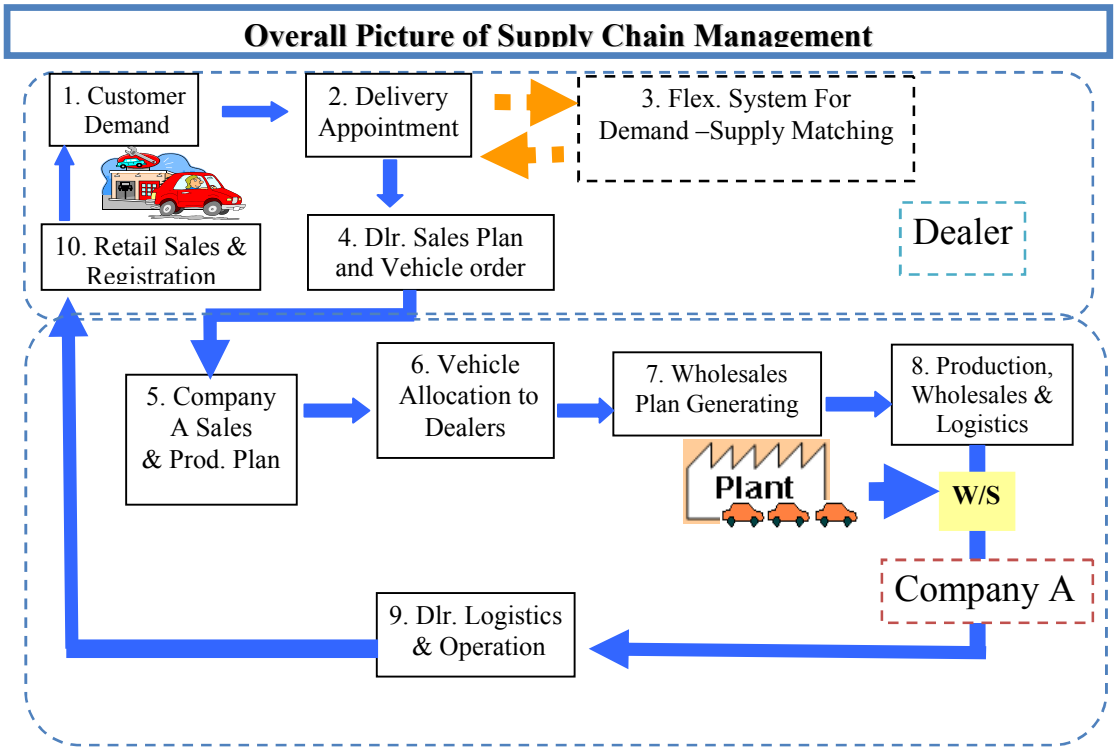


Figure 3.2: Overall Picture of Supply Chain Management

Step 1: Customer Demand

The first step starts from when the customer enters the showroom and shows interest to the product then A-Card will be created. A-Card is the form which customer has to fill-in showing the prospect demand before booking. Next, A-Card will be transformed into proper booking when customer decides to book the product then prospect demand will turn to the real demand. All of this information will be keyed into SMCDS system which Company A will acknowledge this demand in the real time basis. This basis is also counted for the cancellation.

In today's sales section of dealer will monitor and manage customer demand through SMCDS system which consists of 4 main data namely A-Card, New Booking, Back Order and Booking Cancel

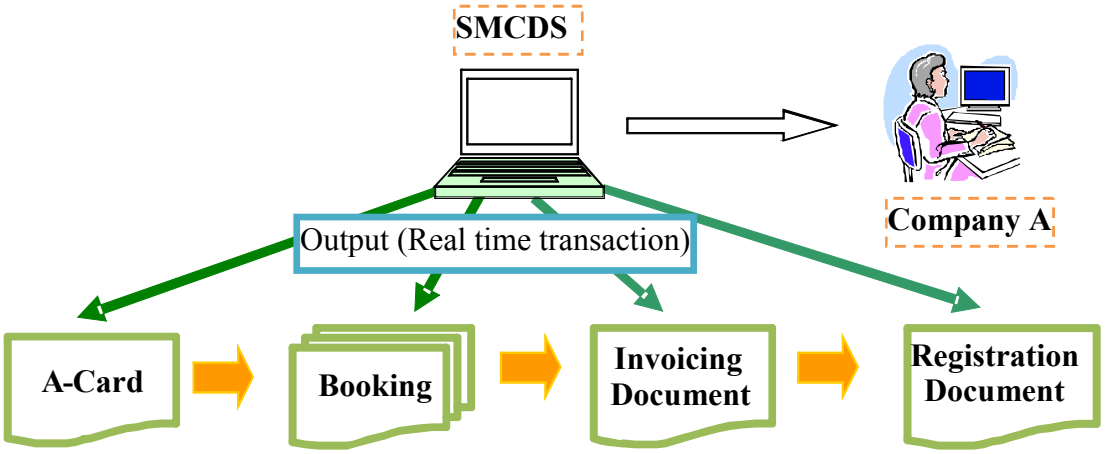


Figure 3.3: Process of Frontline Information Inputting SMCDS

Step 2 & 3: Delivery Appointment & Flexible system

After new customer booking, dealer will try to match the supply to meet with customer requirement either in terms of in-house stock at the dealer, the next coming supply which is called "assignment" or supply that exchange with other dealers which is called "Flexible system". Dealers are able to exchange through SMCDS system. These are basic information which salesperson can provide to customer in the detail such as when customer can expect car to be delivered through the "Matching" process in SMCDS.

The matching process is basically one of the effective tools to help salesperson improving customer satisfaction by enhance the ability to schedule effective customer appointment date right away.

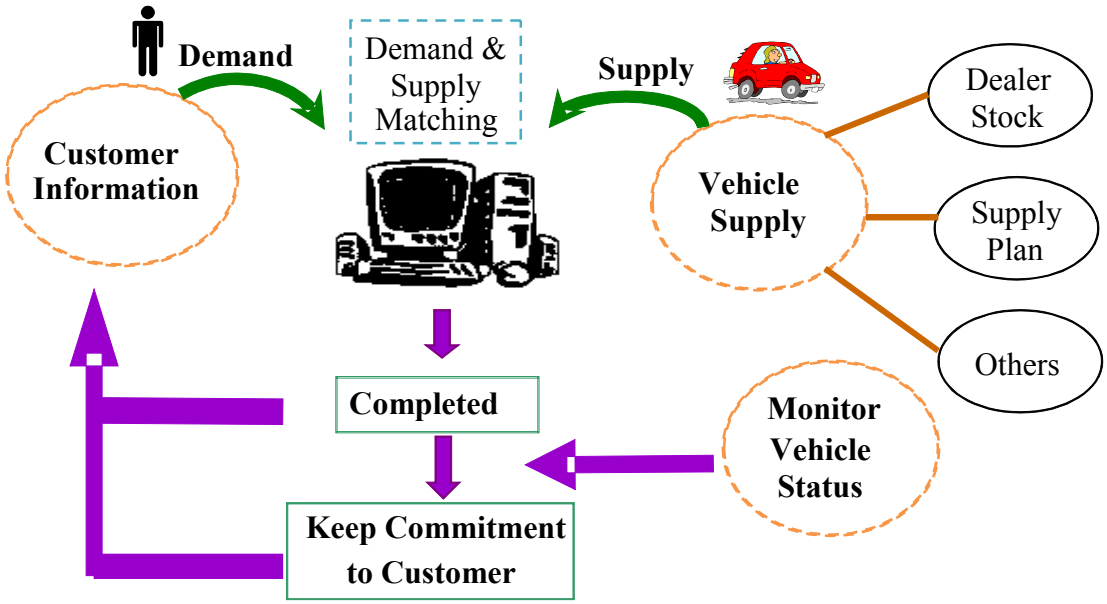


Figure 3.4: Process of Delivery Appointment

Step 4: Dealer Sales Plan and Vehicle Ordering

On the 1st of every month, dealer will forecast the retail sales in the current month (N-1) and the next month (N) and then dealer order must be placed for next month (N) in SMCDS system in line with the retail sales, demand of customer, stock and Back Order from the previous month (N-2).

SMCDS system will provide the necessary information such as Back Order and the Stock in the end of previous month (N-2) to enable and ease dealer on retail sales of the current month (N-1) and the next month (N) forecast. At the end, dealer order will be accurately placed in line with this information.

Figure 3.5 shows the simple classification of the above dialog into 3 categories namely the result of the previous month (N-2), Booking Plan and Retail sales plan of

the current month (N-1) and Vehicle order ,Booking and Retail Sales of the next two months (N and N+1)

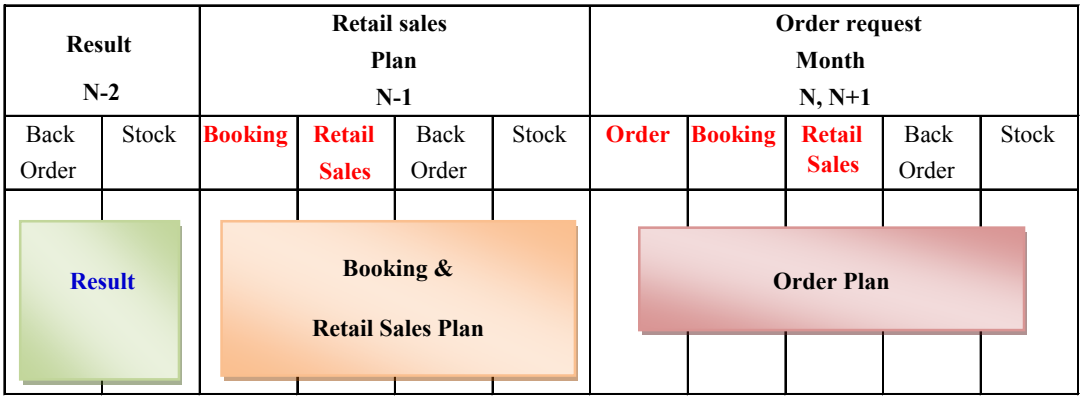


Figure 3.5: Input Format of Dealer Vehicle Ordering

Step 5: Company A Sales and Production Plan

After step 4 of Dealer Sales Plan and Vehicle Ordering is accomplished through SMCDS system on the 1st of every month, this process will enable Sales planning department to observe the demand (dealer order) which dealer requires vehicles to be delivered in the next coming month. Moreover, retail sales plan and model by model booking of vehicle which is planned by dealer can also be monitored together with the demand. All these three important data namely dealer order, retail sales and booking plan for N-1, N, N+1 month can be grouped and named as " Dealer Rundown". Other than the Dealer Rundown, retail sales result of last month and stock situation are additionally utilized by Sales planning department to forecasting demand trend and simulating retail sales and vehicle production plan of each vehicle model for the N, N+1, N+2 and N+3 month which is called "Moving Sales Plan".

Next, Moving Sales Plan will be passed to production planning department in order to consider the production capacity from this demand together with the similar production request of export amount from export department. Around the 17th of every month, production planning department will confirm back the number of vehicle production for the N, N+1, N+2 and N+3 month which Sales planning has requested for.

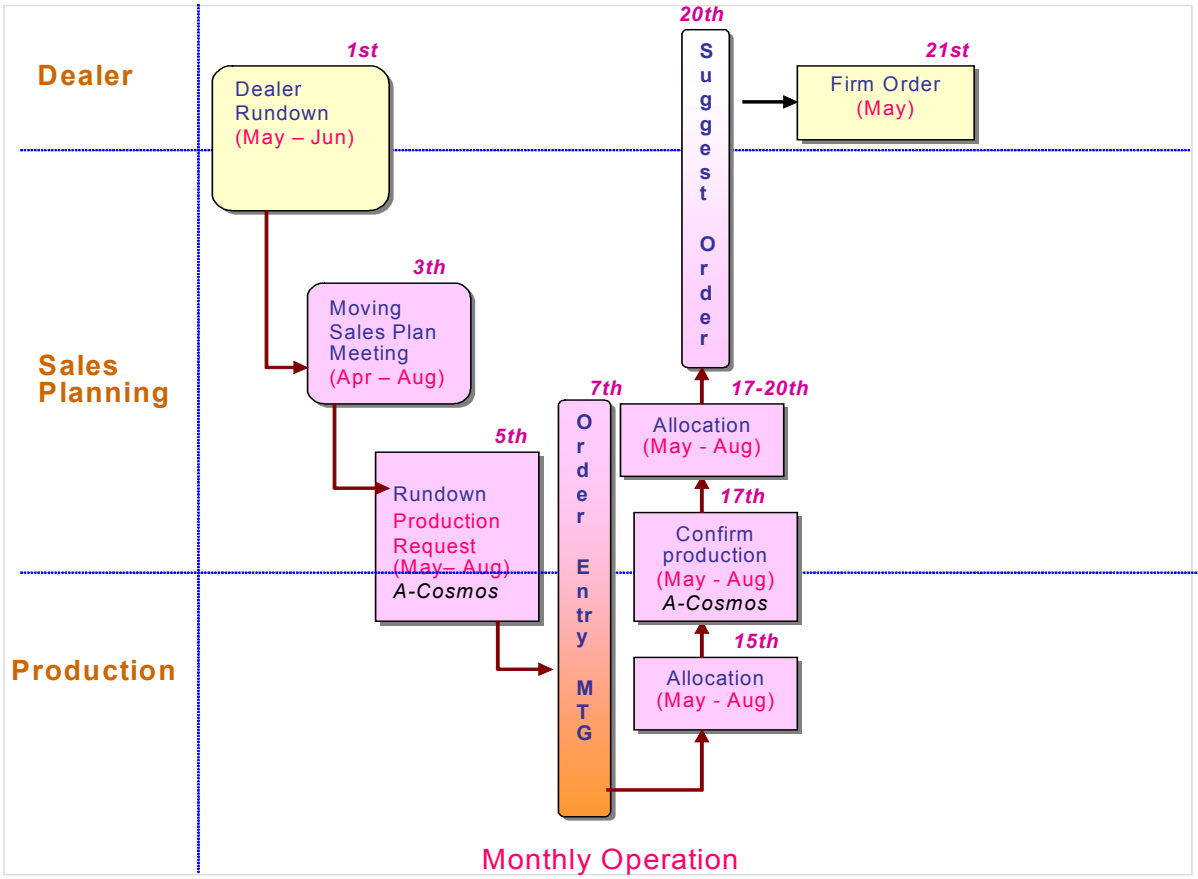


Figure 3.6: Monthly Operations Process

Step 6: Vehicle Allocation to Dealers

After the confirmation of production plan from production planning department on the 17th of every month, Sales planning department will use this number to calculate dealer allocation of the next coming month. Allocation in this case is the method which Sales planning department allocates vehicle for dealers nationwide for the next coming month. In each month, dealers pay a lot of attention to this number which is called "Suggest Order" because it provides dealers with the valuable information such as the number of vehicles by model which dealer can expect to receive in the next month for their appointment of vehicle receiving and Sales planning to customer afterward. In the actual workflow, Sales planning department will provide dealers with suggest order through SMCDS system on the 20th of every month then dealers must confirm back the firm order from the suggest order in the condition that the firm order must not be less than the dealer order which was explained in step 4 within the next working day through SMCDS system.

The vehicle allocation to dealer task is very important since it affects the corporate revenue and the customer satisfaction which are the key driving factors of the company. The best allocation means maximizing profits, minimizing costs or achieving the best possible quantity.

This thesis will mainly focus on how to improve the allocation method and the current method analysis on how the calculation will be done for the allocation will be explained further in detail in section 3.2

Step 7: Whole Sales Plan Generating

Whole sales plan will be generated by sales planning department after production control department daily production plan submission. Sales planning department will figure out the appropriate number of vehicles which to be shared by each dealer proportionally to receive their vehicles by model on daily basis then input back into SMCDS system for dealers. Dealers can find out on what model, and how many vehicles they can expect to receive then use this number to plan for the customer appointment plan of delivery afterward. Daily assignment schedule to dealers will be explained in Section 3.3.

Step 8: Production, Whole Sales and Logistics

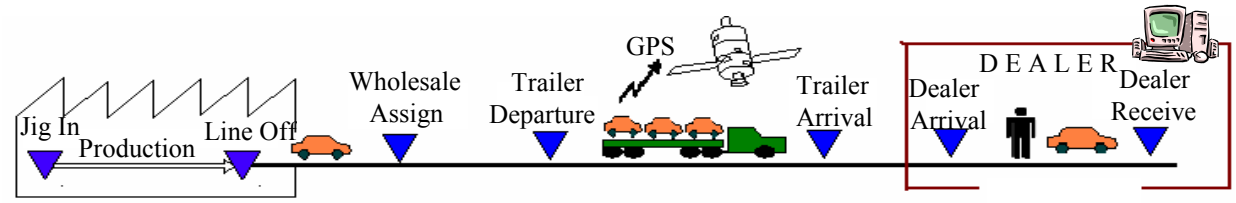


Figure 3.7: Logistics Process

Next task, logistics process will be carried out after the completion of vehicle production which is called “Line off”. Vehicles will be assigned and wholesaled to dealers following the wholesale plan set by Sales planning department in the previous task. Logistics task will start from here by vehicle logistics department (VL) through

the use of trailer carriage. The trailer carriages are installed with the GPS devices for tracking purpose of vehicle logistics department. After the vehicles reach the dealer, dealer will go through the inspection process then key-in the confirmation of receiving through SMCDS system.

Step 9: Dealer Logistics & Operations

After dealers received their expected vehicles as scheduled by sales planning department, vehicles will be transferred to the stock yard waiting to be matched with customer order through SMCDS then accessories/option parts will be installed and managed upon each agreement between salesman and customer. At the same time, the preparation of customer delivery documentation will be carried out which the dealer will cooperate with the salesman to scheduling appointment for customer delivery. Dealers are also responsible for the registration system of license no. and plate to be delivered together at the same time with the vehicle itself. This registration process usually takes no longer than 7 days.

Step 10: Retail sales

Finally, vehicle will be delivered to customer on the appointment date then dealer will key-in the retail sales confirmation through SMCDS system at the end of the workflow.

3.2 Current Vehicle Allocation Method

Allocation is the method which Sales planning department allocates vehicle for dealers nationwide for the next coming month. In each month, dealers pay a lot of attention to this number which is called “Suggest Order” because it provides dealers with the valuable information such as the number of vehicles by model which dealer can expect to receive in the next month for their appointment of vehicle receiving and Sales planning to customer afterward.

From the past until now, Company A has taken many allocation factors into the consideration for allocation which can be classified as followed;

- **Dealer Order**: This is to allocate to meet the dealer order completely. Dealer order allocation factor is one of the first factors around which are employed for allocation to satisfy the dealer demand.

- **Dealer Order ratio**: In the past few years, Thailand automobile industry has been growing continuously and one of the fastest growth industries in the country. From large demand and limited amount of production capacity to satisfy the customer or dealer order, dealer order ratio is taken into the consideration as one of the important factors.

- **Nenkei Ratio** (Annual Dealer Target): It is the allocation factor which takes the dealer yearly sales target into the consideration by breaking down into monthly basis. Nenkei Ratio calculations and objectives are briefly described in the next paragraph. Nenkei data is provided by Retail Sales Development Department. They will send this information to other concern departments at the beginning of the year.

Method of calculation is described step by step as followed;

1. The market volume estimation of all provinces in each segment is calculated by actual market of last year multiplies by up or down trend ratio which is planned by sales planning department.

For example, medium car market in 2008 is 30,000 units. Sales planning department analyzed this figure and come out with the plan for 2009 which to be dropped to 25,000 units or around 16.67% drop, then medium market volume of all provinces in 2009 can be calculated from actual 2008 multiplies by 83.33%. Market volume of each province is shown in Table 3.1.

Provinces	2008	2009
P1	1000	840
P2	500	420
P3	200	170
P4	250	210
P5	300	250
P6	400	340
Total Nationwide	**30,000**	**25,000**

Table 3.1: Example of Medium Market Volume of 2008 and Estimation for 2009

2. The estimation for market share of all provinces in the current year is calculated by taking the actual market share of all provinces of last year into consideration by comparing with the market share of other competitors in the market. Positively adjust market share in all segments in all provinces for the estimation of 2009 market share following six cases of calculation method namely;

To illustrate the actual calculation of the above methods for 6 cases of variable circumstance, 6 provinces are selected as examples namely P1 to P6. These provinces have different circumstances matching 6 cases of calculation which will be shown case by case from 1 to 6 for Province 1 to Province 6 respectively. The example of Company A and Competitor's market share which are used to explain 6 cases are shown in Table 3.2. The explanations of each case are explained below and then Table 3.3 shows the results of each case for 2009.

		2008					
		Market	Company A		Competitor		Diff T/C
Case	Provinces	Volume		*Market Share*		*Market Share*	*Market Share*
Case1	P1	1000	450	45.00%	400	40.00%	5.00%
Case2	P2	500	225	45.00%	215	43.00%	2.00%
Case3	P3	200	80	40.00%	90	45.00%	-5.00%
Case4	P4	250	100	40.00%	105	42.00%	-2.00%
Case5	P5	300	108	36.00%	144	48.00%	-12.00%
Case6	P6	400	124	31.00%	212	53.00%	-22.00%
Total		**30,000**	**13500**	**45.00%**	**10,500**	**35.00%**	**10.00%**

Table 3.2: Example of Company A and Competitor's Market Share of 2008

Case 1: When Company A manages to gain the market share higher than competitor more than 3%, the calculation will be in the case of using Company A market share of the previous year directly for the estimation of this year. From example case1, Company A gains market share 45% which is higher than Competitors 5% then in 2009, Market share of P1 is set the same as pervious year which is 45%.

Case 2: When Company A manages to gain the market share higher than competitor but less than 3%, the calculation will be in the case of using the estimation of this year market share to be calculated by the used of Company A market share of the previous year + [(3% - difference in market share) x 0.5]. The estimation will be slightly greater than the last year to challenge winning some share back from the competitor as shown in below example.

This example shows the case of Market share of Company A is higher than competitor by 2%. The purpose of below formula is to widen the gap of market share between Company A and competitors.

= Company A share + [(3% - difference in market share) x 0.5]

= 45% + [(3%-2%) x 0.5]

Market share of 2009 = 45.5%

Case 3: When Company A fails to gain market share against the competitor, happens to have the market share lower than competitor and the gap is less than 10%, then the estimation of this year market share will be calculated by the used of the result of the following equation classification [(Competitor market share in the previous year-Company A market share in the previous year) x 0.5], result is greater than 1.5%, the estimation of this year market share will be targeted from the additional of the result to Company A market share of Company A from the previous year.

This example shows the case of Market share of Company A is lower than competitor by 5%. The purpose of below formula is to tighten the gap of market share between Company A and competitors in order to compete with more effort for the current year.

= [(Competitor market share - Company A market share) x 0.5]

= 5% x 0.5

= 2.5% , if the result is greater than 1.5%, then

Market share of 2009 = 40.0% + 2.5% = 42.5%

Case 4: When Company A fails to gain market share against the competitor and happens to have the market share lower than competitor and the gap is less than 10%, then the estimation of this year market share to be calculated by the used of the result of the following equation classification [(Competitor market share in the previous year- Company A market share in the previous year)x0.5%], result is lower than 1.5%, the estimation of this year market share will be targeted from the additional of 1.5% to Company A market share of Company A from the previous year.

= [(Competitor market share – Company A market share) x 0.5]

= 2% x 0.5

= 1.0% , if the result is lower than 1.5%, then

Market share of 2009 = 40.0% + 1.5% = 41.5%

Case 5: When Company A fails to gain market share against the competitor and happens to have the market share lower than competitor more than 10%, then the estimation of this year market share to be calculated by the used of the result of the following equation classification [(Competitor market share in the previous year- Company A market share in the previous year) x 0.5]. If result is less than 10%, the estimation of this year market share will be targeted from the additional of the result to Company A market share of Company A from the previous year as shown below. This model example shows that Company A adjusts market share for the current year 6 % higher than the previous year to tighten the gap down against the competitor.

= [(Competitor market share – Company A market share) x 0.5]

= 12% x 0.5

= 6.0% , if the result is lower than 10%, then

Market share of 2009 = 36.0% + 6.0% = 42.0%

Case 6: When Company A fails to gain market share against the competitor and happens to have the market share lower than competitor more than 10%, then the estimation of this year market share to be calculated by the used of the result of the following equation classification [(Competitor market share in the previous year- Company A market share in the previous year) x 0.5]. If result is greater than 10%, the estimation of this year market share will be targeted from the additional of 10% to Company A market share from the previous year. This model example shows that Company A adjusts market share for the current year heftily 10% higher than the previous year to tighten the gap down against the competitor.

= [(Competitor market share – Company A market share) x 0.5]
= 22.0% x 0.5
= 11.0% , if the result is greater than 10%, then

Market share of 2009 = 31.0% + 10.0% = 41.0%

The summary of calculation model examples of the Market Volume, Company A sales & Competitor sales and also their Market share of 2008 together with the calculation result case by case of Market share 2009 are shown in Table 3.3.

		2008						2009
Case	Provinces	Market Volume	Company A	*Market Share*	Competitor	*Market Share*	Diff T/C *Market Share*	*Market Share*
Case1	**P1**	1000	450	45.00%	400	40.00%	5.00%	45.00%
Case2	**P2**	500	225	45.00%	215	43.00%	2.00%	45.50%
Case3	**P3**	200	80	40.00%	90	45.00%	-5.00%	42.50%
Case4	**P4**	250	100	40.00%	105	42.00%	-2.00%	41.50%
Case5	**P5**	300	108	36.00%	144	48.00%	-12.00%	42.00%
Case6	**P6**	400	124	31.00%	212	53.00%	-22.00%	41.00%
Total		**30,000**	**13500**	**45.00%**	**10,500**	**35.00%**	**10.00%**	**46.00%**

Table 3.3: The Summary of Calculation Model Examples of Company A Sales & Competitor Market share of 2009.

3. After calculated market share of each province, then calculate Nenkei of each province by taking the Market Plan 2009 (No.1) from the 16.6% down trend projection from Sales planning department together with calculated market share of 2009 into considerations as summarized in Table 3.4.

		Market Volume		Company A	
Case	Provinces	2008 (Act)	2009 (Plan)	M/S	Est Sales
Case1	P1	1000	840	45.0%	**380**
Case2	P2	500	420	45.5%	**190**
Case3	P3	200	170	42.5%	**70**
Case4	P4	250	210	41.5%	**90**
Case5	P5	300	250	42.0%	**105**
Case6	P6	400	340	41.0%	**140**
Total		**30,000**	**25,000**	**46.0%**	**11,500**

Table 3.4: The Summary of Calculation Examples of Nenkei of Each Province.

After the estimation of this year targeted market share of all provinces are obtained, the dealer demand of the current year will come into the consideration as described in the next paragraph.

4. The final step is to compare the estimation of this year targeted market share obtained from the above section with Dealer Demand for the current year. The reason behind this method is to show that manufacture also pays a lot of attention to the dealer's idea.

Let X equals to the estimation of this year of Company A market share and Y equals to the Dealer Demand of this year. The comparison will be done through the following classification methods:

Case 1: if X is more than Y, then the estimation of Company A market share for the current year can be used directly by disregard to the dealer demand.
Case 2: if X is less than Y but in the condition of Y/X 110%, then Dealer Demand for the current year can be used directly by disregard the estimation from Company A.
Case 3: if X is less than Y but in the condition of Y/X > 110%, then the multiplication of the estimation of Company A market share for this year with 110% ratio is applied for this case.

These provinces have different circumstances matching 3 cases of calculations. The calculated results of 3 cases of circumstance of dealer demand conditions are shown in the Table 3.5.

	Provinces	Company A Est. Sales	Dealer Demand	Diff	Ratio D/T	Final Nenkei
Case1	P1	380	300	80	78.95%	380
	P2	190	150	40	78.95%	190
Case2	P3	70	75	-5	107.14%	75
	P4	90	95	-5	105.56%	95
Case3	P5	105	130	-25	123.81%	116
	P6	140	170	-30	121.43%	154

Table 3.5: Example of Final Nenkei of 3 Cases of Circumstance of Dealer Demand Conditions

The objective of Nenkei ratio is to make sure that the market share estimation of the current year of all provinces are targeted to be No.1 in the market especially for the losing provinces which will be targeted higher than the actual market share result from the previous year from the above calculation to win the market back in the current year.

Nowadays, the allocation will have to consider the situation of supply & demand, market, inventory stock at the dealer and Company A, together with dealer order at that time. All of these factors are employed and considered for the allocation and selection of which allocation method shall be appropriated for the allocation of each vehicle model. The most suitable allocation method will be selected upon market sales trend of each vehicle model. The idea of allocation methods used in the industry for each situation circumstance can be categorized as follows which is shown in Figure 3.8.

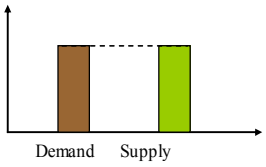
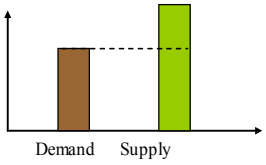
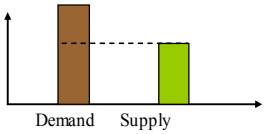
No.	Demand-Supply Situation Circumstance	Allocation Method
1		Dealer Order
2		Dealer Order ratio
3		Nenkei ratio, Dealer Order ratio
4	New Model	Nenkei Ratio

Figure 3.8: Vehicle Allocation Methods in Different Cases

1. When vehicle supply exactly matches or equals to market demand, the Dealer order allocation method will be used to allocate each vehicle to each Dealer by fulfilling dealer order completely.
2. When vehicle supply is more than Dealer order, Dealer order ratio will be used for allocate for this market situation. The allocation can be done to meet with dealer order plus fleet sales order in this case.
3. When vehicle supply is less than Dealer order which most of Company A series are involved in this circumstance therefore in this thesis, it will mainly focused in this allocation method. The allocation method employed for this circumstance is what has been described earlier in this chapter namely "Nenkei Ratio or Annual Dealer Target" allocation method.
4. In the case of Supply of new model where the demand is still unknown, the allocation method employed for this case will also be involved with "Nenkei ratio".

In this thesis, in the case of Vehicle Supply is less than Dealer order (Case 3) will be focused since it is the critical part of the allocation method which needs to be improved. After Nenkei calculation has been calculated, Sales planning department will use these ratios namely yearly and monthly Nenkei to calculate allocation by series to each dealers nationwide which this method of calculation will be described in the following paragraph.

Step1: Nenkei or Annual target retail sale of the dealer for the current year and annual target retail sale nationwide will be used to calculate the annual target ratio of each dealer. This ratio will be counted for 75% of the total allocation.

Step2: Monthly target retail sale of each dealer for a certain series which is estimated by Company A at the beginning of the year by taking seasonal factor and demand into consideration and monthly target retail sale nationwide will be used to calculate the monthly target ratio of each dealer. This ratio will be counted for 25 % of the total allocation.

Monthly target retail sale is considered following the seasonal factor (refer to Chapter 2) month by month which have been set in the beginning of the current year. Normal case of seasonal factor is set at 100% but in the case of a certain month that is in the period of good sales season, seasonal factor is set more than 100%. For the case of low sales season period, the seasonal factor of those months is set below 100% respectively.

Seasonal index is calculated from the Sales data in the past 3 years of every dealer. This figure will reflect the seasonal trend of high and low seasons of the demand in each dealer.

$$\textbf{Seasonal index} = \frac{\textbf{Average 3 year sales in each Month}}{\textbf{[Total Average 3 year / 12]}}$$

In Table 3.6, it shows example of Model A's Sales volume of every month in the past 3 years of 2004-2006 and seasonal index of Dealer A.

Dealer A	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2006	129	143	362	282	258	245	207	193	171	206	179	210	2585
2005	170	120	194	100	150	140	130	200	210	153	185	255	2007
2004	155	173	225	178	201	182	215	167	101	118	189	231	2135
Average	151	145	260	187	203	189	184	187	161	159	184	232	2242
Seasonal Index	81.0%	77.8%	139.3%	99.9%	108.6%	101.1%	98.5%	99.9%	86.0%	85.1%	98.6%	124.2%	1200.0%

Table 3.6: Example of Seasonal Index Calculation

$$\text{Seasonal index of Mar} = \frac{260}{2242/12} = 139.3\%$$

From this example of seasonal index data, it shows that in the high season of dealer A is in March and December months.

Retail sales development section is in charge of providing Monthly sales target data of every dealer which sales department can download for usage right away without new calculation has to be done.

Example of how to calculate monthly Nenkei is shown as below

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Sesaonal index Dealer A	81.0%	77.8%	139.3%	99.9%	108.6%	101.1%	98.5%	99.9%	86.0%	85.1%	98.6%	124.2%	1200.0%
Nenkei by Month Dealer A	**67**	**65**	**116**	**83**	**91**	**84**	**82**	**83**	**72**	**71**	**82**	**103**	**1000**
Nenkei by Month Nationwide	**1,050**	**1,000**	**1,750**	**1,250**	**1,350**	**1,250**	**1,200**	**1,250**	**1,070**	**1,060**	**1,250**	**1,520**	**15,000**

Table3.7: Example of Monthly Nenkei Calculation

Table 3.7 shows an example of monthly sales planning of Dealer A:
Dealer A has Nenkei of Model A at 1000 units and seasonal index of March which is in the good sales season period is set at 139.3%

Monthly Nenkei of Dealer A in March
= (Yearly Nenkei/12) x Seasonal index of March
= 1000/12 x 139.3%
= 116 units

Step3: After the allocation ratio is calculated for each dealer, this ratio will be used to allocate the number of vehicle for each dealer with the multiplication with the monthly production plan of Company A. Each dealer will be allocated with this ratio for the vehicles for the purpose of target sale planning monthly.

Example is continued from last step;

Allocation Ratio for Dealer A

$$= \left[\frac{\text{Yearly Nenkei}}{\text{Yearly Nationwide Nenkei}} \times 75\% \right] + \left[\frac{\text{Monthly Nenkei}}{\text{Monthly Nationwide Nenkei}} \times 25\% \right]$$

$$= [(1000/15000) \times 75\%] + [(67/1050) \times 25\%]$$

$$= 6.6\%$$

If total Model A allocation for Jan08 is 1000 units then Dealer A will be received Model A in January = 6.6% x 1000 = 66 units

From this allocation method, it is significant that yearly and monthly Nenkei plays the top priority for the allocation which affects directly to the accuracy of allocation and the market situation matching indeed.

Table 3.8 shows the Actual allocation of Model A on January in 2008

Dealer	75% Yearly Nenkei		25% Monthly Nenkei		Apply Nenkei	Allo by Nenkei
		%	Jan	%	%	
Dealer 1	779	5.3%	50	5.1%	5.2%	**52**
Dealer 2	439	3.0%	29	2.9%	3.0%	**29**
Dealer 3	199	1.3%	11	1.1%	1.3%	**13**
Dealer 4	214	1.4%	14	1.4%	1.4%	**14**
Dealer 5	387	2.6%	32	3.2%	2.8%	**27**
Dealer 6	219	1.5%	18	1.8%	1.6%	**16**
Dealer 7	2112	14.3%	200	20.3%	15.8%	**158**
Dealer 8	806	5.4%	60	6.1%	5.6%	**55**
Dealer 9	921	6.2%	50	5.1%	5.9%	**58**
Dealer 10	492	3.3%	39	4.0%	3.5%	**35**
Dealer 11	86	0.6%	6	0.6%	0.6%	**6**
Dealer 12	310	2.1%	21	2.1%	2.1%	**21**
Dealer 13	178	1.2%	9	0.9%	1.1%	**11**
Dealer 14	130	0.9%	6	0.6%	0.8%	**8**
Dealer 15	521	3.5%	15	1.5%	3.0%	**30**
Dealer 16	147	1.0%	10	1.0%	1.0%	**10**
Dealer 17	325	2.2%	26	2.6%	2.3%	**23**
Dealer 18	115	0.8%	8	0.8%	0.8%	**8**
Dealer 19	120	0.8%	10	1.0%	0.9%	**9**
Dealer 20	78	0.5%	5	0.5%	0.5%	**5**
Dealer 21	230	1.6%	20	2.0%	1.7%	**17**
Dealer 22	130	0.9%	10	1.0%	0.9%	**9**
Dealer 23	104	0.7%	8	0.8%	0.7%	**7**
Dealer 24	335	2.3%	8	0.8%	1.9%	**19**
Dealer 25	178	1.2%	5	0.5%	1.0%	**10**
Dealer 26	383	2.6%	29	2.9%	2.7%	**27**
Dealer 27	105	0.7%	6	0.6%	0.7%	**7**
Dealer 28	159	1.1%	12	1.2%	1.1%	**11**
Dealer 29	123	0.8%	8	0.8%	0.8%	**8**
Dealer 30	131	0.9%	8	0.8%	0.9%	**9**
Dealer 31	168	1.1%	8	0.8%	1.1%	**10**
Dealer 32	127	0.9%	8	0.8%	0.8%	**8**
Dealer 33	150	1.0%	7	0.7%	0.9%	**9**
Dealer 34	54	0.4%	4	0.4%	0.4%	**4**
Dealer 35	54	0.4%	2	0.2%	0.3%	**3**
Dealer 36	30	0.2%	1	0.1%	0.2%	**2**
Dealer 37	90	0.6%	9	0.9%	0.7%	**7**
Dealer 38	42	0.3%	1	0.1%	0.2%	**2**
Dealer 39	36	0.2%	2	0.2%	0.2%	**2**
Dealer 40	30	0.2%	1	0.1%	0.2%	**2**
Dealer 41	15	0.1%	1	0.1%	0.1%	**1**
Dealer 42	75	0.5%	7	0.7%	0.6%	**6**
Dealer 43	42	0.3%	4	0.4%	0.3%	**3**
Dealer 44	120	0.8%	8	0.8%	0.8%	**8**
Dealer 45	45	0.3%	1	0.1%	0.3%	**3**
Dealer 46	73	0.5%	1	0.1%	0.4%	**4**
Dealer 47	61	0.4%	2	0.2%	0.4%	**4**
Dealer 48	36	0.2%	3	0.3%	0.3%	**3**
Dealer 49	47	0.3%	2	0.2%	0.3%	**3**
Dealer 50	42	0.3%	5	0.5%	0.3%	**3**
Dealer 51	42	0.3%	2	0.2%	0.3%	**3**
Dealer 52	66	0.4%	2	0.2%	0.4%	**4**
Dealer 53	18	0.1%	1	0.1%	0.1%	**1**
Dealer 54	66	0.4%	5	0.5%	0.5%	**5**
Dealer 55	126	0.9%	10	1.0%	0.9%	**9**
Dealer 56	141	1.0%	8	0.8%	0.9%	**9**
Dealer 57	136	0.9%	8	0.8%	0.9%	**9**
Dealer 58	50	0.3%	3	0.3%	0.3%	**3**
Dealer 59	30	0.2%	1	0.1%	0.2%	**2**
Dealer 60	54	0.4%	3	0.3%	0.3%	**3**
Dealer 61	52	0.4%	2	0.2%	0.3%	**3**
Dealer 62	14	0.1%	4	0.4%	0.2%	**2**

Dealer	75% Yearly Nenkei		25% Monthly Nenkei		Apply Nenkei	Allo by Nenkei
		%	Jan	%	%	
Dealer 63	60	0.4%	3	0.3%	0.4%	**4**
Dealer 64	5	0.0%	0	0.0%	0.0%	**0**
Dealer 65	50	0.3%	2	0.2%	0.3%	**3**
Dealer 66	30	0.2%	1	0.1%	0.2%	**2**
Dealer 67	35	0.2%	2	0.2%	0.2%	**2**
Dealer 68	25	0.2%	2	0.2%	0.2%	**2**
Dealer 69	20	0.1%	1	0.1%	0.1%	**1**
Dealer 70	15	0.1%	1	0.1%	0.1%	**1**
Dealer 71	80	0.5%	4	0.4%	0.5%	**5**
Dealer 72	15	0.1%	1	0.1%	0.1%	**1**
Dealer 73	20	0.1%	2	0.2%	0.2%	**2**
Dealer 74	10	0.1%	1	0.1%	0.1%	**1**
Dealer 75	15	0.1%	1	0.1%	0.1%	**1**
Dealer 76	20	0.1%	2	0.2%	0.2%	**2**
Dealer 77	125	0.8%	4	0.4%	0.7%	**7**
Dealer 78	60	0.4%	2	0.2%	0.4%	**4**
Dealer 79	70	0.5%	2	0.2%	0.4%	**4**
Dealer 80	10	0.1%	0	0.0%	0.1%	**1**
Dealer 81	60	0.4%	4	0.4%	0.4%	**4**
Dealer 82	106	0.7%	7	0.7%	0.7%	**7**
Dealer 83	70	0.5%	4	0.4%	0.5%	**5**
Dealer 84	26	0.2%	1	0.1%	0.2%	**2**
Dealer 85	11	0.1%	0	0.0%	0.1%	**1**
Dealer 86	26	0.2%	2	0.2%	0.2%	**2**
Dealer 87	51	0.3%	7	0.7%	0.4%	**4**
Dealer 88	18	0.1%	2	0.2%	0.1%	**1**
Dealer 89	62	0.4%	2	0.2%	0.4%	**4**
Dealer 90	15	0.1%	0	0.0%	0.1%	**1**
Dealer 91	16	0.1%	1	0.1%	0.1%	**1**
Dealer 92	14	0.1%	1	0.1%	0.1%	**1**
Dealer 93	116	0.8%	7	0.7%	0.8%	**8**
Dealer 94	67	0.5%	4	0.4%	0.4%	**4**
Dealer 95	42	0.3%	3	0.3%	0.3%	**3**
Dealer 96	23	0.2%	2	0.2%	0.2%	**2**
Dealer 97	68	0.5%	2	0.2%	0.4%	**4**
Dealer 98	15	0.1%	1	0.1%	0.1%	**1**
Dealer 99	29	0.2%	1	0.1%	0.2%	**2**
Dealer 100	13	0.1%	1	0.1%	0.1%	**1**
Dealer 101	30	0.2%	0	0.0%	0.2%	**2**
Dealer 102	16	0.1%	0	0.0%	0.1%	**1**
Dealer 103	15	0.1%	1	0.1%	0.1%	**1**
Dealer 104	11	0.1%	0	0.0%	0.1%	**1**
Dealer 105	37	0.3%	2	0.2%	0.2%	**2**
Dealer 106	65	0.4%	6	0.6%	0.5%	**5**
Dealer 107	18	0.1%	1	0.1%	0.1%	**1**
Dealer 108	108	0.7%	8	0.8%	0.8%	**7**
Dealer 109	18	0.1%	2	0.2%	0.1%	**1**
Dealer 110	30	0.2%	2	0.2%	0.2%	**2**
Dealer 111	42	0.3%	4	0.4%	0.3%	**3**
Dealer 112	30	0.2%	2	0.2%	0.2%	**2**
Dealer 113	42	0.3%	3	0.3%	0.3%	**3**
Dealer 114	22	0.1%	2	0.2%	0.2%	**2**
Dealer 115	80	0.5%	6	0.6%	0.6%	**6**
Dealer 116	77	0.5%	3	0.3%	0.5%	**5**
Dealer 117	20	0.1%	1	0.1%	0.1%	**1**
Dealer 118	18	0.1%	1	0.1%	0.1%	**1**
Dealer 119	18	0.1%	1	0.1%	0.1%	**1**
Metro	**10901**	**73.7%**	**756**	**76.6%**	**74.4%**	**739**
Central	**1687**	**11.4%**	**103**	**10.4%**	**11.2%**	**113**
North	**725**	**4.9%**	**35**	**3.5%**	**4.6%**	**47**
North-East	**860**	**5.8%**	**49**	**5.0%**	**5.6%**	**59**
South	**625**	**4.2%**	**44**	**4.5%**	**4.3%**	**42**
Grand Total	**14798**	**100.0%**	**987**	**100.0%**	**100.0%**	**1000**

Table 3.8: Actual Model A Allocation of Each Dealer for January 2008

3.3 Daily Assignment Schedule

After the calculation for each dealer allocation of Model A, Sales planning will pass these suggested figures to each dealer via SMCDS for confirmation. When confirmation is completed by each dealer, Sales Planning will employ the production plan which is obtained from Production control department as shown in Table 3.9 for the purpose of planning daily assignment schedule to each dealer, e.g. when dealers can expect to receive their vehicles and at what amount in each model.

ASSEMBLY LINE OFF SCHEDULE

		ZERO				1ST WEEK							2ND WEEK							3RD WEEK							4TH WEEK					
MODEL	Date	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Model A	1000	48	43	44	0	0	44	45	45	42	45	0	0	44	43	42	45	45	0	0	44	44	45	0	42	45	0	42	47	42	45	29
Model B	2000	92	86	88	0	0	88	90	90	85	90	0	0	88	86	85	90	90	0	0	88	88	90	0	85	90	0	85	93	85	90	58
Model C	1500	71	65	66	0	0	66	67	67	64	67	0	0	66	65	64	67	67	0	0	66	66	67	0	64	67	0	64	70	64	67	43
Model D	1200	53	52	53	0	0	53	54	54	51	54	0	0	53	52	51	54	54	0	0	53	53	54	0	51	54	0	51	56	51	54	35
TOTAL(ALL)	5700	264	246	251	0	0	251	256	256	242	256	0	0	251	246	242	256	256	0	0	251	251	256	0	242	256	0	242	266	242	256	165

Table3.9: Example of Assemble Line off Schedule

Table 3.9 shows Daily production plan of each model, e.g. Model A will be totally produced 1,000 units in the month and each day of production capacity will be shown in this plan.

The vehicle distribution to each dealer will be done on the daily numerical order basis from the last dealer in term of code namely dealer 119 which is located in the south of Thailand. This order of distribution comes from the consideration of distance between dealer and the manufacturing plant, the furthest one will get the right to be distributed in the first order then following with 118, 117, and … orderly. For example from Table 3.9, the first day of production gives 48 units of model A which will be distributed to dealers in numerical order from Dealer 119 to Dealer 72. Then, Dealer 71 to Dealer 24 will get their vehicles from the second day of production in the month. This basis of distribution will run until the end of the month for each dealer following the suggested number of vehicle allocation planned by Sales planning department, see daily delivery in Table 3.10

		ZERO				1ST WEEK						2ND WEEK							3RD WEEK							4TH WEEK					
	Date	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Model A	Allocation	48	43	44	0	0	44	45	45	42	45	0	0	44	42	43	45	45	0	0	44	44	45	0	42	45	0	42	47	42	45	29
Dealer 1	52			1	0	0		1		1	1	0	0	1	1	1	1	2	0	0	2	3	3	0	4	6	0	8	11	5		
Dealer 2	29			1	0	0		1		1	1	0	0	1	1	1	1	2	0	0	2	3	4	0	4	6	0					
Dealer 3	13			1	0	0		1		1	1	0	0	1	1	1	1	2	0	0	2	1		0			0					
Dealer 4	14			1	0	0		1		1	1	0	0	1	1	1	1	2	0	0	2	2		0			0					
Dealer 5	27			1	0	0		1		1	1	0	0	1	1	1	1	2	0	0	3	3	4	0	4	3	0					
Dealer 6	16			1	0	0		1		1	1	0	0	1	1	1	1	2	0	0	3	3		0			0					
Dealer 7	158			1	0	0		1		1	1	0	0	1	1	1	1	2	0	0	3	3	4	0	4	7	0	11	12	30	45	29
Dealer 8	55			1	0	0		1		1	1	0	0	1	1	1	1	2	0	0	3	3	4	0	5	6	0	10	12	2		
Dealer 9	58			1	0	0		1		1	1	0	0	1	1	1	1	2	0	0	3	3	4	0	5	6	0	10	12	5		
Dealer 10	35			1	0	0		1		1	1	0	0	1	1	1	2	2	0	0	3	3	4	0	5	6	0	3				
Dealer 11	6			1	0	0		1		1	1	0	0	1	1				0	0				0			0					
Dealer 12	21			1	0	0		1		1	1	0	0	1	1	1	2	2	0	0	3	3	4	0			0					
Dealer 13	11			1	0	0		1		1	1	0	0	1	1	1	2	2	0	0				0			0					
Dealer 14	8			1	0	0		1		1	1	0	0	1	1	1	1		0	0				0			0					
Dealer 15	30			1	0	0		1		1	1	0	0	1	1	1	2	2	0	0	3	3	4	0	5	4	0					
Dealer 16	10			1	0	0		1		1	1	0	0	1	1	1	2	1	0	0				0			0					
Dealer 17	23			1	0	0		1		1	1	0	0	1	1	1	2	3	0	0	3	3	4	0	1		0					
Dealer 18	8			1	0	0		1		1	1	0	0	1	1	1	1		0	0				0			0					
Dealer 19	9			1	0	0		1		1	1	0	0	1	1	1	2		0	0				0			0					
Dealer 20	5			1	0	0		1	1		1	0	0	1					0	0				0			0					
Dealer 21	17			1	0	0		1	1		1	0	0	1	1	1	2	3	0	0	3	2		0			0					
Dealer 22	9			1	0	0		1	1		1	0	0	1	1	1	2		0	0				0			0					
Dealer 23	7			1	0	0		1	1		1	0	0	1	1	1	0		0	0				0			0					
Dealer 24	19			1	0	0		1	1		1	0	0	1	1	1	2	3	0	0	2	3	2	0			0					
Dealer 25	10			1	0	0		1	1		1	0	0	1	1	1	1	2	0	0				0			0					
Dealer 26	27			1	0	0		1	1		1	0	0	1	1	1	2	3	0	0	2	3	4	0	5	1	0					
Dealer 27	7			1	0	0		1	1		1	0	0	1	1	1	1		0	0				0			0					
Dealer 28	11		1		0	0		1	1		1	0	0	1	1	1	1	3	0	0				0			0					
Dealer 29	8		1		0	0		1	1		1	0	0	1	1	1	1		0	0				0			0					
Dealer 30	9		1		0	0		1	1		1	0	0	1	1	1	2		0	0				0			0					
Dealer 31	10		1		0	0		1	1		1	0	0	1	1	1	2	1	0	0				0			0					
Dealer 32	8		1		0	0		1	1		1	0	0	1	1	1	1		0	0				0			0					
Dealer 33	9		1		0	0		1	1		1	0	0	1	1	1			0	0	2			0			0					
Dealer 34	4		1		0	0		1			1	0	0						0	0				0			0					
Dealer 35	3		1		0	0	1		1			0	0						0	0				0			0					
Dealer 36	2		1		0	0	1					0	0						0	0				0			0					
Dealer 37	7		1		0	0	1		1		1	0	0	1	1	1			0	0				0			0					
Dealer 38	2		1		0	0	1					0	0						0	0				0			0					
Dealer 39	2		1		0	0	1					0	0						0	0				0			0					
Dealer 40	2		1		0	0	1					0	0						0	0				0			0					
Dealer 41	1		1		0	0						0	0						0	0				0			0					
Dealer 42	6		1		0	0	1		1		1	0	0	1	1				0	0				0			0					
Dealer 43	3		1		0	0	1		1			0	0						0	0				0			0					
Dealer 44	8		1		0	0	1		1		1	0	0	1	1	1	1		0	0				0			0					
Dealer 45	3		1		0	0	1		1			0	0						0	0				0			0					
Dealer 46	4		1		0	0	1		1		1	0	0						0	0				0			0					
Dealer 47	4		1		0	0	1		1	1		0	0						0	0				0			0					
Dealer 48	3		1		0	0	1		1			0	0						0	0				0			0					
Dealer 49	3		1		0	0	1		1			0	0						0	0				0			0					
Dealer 50	3		1		0	0	1		1			0	0						0	0				0			0					
Dealer 51	3		1		0	0	1		1			0	0						0	0				0			0					
Dealer 52	4		1		0	0	1		1	1		0	0						0	0				0			0					
Dealer 53	1		1		0	0						0	0						0	0				0			0					
Dealer 54	5		1		0	0	1		1	1		0	0	1					0	0				0			0					
Dealer 55	9		1		0	0	1		1	1		0	0	1	1	2	1		0	0				0			0					
Dealer 56	9		1		0	0	1		1	1		0	0	1	1	2	1		0	0				0			0					
Dealer 57	9		1		0	0	1		1	1		0	0	1	1	2	1		0	0				0			0					
Dealer 58	3		1		0	0	1		1			0	0						0	0				0			0					
Dealer 59	2		1		0	0	1					0	0						0	0				0			0					
Dealer 60	3		1		0	0	1		1			0	0						0	0				0			0					
Dealer 61	3		1		0	0	1		1			0	0						0	0				0			0					
Dealer 62	2		1		0	0	1					0	0						0	0				0			0					
Dealer 63	4		1		0	0	1		1	1		0	0						0	0				0			0					
Dealer 64	0				0	0						0	0						0	0				0			0					
Dealer 65	3		1		0	0	1		1			0	0						0	0				0			0					
Dealer 66	2		1		0	0	1					0	0						0	0				0			0					
Dealer 67	2		1		0	0	1					0	0						0	0				0			0					
Dealer 68	2		1		0	0	1					0	0						0	0				0			0					
Dealer 69	1		1		0	0						0	0						0	0				0			0					
Dealer 70	1		1		0	0						0	0						0	0				0			0					
Dealer 71	5		1		0	0	1		1	1		0	0	1					0	0				0			0					
Dealer 72	1	1			0	0						0	0						0	0				0			0					
Dealer 73	2	1			0	0	1					0	0						0	0				0			0					
Dealer 74	1	1			0	0						0	0						0	0				0			0					
Dealer 75	1	1			0	0						0	0						0	0				0			0					
Dealer 76	2	1			0	0	1					0	0						0	0				0			0					
Dealer 77	7	1			0	0	1		1	1		0	0	1	1	1			0	0				0			0					
Dealer 78	4	1			0	0	1		1	1		0	0						0	0				0			0					
Dealer 79	4	1			0	0	1		1	1		0	0						0	0				0			0					
Dealer 80	1	1			0	0						0	0						0	0				0			0					
Dealer 81	4	1			0	0	1		1	1		0	0						0	0				0			0					
Dealer 82	7	1			0	0	1		1	1	1	0	0		1	1			0	0				0			0					
Dealer 83	5	1			0	0	1		1	1	1	0	0						0	0				0			0					
Dealer 84	2	1			0	0	1					0	0						0	0				0			0					
Dealer 85	1	1			0	0						0	0						0	0				0			0					
Dealer 86	2	1			0	0	1					0	0						0	0				0			0					
Dealer 87	4	1			0	0	1		1	1		0	0						0	0				0			0					
Dealer 88	1	1			0	0						0	0						0	0				0			0					
Dealer 89	4	1			0	0	1	1		1		0	0						0	0				0			0					
Dealer 90	1	1			0	0						0	0						0	0				0			0					
Dealer 91	1	1			0	0						0	0						0	0				0			0					
Dealer 92	1	1			0	0						0	0						0	0				0			0					
Dealer 93	8	1		1	0	0		1		1	1	0	0		1	2			0	0				0			0					
Dealer 94	4	1		1	0	0		1		1		0	0						0	0				0			0					
Dealer 95	3	1		1	0	0		1				0	0						0	0				0			0					
Dealer 96	2	1		1	0	0						0	0						0	0				0			0					
Dealer 97	4	1		1	0	0		1		1		0	0						0	0				0			0					
Dealer 98	1	1			0	0						0	0						0	0				0			0					
Dealer 99	2	1		1	0	0						0	0						0	0				0			0					
Dealer 100	1	1			0	0						0	0						0	0				0			0					
Dealer 101	2	1		1	0	0						0	0						0	0				0			0					
Dealer 102	1	1			0	0						0	0						0	0				0			0					
Dealer 103	1	1			0	0						0	0						0	0				0			0					
Dealer 104	1	1			0	0						0	0						0	0				0			0					
Dealer 105	2	1		1	0	0						0	0						0	0				0			0					
Dealer 106	5	1		1	0	0		1		1	1	0	0						0	0				0			0					
Dealer 107	1	1			0	0						0	0						0	0				0			0					
Dealer 108	7	1		1	0	0		1		1	1	0	0	1	1				0	0				0			0					
Dealer 109	1	1		0	0	0						0	0						0	0				0			0					
Dealer 110	2	1		1	0	0						0	0						0	0				0			0					
Dealer 111	3	1		1	0	0		1				0	0						0	0				0			0					
Dealer 112	2	1		1	0	0						0	0						0	0				0			0					
Dealer 113	3	1		1	0	0		1				0	0						0	0				0			0					
Dealer 114	2	1		1	0	0						0	0						0	0				0			0					
Dealer 115	6	1		1	0	0		1		1	1	0	0	1					0	0				0			0					
Dealer 116	5	1		1	0	0		1		1	1	0	0						0	0				0			0					
Dealer 117	1	1			0	0						0	0						0	0				0			0					
Dealer 118	1	1			0	0						0	0						0	0				0			0					
Dealer 119	1	1			0	0						0	0						0	0				0			0					
METRO	739	0	6	27	0	0	0	33	14	19	33	0	0	33	32	31	41	45	0	0	44	44	45	0	42	45	0	42	47	42	45	29
CENTRAL	113	0	29	0	0	0	26	1	21	6	5	0	0	7	6	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NORTH	47	10	8	0	0	0	12	0	7	6	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NORH-EAST	59	23	0	7	0	0	6	5	3	7	3	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOUTH	42	15	0	10	0	0	0	6	0	4	4	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	1000	48	43	44	0	0	44	45	45	42	45	0	0	44	42	43	45	45	0	0	44	44	45	0	42	45	0	42	47	42	45	29

Table 3.10: Example of Assemble Line off Schedule of Model A

3.4 Analysis of Current Method

Current allocation method uses Nenkei ratio as a factor for dealer vehicle allocation. Nenkei ratio was calculated and assigned at the beginning of the current year as explained earlier in this chapter with the corporate objective to gain no.1 market share nationwide. This current method is simply to allocate existing supply to the area in order to make market share of that area higher than the competitor. Thus, the allocated supply may not effectively meet the real demand. For example, some dealers may receive the supply more than the others but not be able to sell therefore this creates inventory stock building up. At some dealers may have many customers but manage to receive very few supplies therefore this creates a long delivery timing for customers. These two examples reflect the sales opportunity losses of the company from using the current method.

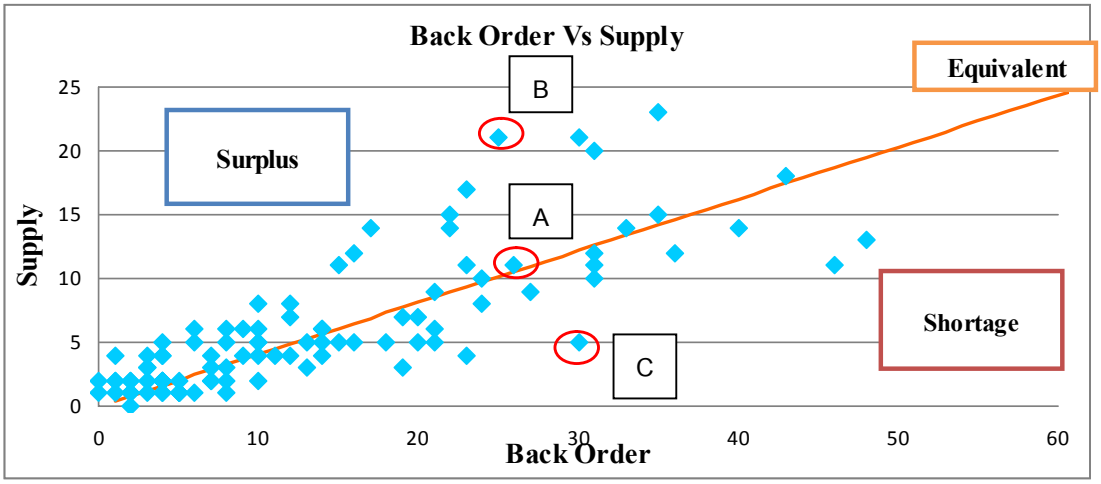


Figure 3.9: Graph of Actual Demand and Supply Situation of January 2008

Figure 3.9 shows the Demand and Supply situation of each dealer in January of 2008 which it can be seen that the supply and demand condition of each dealer is characterized differently. Total supply of January 2008 was 1,553 units which come from the stock from dealers from the end of December 2007 plus the new allocation of January 2008.

For the demand side, Customer booking is the main identification which shows the number of 3,900 units that customer awaiting their vehicles which can be called “Back Order”. Ideally from these figures, dealers should have the supply ratio at 40%

from Back order nationwide (1553/3900 = 40%) but in reality, Demand and Supply situation can be observed from the graph. The orange diagonal line illustrates the equilibrium condition of Supply (stock plus new vehicles to be received) and Dealer Back Order. Each blue spot represents the dealer nationwide. Blue spots which stay above the equivalent line illustrate the market condition when supply is over Back order. Blue spots which stay below the equivalent line illustrate the market condition when Back order is over supply.

For example, when Dealer A has the supply (stock plus new vehicles to be received) equivalent to the Back order, its represented blue spot will stay exactly on the orange diagonal line. In the case of Dealer B which has supply more than Dealer A but have the same level of Back order, it is the surplus condition. Whereas, Dealer C faces the shortage condition which can be seen by very low supply but got high Back order. Thus, if good allocation is in place, over supply amount at Dealer B shall be allocated for Dealer C who is in the badly shortage condition.

When the above graph is considered, it can be seen that the supply and demand condition of each dealer is characterized differently depending on the actual market condition. For example, if Dealer A has the supply (stock plus new vehicles to be received) equivalent to the Back order, its represented blue spot will stay exactly on the orange diagonal line. In the case of Dealer B which has supply more than Dealer A and Back order less than Dealer B, it is the surplus condition, whereas, Dealer C faces the shortage condition which can be seen by very low supply and high Back order. Thus, if good allocation is in place, over supply amount at Dealer B shall be allocated for Dealer C who is in the badly shortage condition.

Demand and Supply of Dealers data in January 2008 is shown in Table 3.11. Some dealers have Supply: Demand ratio over the average of nationwide (which is 40%). In this thesis, Supply: Demand ratio will be referred as “Matching Ratio” which can be calculated by dividing Supply (Stock plus Allocation) by Demand (Back Order). Some dealers have the matching ratio less than the average which means that Dealer have very low supply comparing with their demand. If good allocation is in place, each dealer nationwide shall have the similar situation of demand and supply which means they should have supply 40% of all demand in each dealer.

DEALER	Total Demand			Total Supply			Match Ratio	Back Order Remain	Remaining BackOrder Month
	B/O Last Month	New Booking Jan	(A)	Stock Last Month	Alloc. Jan (B)	(C)	(C)/(A)	(A)-(C) (D)	(E)
Dealer 1	106	61	**167**	21	52	**73**	**43.7%**	**94**	**1.81**
Dealer 2	25	54	**79**	22	29	**51**	**64.6%**	**28**	**0.97**
Dealer 3	20	30	**50**	8	13	**21**	**42.0%**	**29**	**2.23**
Dealer 4	28	7	**35**	9	14	**23**	**65.7%**	**12**	**0.86**
Dealer 5	69	34	**103**	5	27	**32**	**31.1%**	**71**	**2.63**
Dealer 6	65	43	**108**	8	16	**24**	**22.2%**	**84**	**5.25**
Dealer 7	238	218	**456**	28	156	**184**	**40.4%**	**272**	**1.74**
Dealer 8	122	137	**259**	7	56	**63**	**24.3%**	**196**	**3.50**
Dealer 9	67	170	**237**	31	59	**90**	**38.0%**	**147**	**2.49**
Dealer 10	87	35	**122**	17	35	**52**	**42.6%**	**70**	**2.00**
Dealer 11	7	20	**27**	3	6	**9**	**33.3%**	**18**	**3.00**
Dealer 12	74	25	**99**	38	21	**59**	**59.6%**	**40**	**1.91**
Dealer 13	35	11	**46**	0	11	**11**	**23.9%**	**35**	**3.18**
Dealer 14	9	16	**25**	13	8	**21**	**84.0%**	**4**	**0.50**
Dealer 15	83	44	**127**	51	30	**81**	**63.8%**	**46**	**1.53**
Dealer 16	19	14	**33**	4	10	**14**	**42.4%**	**19**	**1.90**
Dealer 17	36	37	**73**	16	23	**39**	**53.4%**	**34**	**1.48**
Dealer 18	14	10	**24**	2	8	**10**	**41.7%**	**14**	**1.75**
Dealer 19	19	12	**31**	11	9	**20**	**64.5%**	**11**	**1.22**
Dealer 20	22	4	**26**	6	5	**11**	**42.3%**	**15**	**3.00**
Dealer 21	58	45	**103**	33	17	**50**	**48.5%**	**53**	**3.12**
Dealer 22	14	26	**40**	5	9	**14**	**35.0%**	**26**	**2.89**
Dealer 23	11	11	**22**	8	7	**15**	**68.2%**	**7**	**1.00**
Dealer 24	24	34	**58**	1	19	**20**	**34.5%**	**38**	**2.00**
Dealer 25	15	16	**31**	2	10	**12**	**38.7%**	**19**	**1.90**
Dealer 26	79	41	**120**	8	27	**35**	**29.2%**	**85**	**3.15**
Dealer 27	17	14	**31**	4	7	**11**	**35.5%**	**20**	**2.86**
Dealer 28	27	16	**43**	7	11	**18**	**41.9%**	**25**	**2.27**
Dealer 29	11	12	**23**	9	8	**17**	**73.9%**	**6**	**0.75**
Dealer 30	5	10	**15**	2	9	**11**	**73.3%**	**4**	**0.44**
Dealer 31	26	9	**35**	5	10	**15**	**42.9%**	**20**	**2.00**
Dealer 32	11	19	**30**	13	8	**21**	**70.0%**	**9**	**1.13**
Dealer 33	48	14	**62**	2	9	**11**	**17.7%**	**51**	**5.67**
Dealer 34	3	9	**12**	4	4	**8**	**66.7%**	**4**	**1.00**
Dealer 35	3	5	**8**	3	3	**6**	**75.0%**	**2**	**0.67**
Dealer 36	0	10	**10**	3	2	**5**	**50.0%**	**5**	**2.50**
Dealer 37	14	8	**22**	7	7	**14**	**63.6%**	**8**	**1.14**
Dealer 38	6	7	**13**	3	2	**5**	**38.5%**	**8**	**4.00**
Dealer 39	2	8	**10**	0	2	**2**	**20.0%**	**8**	**4.00**
Dealer 40	2	2	**4**	0	2	**2**	**50.0%**	**2**	**1.00**
Dealer 41	1	3	**4**	1	1	**2**	**50.0%**	**2**	**2.00**
Dealer 42	11	12	**23**	5	6	**11**	**47.8%**	**12**	**2.00**
Dealer 43	12	4	**16**	2	3	**5**	**31.3%**	**11**	**3.67**
Dealer 44	34	17	**51**	5	8	**13**	**25.5%**	**38**	**4.75**
Dealer 45	15	4	**19**	3	3	**6**	**31.6%**	**13**	**4.33**
Dealer 46	9	9	**18**	1	4	**5**	**27.8%**	**13**	**3.25**
Dealer 47	16	7	**23**	0	4	**4**	**17.4%**	**19**	**4.75**
Dealer 48	5	2	**7**	1	3	**4**	**57.1%**	**3**	**1.00**
Dealer 49	0	3	**3**	0	3	**3**	**100.0%**	**0**	**0.00**
Dealer 50	17	4	**21**	2	3	**5**	**23.8%**	**16**	**5.33**
Dealer 51	4	3	**7**	3	3	**6**	**85.7%**	**1**	**0.33**
Dealer 52	3	9	**12**	0	4	**4**	**33.3%**	**8**	**2.00**
Dealer 53	3	3	**6**	0	1	**1**	**16.7%**	**5**	**5.00**
Dealer 54	6	9	**15**	0	5	**5**	**33.3%**	**10**	**2.00**
Dealer 55	33	15	**48**	4	9	**13**	**27.1%**	**35**	**3.89**
Dealer 56	32	35	**67**	6	9	**15**	**22.4%**	**52**	**5.78**
Dealer 57	39	23	**62**	5	9	**14**	**22.6%**	**48**	**5.33**
Dealer 58	13	6	**19**	0	3	**3**	**15.8%**	**16**	**5.33**
Dealer 59	1	3	**4**	0	2	**2**	**50.0%**	**2**	**1.00**
Dealer 60	15	5	**20**	2	3	**5**	**25.0%**	**15**	**5.00**
Dealer 61	10	0	**10**	2	3	**5**	**50.0%**	**5**	**1.67**
Dealer 62	3	3	**6**	3	2	**5**	**83.3%**	**1**	**0.50**

DEALER	Total Demand			Total Supply			Match Ratio	Back Order Remain	Remaining BackOrder Month
	B/O Last Month	New Booking Jan	(A)	Stock Last Month	Alloc. Jan (B)	(C)	(C)/(A)	(A)-(C) (D)	(E)
Dealer 63	2	8	**10**	0	4	**4**	**40.0%**	**6**	**1.50**
Dealer 64	2	0	**2**	1	0	**1**	**50.0%**	**1**	**1.00**
Dealer 65	2	6	**8**	2	3	**5**	**62.5%**	**3**	**1.00**
Dealer 66	4	4	**8**	0	2	**2**	**25.0%**	**6**	**3.00**
Dealer 67	17	3	**20**	5	2	**7**	**35.0%**	**13**	**6.50**
Dealer 68	7	4	**11**	2	2	**4**	**36.4%**	**7**	**3.50**
Dealer 69	1	4	**5**	0	1	**1**	**20.0%**	**4**	**4.00**
Dealer 70	0	4	**4**	0	1	**1**	**25.0%**	**3**	**3.00**
Dealer 71	21	3	**24**	0	5	**5**	**20.8%**	**19**	**3.80**
Dealer 72	1	1	**2**	0	1	**1**	**50.0%**	**1**	**1.00**
Dealer 73	7	2	**9**	4	2	**6**	**66.7%**	**3**	**1.50**
Dealer 74	1	3	**4**	1	1	**2**	**50.0%**	**2**	**2.00**
Dealer 75	3	2	**5**	1	1	**2**	**40.0%**	**3**	**3.00**
Dealer 76	2	2	**4**	0	2	**2**	**50.0%**	**2**	**1.00**
Dealer 77	15	6	**21**	2	7	**9**	**42.9%**	**12**	**1.71**
Dealer 78	7	5	**12**	3	4	**7**	**58.3%**	**5**	**1.25**
Dealer 79	5	5	**10**	4	4	**8**	**80.0%**	**2**	**0.50**
Dealer 80	1	1	**2**	0	1	**1**	**50.0%**	**1**	**1.00**
Dealer 81	12	2	**14**	0	4	**4**	**28.6%**	**10**	**2.50**
Dealer 82	20	16	**36**	5	7	**12**	**33.3%**	**24**	**3.43**
Dealer 83	5	9	**14**	1	5	**6**	**42.9%**	**8**	**1.60**
Dealer 84	2	3	**5**	2	2	**4**	**80.0%**	**1**	**0.50**
Dealer 85	2	3	**5**	1	1	**2**	**40.0%**	**3**	**3.00**
Dealer 86	1	3	**4**	1	2	**3**	**75.0%**	**1**	**0.50**
Dealer 87	22	7	**29**	6	4	**10**	**34.5%**	**19**	**4.75**
Dealer 88	1	3	**4**	1	1	**2**	**50.0%**	**2**	**2.00**
Dealer 89	7	3	**10**	1	4	**5**	**50.0%**	**5**	**1.25**
Dealer 90	1	1	**2**	0	1	**1**	**50.0%**	**1**	**1.00**
Dealer 91	4	1	**5**	0	1	**1**	**20.0%**	**4**	**4.00**
Dealer 92	2	0	**2**	0	1	**1**	**50.0%**	**1**	**1.00**
Dealer 93	6	11	**17**	6	8	**14**	**82.4%**	**3**	**0.38**
Dealer 94	6	4	**10**	2	4	**6**	**60.0%**	**4**	**1.00**
Dealer 95	1	7	**8**	0	3	**3**	**37.5%**	**5**	**1.67**
Dealer 96	2	1	**3**	0	2	**2**	**66.7%**	**1**	**0.50**
Dealer 97	9	5	**14**	1	4	**5**	**35.7%**	**9**	**2.25**
Dealer 98	1	2	**3**	1	1	**2**	**66.7%**	**1**	**1.00**
Dealer 99	0	5	**5**	2	2	**4**	**80.0%**	**1**	**0.50**
Dealer 100	1	4	**5**	3	1	**4**	**80.0%**	**1**	**1.00**
Dealer 101	0	5	**5**	2	2	**4**	**80.0%**	**1**	**0.50**
Dealer 102	1	1	**2**	1	1	**2**	**100.0%**	**0**	**0.00**
Dealer 103	4	1	**5**	0	1	**1**	**20.0%**	**4**	**4.00**
Dealer 104	3	0	**3**	0	1	**1**	**33.3%**	**2**	**2.00**
Dealer 105	7	7	**14**	4	2	**6**	**42.9%**	**8**	**4.00**
Dealer 106	9	7	**16**	7	5	**12**	**75.0%**	**4**	**0.80**
Dealer 107	0	4	**4**	0	1	**1**	**25.0%**	**3**	**3.00**
Dealer 108	35	17	**52**	11	7	**18**	**34.6%**	**34**	**4.86**
Dealer 109	6	1	**7**	1	1	**2**	**28.6%**	**5**	**5.00**
Dealer 110	3	5	**8**	1	2	**3**	**37.5%**	**5**	**2.50**
Dealer 111	4	5	**9**	1	3	**4**	**44.4%**	**5**	**1.67**
Dealer 112	0	4	**4**	0	2	**2**	**50.0%**	**2**	**1.00**
Dealer 113	6	7	**13**	0	3	**3**	**23.1%**	**10**	**3.33**
Dealer 114	3	4	**7**	0	2	**2**	**28.6%**	**5**	**2.50**
Dealer 115	4	20	**24**	2	6	**8**	**33.3%**	**16**	**2.67**
Dealer 116	9	12	**21**	1	5	**6**	**28.6%**	**15**	**3.00**
Dealer 117	5	3	**8**	0	1	**1**	**12.5%**	**7**	**7.00**
Dealer 118	3	2	**5**	0	1	**1**	**20.0%**	**4**	**4.00**
Dealer 119	1	1	**2**	0	1	**1**	**50.0%**	**1**	**1.00**
Metro	1491	1249	**2740**	399	739	**1138**	**41.5%**	**1602**	**2.17**
Central	312	228	**540**	65	113	**178**	**33.0%**	**362**	**3.20**
North	110	65	**175**	25	47	**72**	**41.1%**	**103**	**2.19**
North-East	101	95	**196**	36	59	**95**	**48.5%**	**101**	**1.71**
South	95	99	**194**	28	42	**70**	**36.1%**	**124**	**2.95**
Grand Total	**2109**	**1736**	**3845**	**553**	**1000**	**1553**	**40.4%**	**2292**	**2.29**

Table 3.11: Actual Model "A" Demand and Supply of Each Dealer in January 2008

When the allocation does not meet with the real demand of customer, it affects directly to dealer management tasks as itemized below:

1. Retail Sales Result: when the dealer who has booking from customer but shorts of supply, sales opportunity is damaged which can be seen from the matching ratio as the indicator for sales opportunity in Table 3.12. If matching ratio between demand and supply is reaching 100%, it reflects the high opportunity of sale respectively. It can be proved from the past that the higher matching ratio, the higher retail sales.

DEALER	Match Ratio	Retail Sales Jan08	Retail Sales Ratio
Dealer 14	**84.0%**	18	85.71%
Dealer 29	**73.9%**	13	76.47%
Dealer 30	**73.3%**	8	72.73%
Dealer 32	**70.0%**	15	71.43%
Dealer 23	**68.2%**	10	66.67%
Dealer 4	**65.7%**	15	65.22%
Dealer 2	**64.6%**	32	62.75%
Dealer 19	**64.5%**	12	60.00%
Dealer 15	**63.8%**	48	59.26%
Dealer 12	**59.6%**	35	59.32%
Dealer 17	**53.4%**	23	58.97%
Dealer 21	**48.5%**	29	58.00%

Table 3.12: Comparison of Retail Sales Ratio and Matching Ratio of January 2008

In Table 3.12, matching ratio from Table 3.11 for metropolitan area dealers is compared with retail sales ratio. It can be seen that dealers with high matching ratio will relatively have high retail sales ratio where retail sales ratio is retail sales over supply in each dealer.

However, nationwide average matching ratio must also be considered in parallel. As in Table 3.11, nationwide average matching ratio is at 41.4% therefore each of every dealer should have the matching ratio nearly in the range of the nationwide average figure to balancing the demand and supply of the whole country to increase the retail sales volume.

2. Long Delivery Lead time to Customer: The delivery lead time figure in Table 3.13 is counted from the time of customer booking to retail sales which shows the average customer delivery lead time nationwide at 28 days. Delivery lead time is the key indicator of customer satisfaction to the delivery scheduling. From Table 3.13, if it is monitored dealer by dealer, it can be seen that some dealers have the figure of delivery lead time higher than the average which reflects customers have to wait for their vehicles longer than expected.

In addition to delivery lead time as the main KPI, Back Order Remaining Month is equally important which can be formulated as Back order that left at the end of month is divided by Allocation. Main importance of this figure is that it shows the number of month which Back Order Remaining is expected to be cleared or in another meaning of how long next coming customer has to wait for their booking. For example as shown in Table 3.11 for Dealer 6 who has Back Order Remaining ratio of 5.25 reflecting around 5 and a half months which dealer will clear their existing Back Orders and also can imply that next coming customer booking will have to wait for 5 and a half months for the vehicle while Nationwide average of Back Order Remaining Month is at 2.75.

Effective allocation in this case should refer to each dealer having the same level of both delivery lead time and Back Order Remaining Month which reflects that customer can go to any dealer and expect to have the same delivery lead time balance then good customer satisfaction can be expected.

DEALER	Customer Delivery Leadtime (DAY)
Dealer 1	36.4
Dealer 2	18.1
Dealer 3	19.7
Dealer 4	49.6
Dealer 5	45.6
Dealer 6	41.1
Dealer 7	21.2
Dealer 8	40.9
Dealer 9	14.7
Dealer 10	30.0
Dealer 11	31.2
Dealer 12	54.9
Dealer 13	30.7
Dealer 14	10.8
Dealer 15	15.8
Dealer 16	16.4
Dealer 17	17.9
Dealer 18	43.0
Dealer 19	23.3
Dealer 20	30.8
Dealer 21	19.4
Dealer 22	23.8
Dealer 23	28.4
Dealer 24	16.4
Dealer 25	39.6
Dealer 26	35.0
Dealer 27	36.6
Dealer 28	27.9
Dealer 29	22.1
Dealer 30	13.0
Dealer 31	28.7
Dealer 32	22.2
Dealer 33	14.2
Dealer 34	6.2
Dealer 35	14.0
Dealer 36	7.5
Dealer 37	13.6
Dealer 38	15.7
Dealer 39	26.0
Dealer 40	51.0
Dealer 41	27.6
Dealer 42	18.1
Dealer 43	10.3
Dealer 44	24.6
Dealer 45	15.7
Dealer 46	15.0
Dealer 47	1.0
Dealer 48	23.0
Dealer 49	1.0
Dealer 50	64.0
Dealer 51	1.0
Dealer 52	10.5
Dealer 53	17.0
Dealer 54	25.7
Dealer 55	44.5
Dealer 56	24.6
Dealer 57	55.3
Dealer 58	73.0
Dealer 59	27.6
Dealer 60	68.8
Dealer 61	6.5
Dealer 62	11.5

DEALER	Customer Delivery Leadtime (DAY)
Dealer 63	38.0
Dealer 64	25.0
Dealer 65	1.0
Dealer 66	17.0
Dealer 67	48.3
Dealer 68	61.3
Dealer 69	25.0
Dealer 70	4.0
Dealer 71	81.3
Dealer 72	25.0
Dealer 73	47.4
Dealer 74	39.0
Dealer 75	8.5
Dealer 76	81.0
Dealer 77	29.0
Dealer 78	2.7
Dealer 79	26.8
Dealer 80	20.0
Dealer 81	51.0
Dealer 82	32.0
Dealer 83	32.4
Dealer 84	20.0
Dealer 85	4.0
Dealer 86	20.0
Dealer 87	21.8
Dealer 88	20.0
Dealer 89	14.5
Dealer 90	25.0
Dealer 91	25.0
Dealer 92	59.0
Dealer 93	23.0
Dealer 94	25.3
Dealer 95	20.0
Dealer 96	1.0
Dealer 97	13.7
Dealer 98	20.0
Dealer 99	15.0
Dealer 100	35.0
Dealer 101	24.0
Dealer 102	25.0
Dealer 103	36.0
Dealer 104	25.0
Dealer 105	37.0
Dealer 106	27.9
Dealer 107	13.5
Dealer 108	56.5
Dealer 109	29.0
Dealer 110	27.0
Dealer 111	12.7
Dealer 112	27.0
Dealer 113	11.5
Dealer 114	27.6
Dealer 115	6.7
Dealer 116	49.7
Dealer 117	133.0
Dealer 118	55.5
Dealer 119	25.0
Metro	27.9
Central	24.1
North	33.2
North-East	23.3
South	36.0
Grand Tota	28.0

Table 3.13: Actual Customer Delivery Lead Time of Each Dealer in January 2008

3. Dealer Inventory Stock Management Problem which can be seen when the allocation does not take place at the right dealer at the right time. When any dealer have supply more than demand, the greater difficulty to mange inventory stock. Nowadays, "**Stock Turnover**" is used as one of the KPI of dealer management. Stock Turnover is basically the flow from dealer stock to customer in term of retail sales with the unit in Day. An example of Stock Turnover in January 2008 is shown as Table 3.14 which the average of stock turnover nationwide is at 23.9 days. Some dealers who have their figure below the average will face the direct impact of the responsibility to absorb the stock holding cost. Overall damage from poor allocation affecting stock turnover is the sales opportunity loss if some dealer who needs the supply but the supply was allocated to the unwanted dealer. This could also affect the nationwide sales target of the company.

In addition to Stock Turnover as the main KPI, Stock ratio pays an important as the KPI. The example of January 2008 Stock Ratio is shown in Table 3.15. Table 3.15, actually shows the comparison of stock level versus total supply in January 2008 of each dealer and come out with the conclusion of Stock ratio which can be formulated as Stock at the end of January divided by Total supply of January. From Table 3.15, nationwide average is at 41.6% reflecting a high number of stocks. If good allocation is in place which supply will be lower than demand and vehicle can be allocated to the right demand, stock at each dealer will be lean.

Current Allocation method has the gap of various problems which leads to the presence of this thesis on how to improve the system, working method and to thoroughly get rid of the problems to achieving the best customer satisfaction and the best sales performance of the company. The conclusion will be briefly described in the Chapter 5

DEALER	Stock Turnover (DAY)
Dealer 1	**14.6**
Dealer 2	**21.9**
Dealer 3	**22.4**
Dealer 4	**17.2**
Dealer 5	**15.7**
Dealer 6	**16.9**
Dealer 7	**6.1**
Dealer 8	**9.5**
Dealer 9	**14.2**
Dealer 10	**33.1**
Dealer 11	**17.7**
Dealer 12	**64.9**
Dealer 13	**4.0**
Dealer 14	**34.4**
Dealer 15	**22.7**
Dealer 16	**28.6**
Dealer 17	**15.0**
Dealer 18	**15.5**
Dealer 19	**14.3**
Dealer 20	**29.8**
Dealer 21	**21.3**
Dealer 22	**23.8**
Dealer 23	**21.7**
Dealer 24	**10.6**
Dealer 25	**10.6**
Dealer 26	**7.9**
Dealer 27	**16.1**
Dealer 28	**41.8**
Dealer 29	**33.3**
Dealer 30	**14.3**
Dealer 31	**14.4**
Dealer 32	**20.2**
Dealer 33	**9.6**
Dealer 34	**111.8**
Dealer 35	**33.3**
Dealer 36	**40.3**
Dealer 37	**14.7**
Dealer 38	**11.0**
Dealer 39	**6.3**
Dealer 40	**5.0**
Dealer 41	**13.0**
Dealer 42	**28.8**
Dealer 43	**19.0**
Dealer 44	**23.5**
Dealer 45	**13.3**
Dealer 46	**17.0**
Dealer 47	**9.0**
Dealer 48	**13.5**
Dealer 49	**16.0**
Dealer 50	**26.5**
Dealer 51	**39.0**
Dealer 52	**7.0**
Dealer 53	**7.0**
Dealer 54	**4.7**
Dealer 55	**18.3**
Dealer 56	**17.2**
Dealer 57	**21.4**
Dealer 58	**8.0**
Dealer 59	**20.4**
Dealer 60	**15.0**
Dealer 61	**8.0**
Dealer 62	**21.7**

DEALER	Stock Turnover (DAY)
Dealer 63	**5.5**
Dealer 64	**27.0**
Dealer 65	**18.0**
Dealer 66	**3.0**
Dealer 67	**22.3**
Dealer 68	**24.5**
Dealer 69	**20.0**
Dealer 70	**10.0**
Dealer 71	**7.0**
Dealer 72	**20.0**
Dealer 73	**18.5**
Dealer 74	**45.0**
Dealer 75	**513.5**
Dealer 76	**5.0**
Dealer 77	**7.7**
Dealer 78	**24.7**
Dealer 79	**36.5**
Dealer 80	**25.0**
Dealer 81	**5.0**
Dealer 82	**35.0**
Dealer 83	**14.0**
Dealer 84	**35.0**
Dealer 85	**26.5**
Dealer 86	**40.0**
Dealer 87	**24.3**
Dealer 88	**22.5**
Dealer 89	**13.0**
Dealer 90	**20.0**
Dealer 91	**16.0**
Dealer 92	**2.0**
Dealer 93	**24.3**
Dealer 94	**25.0**
Dealer 95	**11.0**
Dealer 96	**20.0**
Dealer 97	**5.3**
Dealer 98	**2.0**
Dealer 99	**45.0**
Dealer 100	**8.0**
Dealer 101	**20.0**
Dealer 102	**11.0**
Dealer 103	**20.0**
Dealer 104	**20.0**
Dealer 105	**12.0**
Dealer 106	**17.6**
Dealer 107	**4.0**
Dealer 108	**25.5**
Dealer 109	**25.0**
Dealer 110	**55.3**
Dealer 111	**7.5**
Dealer 112	**20.0**
Dealer 113	**11.0**
Dealer 114	**20.3**
Dealer 115	**37.0**
Dealer 116	**15.3**
Dealer 117	**5.0**
Dealer 118	**20.0**
Dealer 119	**20.0**
Metro	**20.1**
Central	**20.3**
North	**44.1**
North-East	**20.0**
South	**19.7**
Grand Total	**23.9**

Table3.14: Actual Stock Turnover of Each Dealer in January 2008

DEALER	Total Supply			RS	Stock	Stock
	Stock Last Mth	Alloc. Jan	(A)	Jan (B)	End Jan (C)	Ratio (C) / (A)
Dealer 1	21	52	73	51	22	30.1%
Dealer 2	22	29	51	31	20	39.2%
Dealer 3	8	13	21	18	3	14.3%
Dealer 4	9	14	23	14	9	39.1%
Dealer 5	5	27	32	19	13	40.6%
Dealer 6	8	16	24	22	2	8.3%
Dealer 7	28	158	186	104	82	44.1%
Dealer 8	7	55	62	36	26	41.9%
Dealer 9	31	58	89	64	25	28.1%
Dealer 10	17	35	52	21	31	59.6%
Dealer 11	3	6	9	9	0	0.0%
Dealer 12	38	21	59	30	29	49.2%
Dealer 13	0	11	11	3	8	72.7%
Dealer 14	13	8	21	9	12	57.1%
Dealer 15	51	30	81	54	27	33.3%
Dealer 16	4	10	14	8	6	42.9%
Dealer 17	16	23	39	24	15	38.5%
Dealer 18	2	8	10	4	6	60.0%
Dealer 19	11	9	20	14	6	30.0%
Dealer 20	6	5	11	6	5	45.5%
Dealer 21	33	17	50	38	12	24.0%
Dealer 22	5	9	14	11	3	21.4%
Dealer 23	8	7	15	14	1	6.7%
Dealer 24	1	19	20	12	8	40.0%
Dealer 25	2	10	12	9	3	25.0%
Dealer 26	8	27	35	20	15	42.9%
Dealer 27	4	7	11	8	3	27.3%
Dealer 28	7	11	18	12	6	33.3%
Dealer 29	9	8	17	7	10	58.8%
Dealer 30	2	9	11	7	4	36.4%
Dealer 31	5	10	15	7	8	53.3%
Dealer 32	13	8	21	15	6	28.6%
Dealer 33	2	9	11	11	0	0.0%
Dealer 34	4	4	8	5	3	37.5%
Dealer 35	3	3	6	2	4	66.7%
Dealer 36	3	2	5	2	3	60.0%
Dealer 37	7	7	14	9	5	35.7%
Dealer 38	3	2	5	3	2	40.0%
Dealer 39	0	2	2	2	0	0.0%
Dealer 40	0	2	2	1	1	50.0%
Dealer 41	1	1	2	2	0	0.0%
Dealer 42	5	6	11	10	1	9.1%
Dealer 43	2	3	5	4	1	20.0%
Dealer 44	5	8	13	9	4	30.8%
Dealer 45	4	3	7	7	0	0.0%
Dealer 46	1	4	5	3	2	40.0%
Dealer 47	0	4	4	1	3	75.0%
Dealer 48	1	3	4	1	3	75.0%
Dealer 49	0	3	3	2	1	33.3%
Dealer 50	2	3	5	4	1	20.0%
Dealer 51	3	3	6	1	5	83.3%
Dealer 52	0	4	4	2	2	50.0%
Dealer 53	0	1	1	1	0	0.0%
Dealer 54	0	5	5	3	2	40.0%
Dealer 55	4	9	13	6	7	53.8%
Dealer 56	6	9	15	12	3	20.0%
Dealer 57	5	9	14	9	5	35.7%
Dealer 58	0	3	3	1	2	66.7%
Dealer 59	0	2	2	0	2	100.0%
Dealer 60	2	3	5	4	1	20.0%
Dealer 61	2	3	5	4	1	20.0%
Dealer 62	3	2	5	4	1	20.0%

DEALER	Total Supply			RS	Stock	Stock
	Stock Last Mth	Alloc. Jan	(A)	Jan (B)	End Jan (C)	Ratio (C) / (A)
Dealer 63	0	4	4	3	1	25.0%
Dealer 64	0	0	0	0	0	0.0%
Dealer 65	2	3	5	1	4	80.0%
Dealer 66	0	2	2	1	1	50.0%
Dealer 67	5	2	7	6	1	14.3%
Dealer 68	2	2	4	3	1	25.0%
Dealer 69	0	1	1	0	1	100.0%
Dealer 70	0	1	1	1	0	0.0%
Dealer 71	0	5	5	3	2	40.0%
Dealer 72	0	1	1	0	1	100.0%
Dealer 73	4	2	6	5	1	16.7%
Dealer 74	1	1	2	1	1	50.0%
Dealer 75	1	1	2	2	0	0.0%
Dealer 76	0	2	2	1	1	50.0%
Dealer 77	2	7	9	4	5	55.6%
Dealer 78	3	4	7	3	4	57.1%
Dealer 79	4	4	8	5	3	37.5%
Dealer 80	0	1	1	0	1	100.0%
Dealer 81	0	4	4	3	1	25.0%
Dealer 82	5	7	12	8	4	33.3%
Dealer 83	1	5	6	5	1	16.7%
Dealer 84	2	2	4	1	3	75.0%
Dealer 85	1	1	2	1	1	50.0%
Dealer 86	1	2	3	1	2	66.7%
Dealer 87	6	4	10	4	6	60.0%
Dealer 88	1	1	2	2	0	0.0%
Dealer 89	1	4	5	2	3	60.0%
Dealer 90	0	1	1	0	1	100.0%
Dealer 91	0	1	1	1	0	0.0%
Dealer 92	0	1	1	1	0	0.0%
Dealer 93	6	8	14	5	9	64.3%
Dealer 94	2	4	6	4	2	33.3%
Dealer 95		3	3	1	2	66.7%
Dealer 96	0	2	2	1	1	50.0%
Dealer 97	1	4	5	3	2	40.0%
Dealer 98	1	1	2	1	1	50.0%
Dealer 99	2	2	4	2	2	50.0%
Dealer 100	3	1	4	1	3	75.0%
Dealer 101	2	2	4	0	4	100.0%
Dealer 102	1	1	2	0	2	100.0%
Dealer 103	0	1	1	1	0	0.0%
Dealer 104	0	1	1	0	1	100.0%
Dealer 105	4	2	6	4	2	33.3%
Dealer 106	7	5	12	9	3	25.0%
Dealer 107	0	1	1	1	0	0.0%
Dealer 108	11	7	18	13	5	27.8%
Dealer 109	1	1	2	1	1	50.0%
Dealer 110	1	2	3	1	2	66.7%
Dealer 111	1	3	4	3	1	25.0%
Dealer 112	0	2	2	0	2	100.0%
Dealer 113	0	3	3	2	1	33.3%
Dealer 114	0	2	2	1	1	50.0%
Dealer 115	2	6	8	6	2	25.0%
Dealer 116	1	5	6	3	3	50.0%
Dealer 117	0	1	1	1	0	0.0%
Dealer 118	0	1	1	1	0	0.0%
Dealer 119	0	1	1	0	1	100.0%
Metro	399	739	**1138**	**701**	**426**	**35.5%**
Central	66	113	**179**	**125**	**65**	**38.0%**
North	24	47	**71**	**42**	**29**	**43.5%**
North-East	36	59	**95**	**45**	**50**	**51.8%**
South	28	42	**70**	**46**	**24**	**39.1%**
Grand Total	**553**	**1000**	**1553**	**959**	**594**	**41.6%**

Table 3.15: Actual Stock Ratio of Each Dealer at the End of January 2008

CHAPTER 4
THE PROPOSED VEHICLE ALLOCATION METHOD

In this chapter, the proposed vehicle allocation method would be described. Section 4.1 shows the introduction of the proposed allocation method which Back order is used as the main factor to indicate the real demand. Proposed method data is verified and validated in section 4.2. A brief proposed vehicle allocation method and implementation of the proposed method is described in section 4.3 and 4.4, respectively. Finally, the comparison between the existing method and proposed method is discussed in section 4.5.

4.1 Introduction of the Proposed Vehicle Allocation Method

The nature of automobile retail business in Thailand, Majority of the customers who want to buy vehicles, would preliminary book the vehicle at the first stage after that go through the loan approval process with the car finance company together with an addition of car accessory requisition. Then, the vehicle delivery scheduling will come into the consideration after the booking which is different from the other ordinary products which customers will pay for the product and receive their goods right away after the payment.

The automobile retail business in some countries, for example in USA, dealer must spare certain amount of vehicles in stock just in case of customer walks into the dealer showroom and decide to buy the vehicle. Then, the delivery can be made right away. In this example, dealer can manage the demand only by rely on its past sale history and future sale target to forecast the upcoming customer demand then prepare the vehicle or supply to meet with predicted future customer demand.

In Thailand automobile retail business, dealer has its most effective data of demand to manage that is **"**Back Order**"**. When customer decides to book the vehicle (Customer Booking), this booking data will transform to Back Order which dealer can use to foresee the demand. Back order will lead to the retail sales and vehicle delivery or in the other way round, may turn out to be cancel of booking at the end.

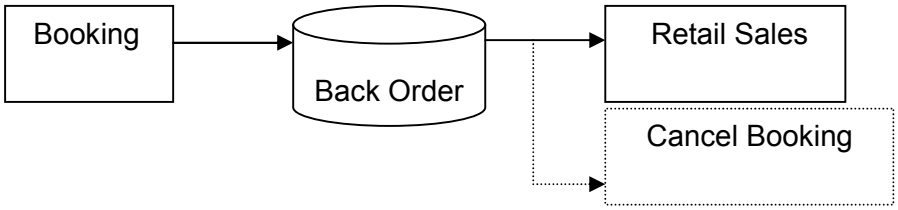


Figure 4.1: Process Flow of Customer Booking

Back Order data for allocation is obtained from SMCDS system which dealer keys into the system when customer booking is being made. Figure 4.1 shows the process flow of customer booking until data key into SMCDS system.

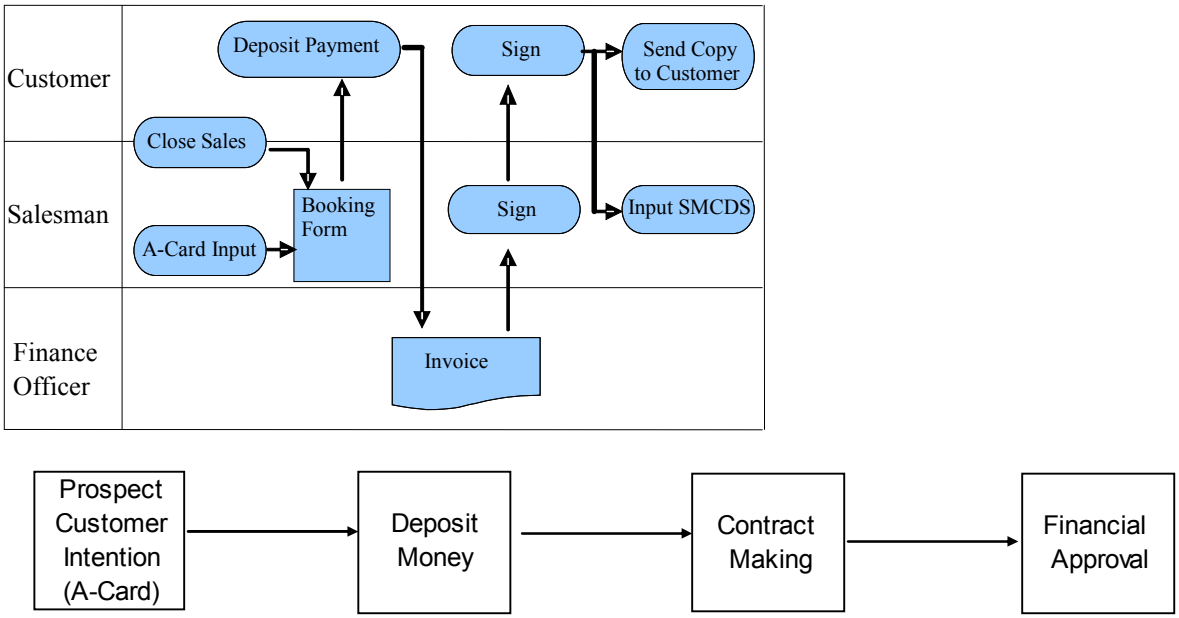


Figure 4.2: Process of Booking Key into SMCDS System

From Figure 4.2, the flow starts from potential customers show their interest to buy the vehicle. Customers in this case may come from old customer, walk-in customer to showroom, customer approached by salesman or customer from the special events. After an interest from customers, salesman will start creating A-Card by asking customer to provide necessary information namely:

- Target customer name (can be changed even though A-Card is saved)
- Telephone No. and Mobile No.
- Series
- Estimate Delivery Date

- Sources of A-Card
- Contact date
- Details of Follow Up
- Appointment Date
- Sex
- Customer contact address

A-Card window in SMCDS system and actual key-in fields are shown in Figure 4.3.

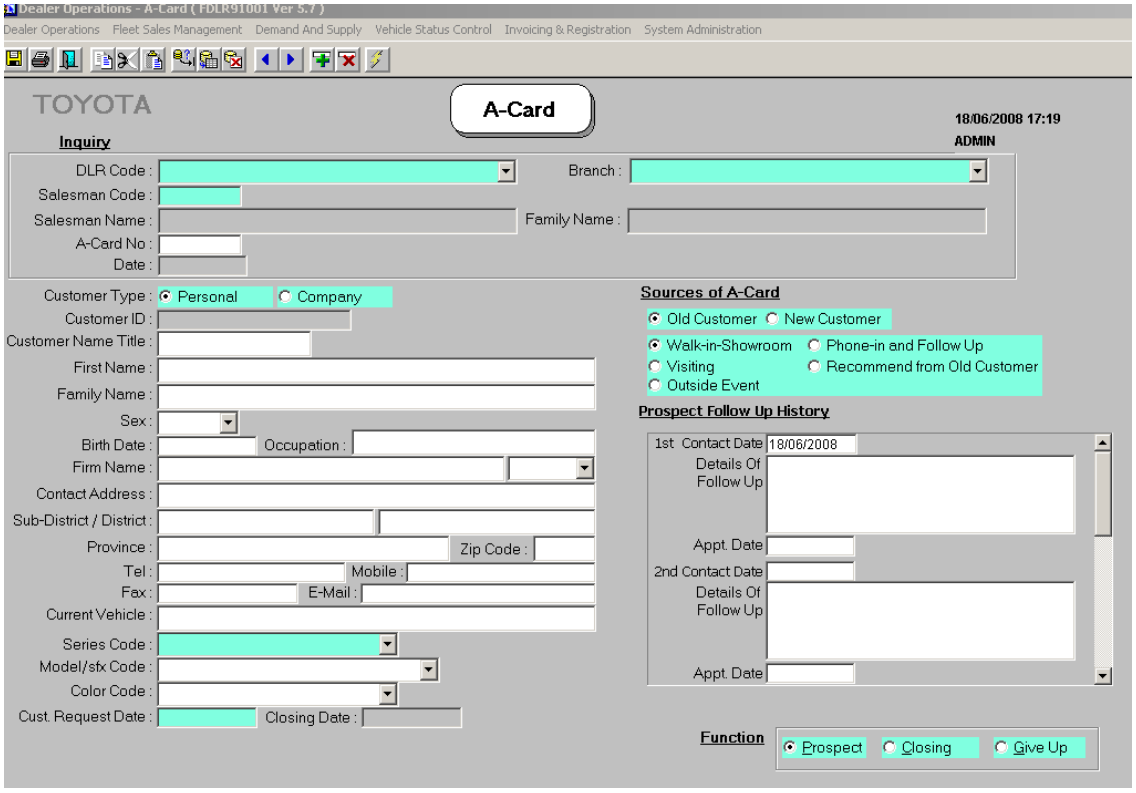


Figure 4.3: SMCDS Interface of A-Card Form

Next step, when customer decided to book the vehicle, Booking form (Contract making) must be filled and deposit payment will be paid. Customer official invoice will be issued by finance office with customer acknowledge signature. One copy of invoice will be given to customer for reference.

Finally, salesman will key-in Booking in SMCDS platform which A-Card prelim customer information will be transferred to SMCDS Booking step with addition information requested namely:

- Customer Identification No.
- Contract customer name (First name and Family name)
- Complete contact address (must be completely fill-in including postcode)
- Series/Model/Color codes
- Target delivery date
- Price
- Deposit payment amount
- Type of payment (cash or installment)

Proposed Allocation Method is being studied in this thesis to allocate the supply to the location where it has demand and try to optimize the balance between demand and supply. When supply and demand is in balance, it can enlarge the retail sales opportunity for the company, enhance ability to manage stock of each dealer becoming much easier and more effective and also minimize the problem of long delivery lead time for customers.

The main purpose of Back Order being brought into this thesis as the important factor of the Proposed Allocation Method is to indicate where the demand is actually in which dealer and at what amount. In another word, “Back Order” is the key identification which indicates the real demand of market as mentioned in the above. Thus, the suitable proposed allocation method will need to consider for Back Order ratio to target meeting the real market demand. This allocation will be able to allocate supply and fully utilize the supply to get rid of Back order and Back order after allocation of all dealers, shown in Figure 4.4, should be in the same ratio in order to have the same delivery lead time of customer. And the most important point to effectively allocate with the real demand to the right place in the right timing.

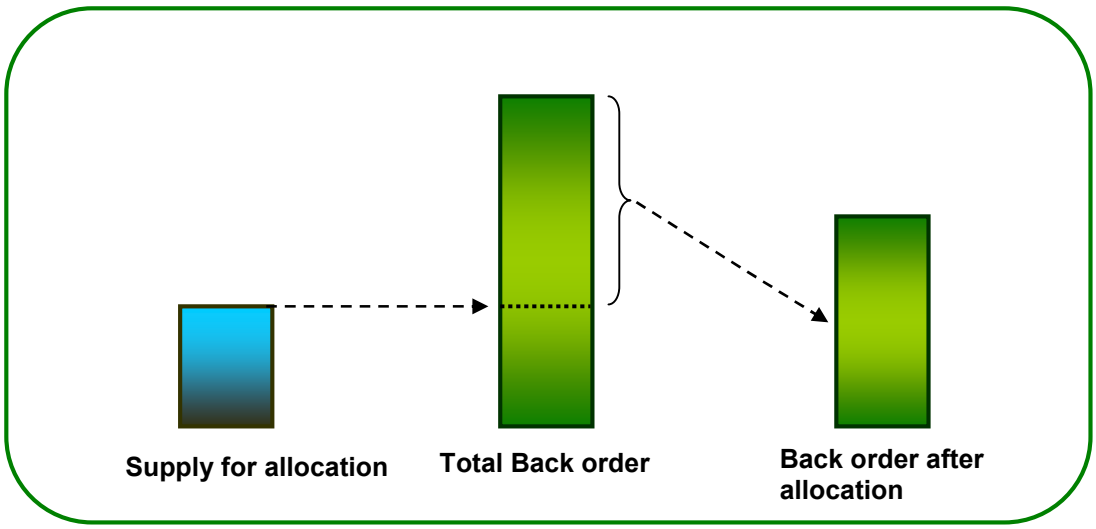


Figure 4.4: Example of Back Order after Allocation

However, in order to use Back order for allocation effectively, perfectly reliable Back order data must be used in this case, then Back order need to be verified before using.

4.2 Data Verification

4.2.1 The Current Situation of Back Order

Back order data is not only important as the key usage of dealer for sale management purpose but also it is one of the key databases for Company A production planning department to plan their production of vehicle. If production plan corresponds with the real market demand, it will ease back to the dealer for effective allocation in place to meet with dealer requirement of vehicle.

Although, customer booking numbers are important for sale planning, but in fact of the present situation nowadays Booking Cancel data nationwide is equally important which this is shown in Table 4.1 reflecting a high percentage of cancellation which needs to be considered carefully.

Series	2007	2008
Pick-UP	29.60%	29.50%
Pessenger Car	26.40%	29.00%
Total	28.20%	29.30%

Table 4.1: Actual Booking Cancel Ratio of 2007-2008

Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
New Booking	1786	1818	1880	1709	1585	1515	1570	1518	1392	1650	1542	1069	19034
Cancel	358	427	621	548	589	454	348	448	431	435	406	422	5487
Cancel Ratio	20.04%	23.49%	33.03%	32.07%	37.16%	29.97%	22.17%	29.51%	30.96%	26.36%	26.33%	39.48%	28.83%

Table 4.2: Actual Cancel Ratio of Model A in 2008

From Table 4.1, the percentage of all series for Booking Cancel of both pick-up and passenger car are at 29.30%. In detail, Table 4.2 shows the cancellation of Model A Booking in 2008 which the percentage is at around 30%. This number reflects that in every 100 customer bookings, Company A could actually deliver or sell only 70 units to customers. In another word, Company A lost the opportunity to sell 30 units of Model A monthly from various reasons of cancellation such as customer has financial problems, change of model, change of dealer, change of brand, fault key-in by salesman for customer name and etc. Figure 4.5 shows the Booking Cancellation categorized in percentage which is obtained from SMCDS system in 2008.

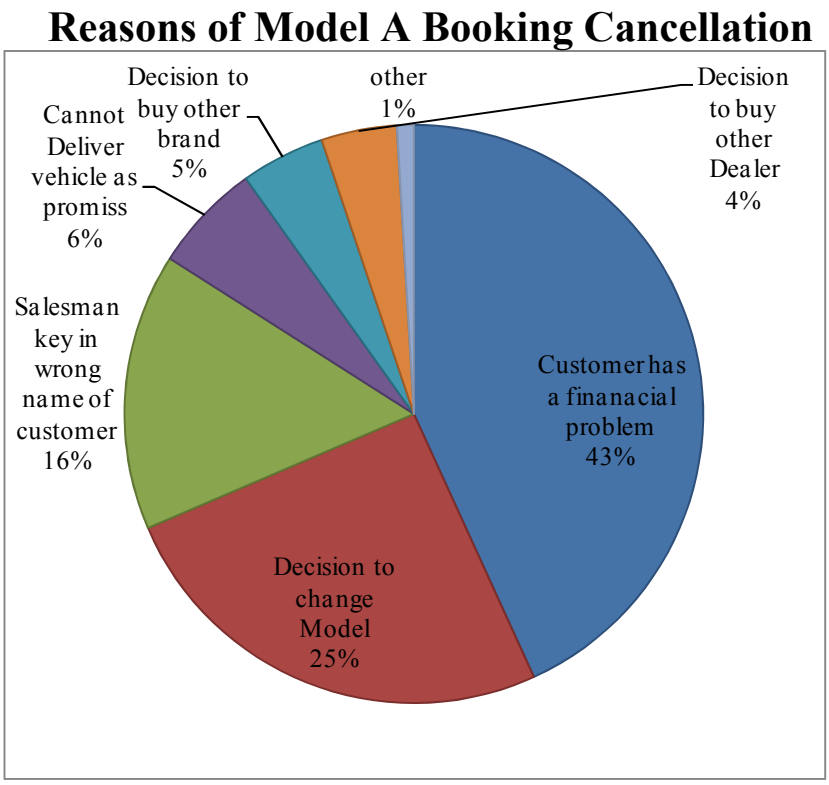


Figure 4.5: Reasons of Model A Booking Cancellation in 2008

From Cancel Ratio, it shows that booking data in SMCDS system may not fully be the real demand in total. Therefore, Back order data from SMCDS must also be verified at the first stage in this study before it can be used as one of the factor for consideration in the proposed allocation method in order to meet with the real demand. Cause of inaccurate Back Order data in SMCDS system is explained in the next paragraph.

4.2.2 Cause of Inaccurate Back Order Data in SMCDS System

Cause of inaccurate booking data in SMCDS system can be identified by Cause and effect diagram which is shown in Figure 4.6.

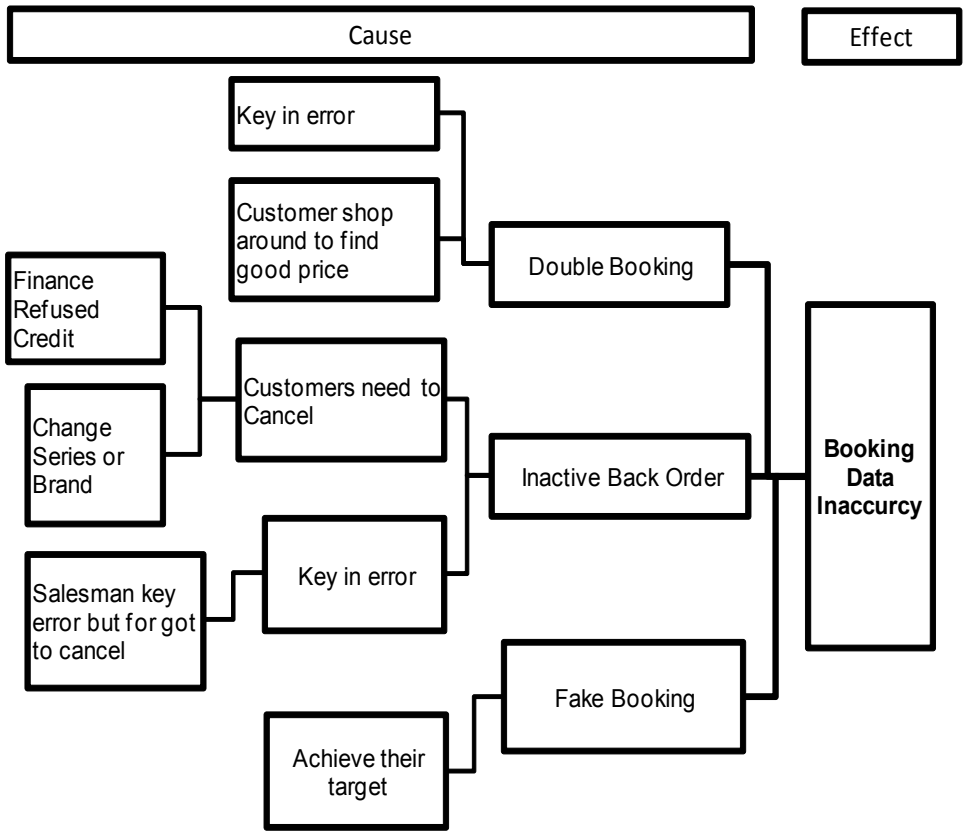


Figure 4.6: Causes and Effect Diagram of Booking Data Inaccuracy

Grouping of these inaccuracy causes to Back Order misleading the real demand of customer which occurs in the system can be classified into **3** groups as followed:

1. **Double Booking**: there are 2 causes leading to Double Booking in SMCDS system namely:
   1.1 Error key-in: salesman enters the data mistakenly into SMCDS system without cancellation before keying-in the same data for the same customer.
   1.2 Customers shop around: one customer with bookings in many dealers causing system to a misleading number of demands instead of only one vehicle. The motives to this bad habit are such as new promotion coming out later is better, bookings in many dealers in search for faster delivery lead time in the case that supply is not enough.

2. **Inactive Back Order**: this is the data of Back order which is left over in the system without cancellation which can be identified as followed:
   2.1 Customer cancels booking intentionally from many reasons such as finance refused credit for the loan proposal and customer does not have the buying power financially.
   2.2 Customer decided to change Series as for example changing from Model A to Model B or even changing in brand such as from Company A to Company B.
   2.3 Salesman enters the data mistakenly into SMCDS system without cancellation of old booking before keying-in the same data for the same customer.

3. **Enter fraud booking intentionally without the real demand** by salesman: At some dealers, monthly target is set for salesman to achieve therefore salesman may carelessly enter this fraud booking into the system to reach the target.

4.2.3 Back Order Data Verification

From the problem of Back Order inaccuracy explained earlier in this chapter, data verification will be focused in 2 steps of Aging of Back Order Verification and Customer ID Verification.

- **Aging of Back Order and FIFO Verification:**

This will be the first step of data verification method which will verify Back order in its aging. Long aging counts from the first day of booking until the current day of verification with queuing or FIFO system in consideration. Long aging Back order will be verified and eliminated when data found in active, i.e. Back order which has long aging and FIFO is being skipped, can be called Inactive Back order. Inactive Back Order may occur from salesman do not follow the procedure of Booking cancellation, i.e. forget to cancel booking. This leads to the occurrence of long aging

Back order which is inactive and will not be considered when vehicle allocation proceeds.

Standard of Back order aging shall not be more than 2 months but however, it is also up to the supply to dealer as well whether it is being placed to dealers in time or not, e.g. if FIFO is being followed or in another word, vehicle delivery follows the order then this Back Order is still considered as an active Back order. Aging of Back order and FIFO verification can be classified into 3 cases and examples of these 3 cases are shown with the aging counts from booking date until end of January 2008 as followed. Table 4.3, Table 4.4 and Table 4.5 show the example of an Inactive Back order and 2 cases of active Back order respectively.

From table 4.3, Booking No. 7A0036 and No. 7A0103 have aging more than 2 months which are considered as Long Aging Back Order. Booking No. 7A0110 has aging 1 month but vehicle was delivered and retail sales was made. Thus, the first two bookings namely No. 7A0036 and No. 7A0103 were skipped therefore these two books are now inactive and will be eliminated from the system before proceeds to the next step of allocation.

Dealer Name	Series	Booking No	Booking Date	Retail Sales Date	Customer Name	Customer Family Name	Customer ID	BO aging (Mth)	Status
Dealer 1	Model A	7A0036	15-Sep-07		Sirin	S.	3101202291523	5	Non Active
Dealer 1	Model A	7A0103	16-Oct-07		Polla	A.	3730101168304	4	Non Active
Dealer 1	**Model A**	**7A0110**	**5-Dec-07**	**15-Jan-08**	**Monrada**	**L.**	**3730100611620**	**1**	**Retail sales**
Dealer 1	**Model A**	**7A0099**	**8-Dec-07**	**25-Jan-08**	**Naraporn**	**B.**	**3102400593632**	**1**	**Retail sales**
Dealer 1	Model A	7A0434	15-Jan-08		Phan	N.	3101700539144	0	Active BO

Table 4.3: Example of Inactive Back Order

From table 4.4, even though Booking No7A0172 has aging over 3 months but has not been skipped from other bookings, therefore Booking No7A0172 is still considered as Active Back Order.

Dealer Name	Model A	Booking No	Booking Date	Retail Sales Date	Customer Name	Customer Family Name	Customer ID	BO aging (Mth)	Status
Dealer 1	Model A	7A0146	10-Sep-07		Rungpa	A.	3102400991140	4	Non Active
Dealer 1	Model A	7A0124	14-Oct-07		Kanya	K.	3101701280624	3	Non Active
Dealer 1	**Model A**	**7A0156**	**20-Oct-07**	**17-Jan-08**	**Bua**	**O.**	**3570900327111**	**3**	**Retail sales**
Dealer 1	Model A	7A0172	25-Oct-07		Peeraphat	S.	3101200071186	3	Active Long aging
Dealer 1	Model A	7A0260	15-Dec-07		Chaiwut	T.	3100500649182	1	Active BO
Dealer 1	Model A	7A0317	13-Jan-08		Jack	N.	5101200053371	0	Active BO

Table 4.4: Example of Active Back Order Case 1

From Table 4.5, Even though Booking No.7A0338 and 7A0404 were skipped by Booking No 7A0436 but has aging lower than 2 months therefore it is still considered as Active Back Order because customer may still await for financial approval or does not want to receive the vehicle at the certain period of time.

Dealer Name	Model A	Booking No	Booking Date	Retail Sales Date	Customer Name	Customer Family Name	Customer ID	BO aging (Mth)	Status
Dealer 1	Model A	7A0314	1-Sep-07		Preenuch	S.	3440100790144	4	Non Active
Dealer 1	Model A	7A0309	16-Oct-07		Suma	A.	1101400196164	3	Non Active
Dealer 1	Model A	7A0338	9-Nov-07		Somsuk	H.	3101403088903	2	Active BO
Dealer 1	Model A	7A0404	12-Dec-07		Rawan	M.	3100602851061	1	Active BO
Dealer 1	**Model A**	**7A0436**	**11-Jan-08**	**28-Jan-08**	**Pit**	**R.**	**3101800943711**	**0**	**Retail Sales**
Dealer 1	Model A	7A0434	12-Jan-08		Phan	N.	3101700539144	0	Active BO
Dealer 1	Model A	7A0425	13-Jan-08		Suda	P.	3101500383922	0	Active BO

Table 4.5: Example of Active Back Order Case 2

- **Customer ID Verification:**

This step is to verify Customer ID data which is obtained after each Booking as the prevention of key-in error of salesman or even Shop around habit of customer.
The logic of ID will be checked whether it is correct or not which detailed procedure will be explained briefly as followed.

Logic of ID Verification will be done on the first 12 digits of number from the total of Thai nationality person ID of 13 digits of number which the last digit shall be calculated by modular arithmetic method from the first 12 digits. Let the first digit equals to N1, 2nd digit is N2 and so on until it reaches N12 then N13 is the result of the arithmetic which will be the key indicator to verify whether this ID is real or not. ID Verification of Thai national ID modular arithmetic can be expressed as follows:

$$x = (\sum_{i=1}^{i=12} (14-i)N_i) \,(\mathrm{mod} 11)$$

$$x = (13N_1+12N_2+11N_3+10N_4+9N_5+8N_6+7N_7+6N_8+5N_9+4N_{10}+3N_{11}+2N_{12}) \,(\mathrm{mod} 11)$$

$$N_{13} = \begin{cases} 1-x, & \text{if } x \leq 1 \\ 11-x, & \text{if } x > 1 \end{cases}$$

(Resource from http://www.thaicreate.com/community/thai-id-card.html)

For example, let customer equals to **1201541462234** then the following steps will illustrate the proper logic of ID verification:

Step1: Separate 12 digits independently as follows (ignore the 13th digit):

1	**2**	**0**	**1**	**5**	**4**	**1**	**4**	**6**	**2**	**2**	**3**

Step 2: Multiply those numbers in step 1 with the following multipliers of 13, 12, 11,…, 2.

13	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**

By,

ID	**1**	**2**	**0**	**1**	**5**	**4**	**1**	**4**	**6**	**2**	**2**	**3**
Multiplier	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**
Result	**13**	**24**	**0**	**10**	**45**	**32**	**7**	**24**	**30**	**8**	**6**	**6**

Step 3: Add those 12 numbers from the result of multiplication above:

13+24+0+10+45+32+7+24+30+8+6+6=205

Step 4: Use the result from step 3, which is 205 and take mod 11 then the result is 7.

Step 5: Use 11 and minus by the result of Step 4 which is 7.

11-7= 4

4 is the result which should be exactly the same with 13th digit the customer ID number. As in this case, it can be verified that this logic is real since customer ID in this case is 1201541462234.

In the case of the result obtained from Step 5 has two digits, the second digit will be used to verify the logic of ID, e.g. 11 (1 will be used) or 10 (0 will be used).

From causes of Inaccurate Back Order Data concerning Customer ID can be classified into **2** categories namely:

- **Non-Duplication ID**

This represents non-existing or fake ID which has no concern of duplication. This verification can enhance the ability to filtering out misleading Back order from key-in error of salesman and also for the intentionally enter of fake ID.

Back Order data which fake ID found with wrong logic will be deleted from the system before data is used for allocation.

Example of fake ID customer elimination from end of January 2008 data is shown below.

Dealer Name	Series	Booking No	Booking Date	Customer Name	Customer Family Name	Customer ID	Check Digit 13rd by Formula	Check
Dealer 1	Model A	7A0028	11-Jan	Rungnapa	W.	5220600001911	1	correct
Dealer 2	Model A	7A0078	19-Jan	Sukanya	K.	5190300004621	1	correct
Dealer 3	**Model A**	**7A0107**	**22-Jan**	**Buajum**	**S.**	**5169900016121**	**2**	**wrong**
Dealer 4	Model A	7A0024	15-Jan	Teerasit	D.	5102099018057	7	correct
Dealer 5	Model A	7A0365	12-Jan	Thanawut	T.	5101700012215	5	correct

Table 4.6: Example of Fake ID Customer Elimination

At Dealer 3, for Booking Number 7A0107 which is from Khun Buajum with ID number of 5169900016121 will be eliminated from the system since after logic is checked, the result is 2 which is not the same with the last ID digit of Khun Buajum which is 1 therefore this can be considered as inaccurate data will be deleted from the system before data is used for allocation.

- **Duplication ID**

This is the duplication of ID which occurs in the same dealer and also in multiple dealers. This verification step can filter out Double Booking from key-in error of salesman and also for shop around habit of customer. Two characteristics of duplication ID is explained as the following example:

Dealer Name	Series	Booking No	Booking Date	Customer Name	Customer Family Name	Customer ID	Check Digit 13rd by formula	Check
Dealer 1	Model A	7A0015	5-Jan	Suradech	S.	3830100037043	3	correct
Dealer 2	Model A	7A0150	16-Jan	Saimai	A.	3820500120835	5	correct
Dealer 3	**Model A**	**7A0301**	**11-Jan**	**Nittaya**	**T.**	**3830300375651**	**1**	**correct**
Dealer 3	**Model A**	**7A0303**	**11-Jan**	**Nittaya**	**T.**	**3830300375651**	**1**	**correct**
Dealer 4	Model A	7A0166	31-Jan	Sarayut	R.	3819900157106	6	correct
Dealer 5	Model A	7A0111	31-Jan	Thinee	H.	3739900068821	1	correct
Dealer 6	**Model A**	**7A0051**	**19-Jan**	**Sak**	**N.**	**3730601000178**	**8**	**correct**
Dealer 7	**Model A**	**7A0205**	**31-Jan**	**Sak**	**N.**	**3730601000178**	**8**	**correct**
Dealer 8	Model A	7A0113	26-Jan	Saijai	O.	3730600976783	3	correct

Table 4.7: Example of Duplication ID Customer Elimination

For identical ID with 2 Bookings at the same dealer which caused by key-in error of salesman, one Booking which has the same ID will be canceled out after the reconfirmation process of salesman. Basically, the reconfirmation process of salesman will be done after sales planning has gathered and summarized the list of duplication of ID with 2 Bookings which sales planning will feed this information back to dealers for the reconfirmation of salesman. The necessity of this process comes around from the reason of some customers may want to buy two or more cars at the same time either with the same dealer or otherwise. Example is shown in Table 4.7, Dealer 3 faced the same situation of Booking Double which has identical name and ID keyed-in the same day.

For identical ID with booking at the different dealer from the bad habit of customer shop around for better deal of price or special campaign, the first booking will be eliminated from the system after the reconfirmation process of salesman same as the case of identical ID with two Booking at the same dealer. Example is shown in Table 4.7, Khun Sak with ID of 3730601000178 has 2 bookings at two dealers

namely Dealer 6 on January 19th and Dealer 7 on January 31st then the first booking at Dealer 6 will be deleted.

From the above verification methods and procedures, process of Back Order Data Verification can be illustrated as the following process flowchart in Figure 4.7.

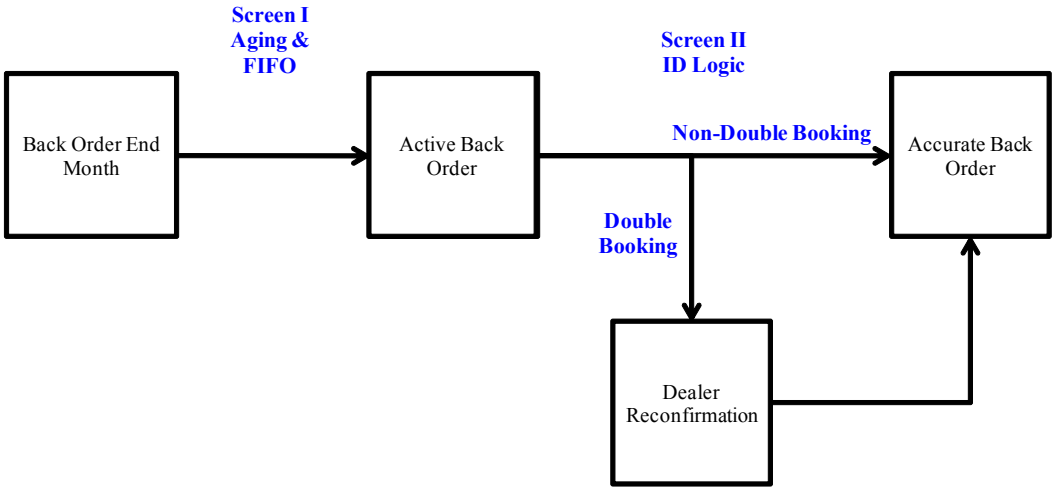


Figure 4.7: Process of Data Verification

In summary, Back Order data will be downloaded out from SMCDS system and screened by aging of Back Order and FIFO Verification firstly for Active Back Order data. Then, Customer ID Logic Verification will be employed to screen out wrong ID logic and Double Booking after reconfirmation from Dealers to obtain the most accurate Active Back Order data for allocation. In the end, effective Back Order data of real demand can now be used for Vehicle Allocation of each dealer nationwide and match with the actual demand fairly.

4.3 Procedure of Propose Allocation Method

- **Time Frame of Allocation**

As mentioned in Chapter 3, Vehicle allocation will start after the confirmation of production plan from production planning department on the 17th of every month, sales planning department will use this number to calculate dealer allocation of the next coming month. Sales planning department will provide dealers with suggest

order through SMCDS system on the 20th of every month. (Refer to Figure 3.6 Monthly Operations)

- **Data Requirement for Allocation**

To allocate the vehicle for N month, Demand from the day of allocating calculation to the end of N month will be forecasted in order to foresee the requirement of vehicle from each dealer. This Demand forecasted figure will be used to calculate the supply to each dealer in consideration of fairness and balance allocation. Figure 4.8 illustrates the Demand and Supply of dealer allocation in quantitative bar charts for period of the 17th of N-1 month to the end of N month. Point A to Point E will be focused for allocation. Point A, B and C which are located at Demand bar representing the vehicle demand of customer awaiting their vehicles for N month and for Point D and E which are located at Supply bar representing stock of vehicles in each dealer together with the numbers of vehicle expected to receiving by each dealer in the period of the 18th of N-1 month until the end of N month. Detailed explanation point by point will be discussed in the next following sections:

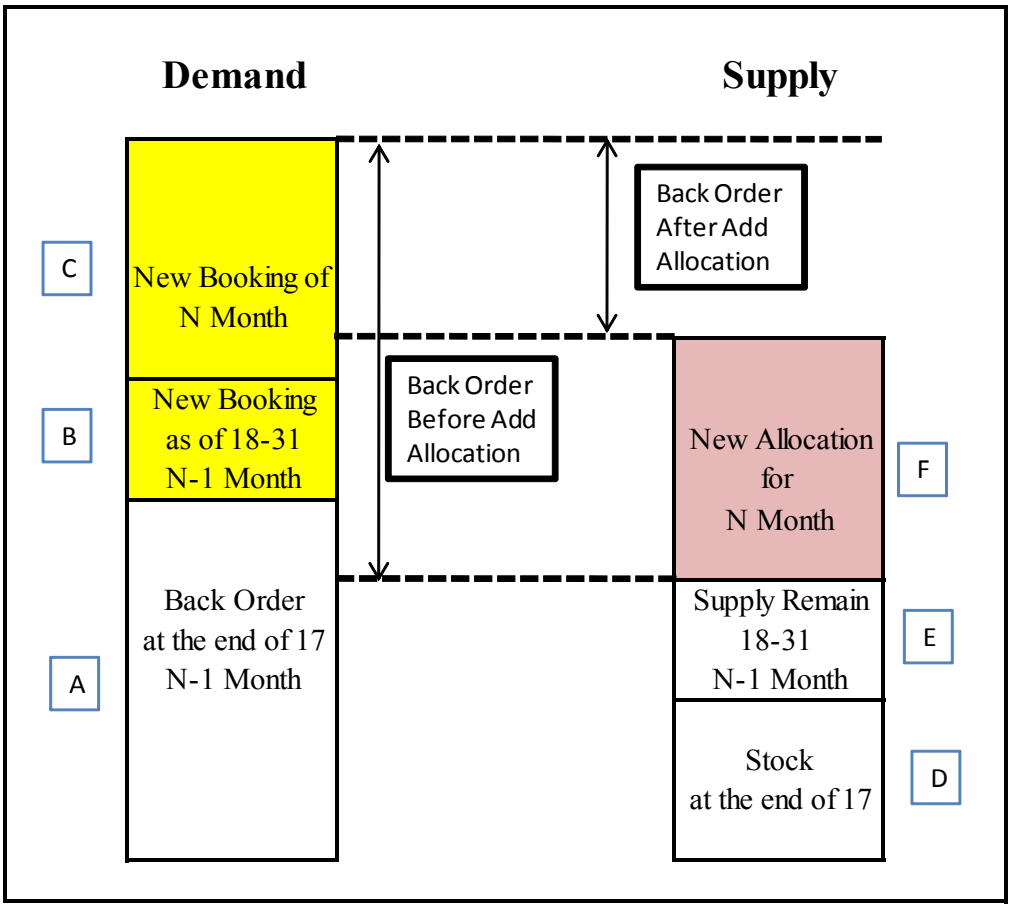


Figure 4.8: Demand and Supply Figure after Vehicle Allocation

- **Demand Area**

Point A illustrates Back order at the end of 17th of the Current month (N-1 month). After getting the production confirmation, Sales Planning will start to calculate the allocation for N month (Next month) around the 18th from the used of Back order at the end of the 17th generating by SMCDS System. This Back Order data must be verified before the calculation of Allocation as mentioned in Section 4.2.3 by Macro programming in Excel to generate the data report as shown in Table 4.8 after the verification. This task is responsible by one person for data verification and preparation.

	A	B	C=A-B	D	E	F	G	H=D+F+G	I=B+H	J=A-I
Dlr Name	Total BO	Long Aging	Active BO	Non duplication		Duplication		Active Inaccurate	Est. BO	
	Total	Total	Total	Wrong logic	Correct logic	Shoparound	Double		Non-Active	Accuracy
Dealer 1										
Dealer 2										
Dealer 3										
Dealer 4										
Dealer 5										
Dealer 6										
. . .										
Total										

Table 4.8: Back Order Verification Form

Point B illustrates New Booking during the period of 18th – 31st of N-1 month which is forecasted by Moving Average methodology with Seasonal index in consideration (refer to Chapter 2). This method will provide the data of Booking for the entire N-1 month therefore the deduction of data of Booking from 1st – 17th of the month is necessary in order to obtain the New Booking data only for 18th -31st.

To obtain the forecast of New Booking of N-1 month, Past 3 months record of booking in each dealer generated from SMCDS system (See in Appendix) will be averaged and this average of past 3 months record of booking is used to divide the average of Seasonal index of those past 3 months in order to get the real average of Booking with the deduction of effects of the seasonal factor. Finally, the multiplication of the real average of booking and Seasonal index of N-1 Month will provide the result of N-1 month forecast of Booking.

The Actual example of how to obtain New Booking during the period of 18th – 31st of N-1 month by Moving Average methodology with Seasonal index in consideration is shown in the following section:

Moving average Forecasting Method is one of the well-known forecast methodology nowadays which the actual data is used to forecast with the used of Moving Average-M.A. calculation.

$$\textbf{MOVING AVERAGE} = \sum \textbf{(Demand for n period)/n}$$

Where **n** is the number of months for forecast which 3 months is used in this case. The reason why 3 months are used for moving average is because of the high fluctuation in demand of automobile business which anything could happen; in the certain month, sales could be at the bottom but next month, the record high sales could also be expected. Therefore, the optimum of months for moving average must be found with one condition; i.e. it shall not be too long since the data can be misleading from the fluctuation. The experiment to find the optimum had been carried out as shown in Table 4.9 for 3, 4 and 5 months for the data of dealers in the metropolitan area. The data of metropolitan area is tested because it has the most suitable set of demand for such an experiment. It is found that 3 months is the most suitable figure for the Moving Average Forecast Method for this paper since Mean Absolute Percent Error (MAPE) is the least which can be review in Chapter 2 of Literature Review.

	Booking of Dec08			Mean Absolute Percent Error		
Dealer Name	n=3	n=4	n=5	n = 3	n = 4	n = 5
Dealer 1	32	30	29	8.6%	14.3%	17.1%
Dealer 2	24	22	21	20.0%	26.7%	30.0%
Dealer 3	11	11	10	26.7%	26.7%	33.3%
Dealer 4	7	7	9	65.0%	65.0%	55.0%
Dealer 5	20	18	21	55.6%	60.0%	53.3%
Dealer 6	12	12	13	7.7%	7.7%	0.0%
Dealer 7	165	165	167	2.9%	2.9%	1.8%
Dealer 8	55	53	62	35.3%	37.6%	27.1%
Dealer 9	78	70	75	25.7%	33.3%	28.6%
Dealer 10	44	38	40	4.8%	9.5%	4.8%
Dealer 11	2	1	2	33.3%	66.7%	33.3%
Dealer 12	39	35	35	29.1%	36.4%	36.4%
Dealer 13	17	13	15	26.1%	43.5%	34.8%
Dealer 14	5	4	5	61.5%	69.2%	61.5%
Dealer 15	39	32	35	13.3%	28.9%	22.2%
Dealer 16	12	11	13	50.0%	54.2%	45.8%
Dealer 17	27	23	23	6.9%	20.7%	20.7%
Dealer 18	13	12	13	45.8%	50.0%	45.8%
Dealer 19	5	4	5	37.5%	50.0%	37.5%
Dealer 20	6	5	5	33.3%	44.4%	44.4%
Dealer 21	7	7	8	50.0%	50.0%	42.9%
Dealer 22	11	11	11	57.1%	57.1%	57.1%
Dealer 23	4	5	6	20.0%	0.0%	20.0%
Dealer 24	20	22	23	37.5%	31.3%	28.1%
Dealer 25	5	4	4	76.2%	81.0%	81.0%
Dealer 26	28	27	27	26.3%	28.9%	28.9%
Dealer 27	7	7	9	16.7%	16.7%	50.0%
Dealer 28	17	17	16	10.5%	10.5%	15.8%
Dealer 29	5	6	7	66.7%	60.0%	53.3%
Dealer 30	13	12	9	13.3%	20.0%	40.0%
Dealer 31	24	22	23	4.0%	12.0%	8.0%
Dealer 32	7	6	6	46.2%	53.8%	53.8%
Dealer 33	5	6	9	0.0%	20.0%	80.0%
Total	**766**	**718**	**756**	**30.7%**	**36.0%**	**36.1%**

Table 4.9: Experiment of Optimum Finding by Mean Absolute Percent Error (MEPE)

Seasonal index is calculated from the data of Booking in the past 3 years of every dealer. This figure will reflect the seasonal trend of high and low seasons of the demand in each dealer. The method of calculation is explained in Chapter 3 but in this part booking data is used instead of Retail sales.

Example of Model A Forecast Booking of N-1(Dec) of Dealer A is shown below. Data from Table 4.10 is obtained from 3 months past record of Model A Booking and Seasonal index to forecast for N-1 month and N month.

	N-4	N-3	N-2		N-1	N
	Sep	Oct	Nov	Average 3 Mth	Dec07	Jan08
Past record 3month	50	55	60	55	76	50
Seasonal Index	85.98%	85.09%	98.65%	89.91%	124.16%	80.99%

Table 4.10: Example of Moving Average Forecasting by Considering Seasonal Index

Average Past Booking record 3 month = [50+55+60] / 3 = 55 units

Average Seasonal Index 3 month = [85.98%+85.09%+98.65%] / 3 = 89.91%
Average Booking 3 month without Seasonal = 55 / 89.91% = 61 units
Forecast Booking of N-1 (Dec) = 61 x 124.16% = 76 Units

The calculation result of 76 units which is the Forecast Booking of N-1 month (Dec, will be deducted by the actual booking from the period of the 1^{st} – 17^{th} in order to get the figure of forecast booking for the period of the 18^{th}- 31^{st}, e.g. if Booking at Dealer A for the period of the 1^{st} – 17^{th} of December was 45 units, the Forecast Booking from the period of the 18^{th} -31^{st} is 76 -45 = 31 units.

Point C shows New Booking of N month. To forecast Booking of N month, the same method of N-1 month Booking forecast can be used by taking the average of Booking for 3 months but to neglect the multiplication of the seasonal index of N month, e.g. if seasonal index of Jan (N) is 80.99% (from Table 4.10) then the Forecast of Booking for Jan of Dealer A is 61 (from the above calculation of Average Booking 3 month without Seasonal) x 80.99% = 50 units.

- **Supply Area**

Point D illustrates the stock at the end of 17th of N-1 month. This data can be obtained from SMCDS system which shows the inventory stock in each dealer awaiting delivery.

Point E illustrates the Supply remaining during the period of 18th -31st. This data is actually the expected supply which dealer will receive during the period of 18th -31st of N-1 month, e.g. if Company A allocated the supply for this dealer in the number of 40 units for N-1 month and dealer has already received 25 units of vehicle as of 17th therefore the expected supply which dealer will receive during the period of 18th -31st is 40-25 = 15 units.

In summary, Point A to E in Figure 4.8 illustrates the quantitative data for Demand and Supply which are used for calculation of Vehicle Allocation of N month. Vehicle Allocation of N month actually is Point F in Figure 4.8. If good and effective Allocation is in place, the remaining Back Order after the supply comes in for the N month shall be in the same level nationwide. Thus, in Figure 4.8 of Propose Method vehicle allocation, data of Back Order before Allocation will be used for the calculation of the proportion between each dealer nationwide and this proportion will be used to calculate the Allocation of N month for each dealer which will be explained in the next section.

- **Calculation Process**

To conduct Vehicle Allocation calculation for N month of each dealer, Back Order before allocation will be employed to find the proportion of each dealer nationwide. Back Order before allocation which was preliminary referred to earlier in this chapter simply comes from the summation of all the demand minus the actual supply. Demand in this case is the summation of the Back Order data at the end of the 17th of N-1 month, New Booking Forecast in the period of the 18th to 31st of N-1 month, and Booking forecast of N month which actually are Point A, Point B and Point C in Figure 4.8 respectively, whereas Supply is the summation of Stock at the end of the 17th and the remain supply in the period of the 18th to 31st of N-1 month. Then, the

Back Order before allocation of each dealer can be obtained from this calculation. Next step is to find the proportion between Back Order before allocation and total volume of Back Order before allocation nationwide. This proportion of Back Order will be used for the allocation by simply to multiply with the total volume of vehicles available for allocation in N month. Table 4.11 is the propose format of table for allocation.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
	Demand																Supply					
DEALER	Back Order Verification at 17 Dec	Booking Record				Seasonal Index				Seasonal Dec	Booking Plan in Dec	Booking Dec 1-17	Booking Remain 18-31	Seasonal Jan	Booking Plan in Jan	Total Demand	Remain Supply		Total Supply	Back Order Remain	Back Order Remain Ratio	Allocation Jan
		Sep	Oct	Nov	Average	Sep	Oct	Nov	Average								Stock	Supply Remain 18-31				
A	50	20	15	25	20	86	90	100	92	110	24	10	14	80	17	81	15	2	17	64	29.7%	**30**
B	60	30	25	30	28	90	80	110	93	120	36	15	21	70	21	103	20	3	23	80	36.8%	**37**
C	20	10	15	20	15	75	90	110	92	115	19	15	4	85	14	38	10	2	12	26	11.9%	**12**
D	10	5	10	15	10	85	90	120	98	110	11	5	6	75	8	24	5	4	9	15	6.8%	**7**
F	30	15	20	25	20	90	120	100	103	100	19	15	4	90	17	52	15	5	20	32	14.7%	**15**
Total	**170**	**16**	**17**	**23**	**19**	**85**	**94**	**108**	**96**	**111**	**110**	**60**	**50**	**80**	**78**	**297**	**65**	**16**	**81**	**216**	**100.0%**	**100**

Table 4.11: Propose Allocation Format

From the example of proposed allocation table of January 2008 in Table 4.11, the allocations for 5 selected dealers are used to illustrate the Proposed Allocation method calculation. Column A to P are for the Demand and Column Q to S are for the Supply. The explanation of each main column is explained below:

Column A is the data of Back Order after the verification nationwide which in this case is 170 units.

Column E is the average booking of the past 3 months record which in this case are September to November.

Column I is the average of Seasonal index of the past 3 months record.

Column J and N are the Seasonal index of December and January respectively.

Column K and O are the forecast Booking plan of December and January which can be calculated by the following formula:

$$\text{Forecast Booking plan in December (for Dealer A)} = \frac{\text{Column E}}{\text{Column I}} \times \text{Column J}$$

$$= \frac{20}{92} \times 110$$

$$= 24$$

$$\text{Forecast Booking plan in January (for Dealer A)} = \frac{\text{Column E}}{\text{Column I}} \times \text{Column N}$$

$$= \frac{20}{92} \times 80$$

$$= 17$$

Column L is the actual Booking during the 1st to 17th of December.

Column M is the remaining of Booking during the period of December18th to 31st (N-1 month) which can be calculated by the following formula:

$$\text{Remaining of Booking for N-1 month} = \text{Column K} - \text{Column L}$$

$$= 24 - 10$$

$$= 14$$

Column P shows the total demand from the summation of the Back Order data at the end of the 17th of N-1 month, New Booking Forecast in the period of the 18th to 31st of N-1 month, and Booking forecast of N month, e.g. total Demand of Dealer A is 50+14+17 = 81which is point A, B, and C in Figure 4.8.

Column S shows the total Supply from the summation of Stock at the end of the 17th (Column Q) and the remaining supply in the period of the 18th to 31st of N-1 month (Column R) which data in Column Q and R are generated from SMCDS system, e.g. Total Supply of Dealer A is 15+2 = 17units. So Back Order after allocation is Demand minus Supply which is Column P minus Column S, then Back Order after Allocation or the remaining of Back Order for Dealer A is 81-17 = 64 units. After calculate Back Order remain of all dealer, After the calculation of the remaining of Back Order of all dealers, the proportion of the remaining of Back Order of each

dealer nationwide is calculated, e.g. For Dealer A, the remaining of Back Order ratio is 64/216 = 29.7%. This ratio will be used for vehicle allocation to each dealer by multiply with the total amount of vehicles which Company A will allocate for each dealer nationwide, e.g. If Company A to allocate 100 units of vehicle for each Dealer nationwide for the month of January, the Dealer A will be allocate with 29.7% x 100 = 30 units.

- **Proposed Vehicle Distribution Method**

New vehicle distribution method for this proposed model is to conduct the dealer distribution by considering the aging of Back order. Therefore, long aging back order will be listed in numerical order from the longest to the lowest then the dealer who has the longest aging back order will be distributed first. As shown in Table 4.12, an example of distribution queuing list of dealers, e.g. If dealer 1 to be allocated with 3 vehicles, dealer 2 to be allocated with 3 vehicles, dealer 3 to be allocated with 2 vehicles, dealer 4 to be allocated with 4 vehicles, then these four dealers will be put in numerical order of long aging back order queue awaiting the distribution. Thus, dealer 4 will get the first 3 vehicles; dealer 2 will get the next 2 vehicles following by dealer 1 with 1 vehicle, dealer 2 with 1 more vehicle to complete 3 allocated vehicles, then dealer 3 with one more vehicle, and etc.

Dealer	Booking No	Aging of BO (DAYs)
Dealer 1	7A0007	7
Dealer 1	7A0010	10
Dealer 1	7A0015	15
Dealer 2	7A0014	14
Dealer 2	7A0020	20
Dealer 2	7A0030	30
Dealer 3	7A0002	2
Dealer 3	7A0012	12
Dealer 4	7A0005	5
Dealer 4	7A0035	35
Dealer 4	7A0040	40
Dealer 4	7A0045	45

Dealer	Booking No	Aging of BO (DAYs)
Dealer 4	7A0045	45
Dealer 4	7A0040	40
Dealer 4	7A0035	35
Dealer 2	7A0030	30
Dealer 2	7A0020	20
Dealer 1	7A0015	15
Dealer 2	7A0014	14
Dealer 3	7A0012	12
Dealer 1	7A0010	10
Dealer 1	7A0007	7
Dealer 4	7A0005	5
Dealer 3	7A0002	2

Table 4.12: Example of Vehicle Distribution Method

For the aging of back order for dealers who located in the South, North, and Northeast regions will be added with 2 extra days for longer destination distribution.

4.4 Implementation of Proposed Allocation Method

The implementation of Proposed Allocation Method in this thesis will employ the usage of actual data of Model A allocation in January 2008. First of all, Back Order will be verified as explained earlier in Section 4.2 by Excel as shown in Table4.13.

	A	B	C=A-B	D	E	F	G	H=D+F+G	I=B+H	J=A-I
Dlr Name	Total BO	Long Aging	Active BO	Non duplication		Duplication		Active Inaccurate	Est. BO	
	Total	Total	Total	Wrong logic	Correct logic	Shop-around	Double		Non-Active	Accuracy
Dealer 1	120	12	108	5	103	10	2	17	29	91
Dealer 2	36	4	32	2	24	7	3	12	16	20
Dealer 3	30	3	27	2	25	3		5	8	22
Dealer 4	35	4	31		29	6		6	10	25
Dealer 5	70	8	62	3	60	6	1	10	18	52
Dealer 6	75	9	66		67	7	1	8	17	58
Dealer 7	310	32	278	10	236	14	50	74	106	204
Dealer 8	100	12	88	5	65	15	15	35	47	53
Dealer 9	90	10	80	4	60	16	10	30	40	50
Dealer 10	100	12	88	3	82	10	5	18	30	70
Dealer 11	15	2	13		13	2		2	4	11
Dealer 12	65	7	58	1	54	9	1	11	18	47
Dealer 13	40	4	36	1	38	1		2	6	34
Dealer 14	15	1	14		15				1	14
Dealer 15	90	10	80	5	77	6	2	13	23	67
Dealer 16	29	3	26		25	4		4	7	22
Dealer 17	54	6	48	1	41	2	10	13	19	35
Dealer 18	20	2	18		19	1		1	3	17
Dealer 19	25	3	22		22	3		3	6	19
Dealer 20	30	3	27		29	1		1	4	26
Dealer 21	60	7	53	5	48	7		12	19	41
Dealer 22	23	2	21		22	1		1	3	20
Dealer 23	16	1	15		12	4		4	5	11
Dealer 24	30	2	28		25	2	3	5	7	23
Dealer 25	30	3	27		23	4	3	7	10	20
Dealer 26	85	10	75	2	78	4	1	7	17	68
Dealer 27	20	2	18		19		1	1	3	17
Dealer 28	30	3	27		30				3	27
Dealer 29	15	1	14		12	2	1	3	4	11
Dealer 30	4		4		2	1	1	2	2	2
Dealer 31	30	3	27		29	1		1	4	26
Dealer 32	32	3	29		27	3	2	5	8	24
Dealer 33	55	5	50		53	2		2	7	48
Dealer 34	3		3		3					3
Dealer 35	8	1	7		7	1		1	2	6
Dealer 36	2		2		2					2
Dealer 37	10	1	9		10				1	9
Dealer 38	6		6		6					6
Dealer 39	3		3		2	1		1	1	2
Dealer 40	5	1	4		5				1	4
Dealer 41	3		3		3					3
Dealer 42	10		10		10					10
Dealer 43	15	2	13		14	1		1	3	12
Dealer 44	20	3	17	1	17	1	1	3	6	14
Dealer 45	4		4		4					4
Dealer 46	17		17		17					17
Dealer 47	20	2	18	1	18		1	2	4	16
Dealer 48	16	1	15	1	15			1	2	14
Dealer 49	4		4		4					4
Dealer 50	20	2	18		17	1	2	3	5	15
Dealer 51	5		5		4	1		1	1	4
Dealer 52	1		1		1					1
Dealer 53	2		2		2					2
Dealer 54	8	1	7		8				1	7
Dealer 55	40	5	35	2	33		5	7	12	28
Dealer 56	45	2	43	3	40	2		5	7	38
Dealer 57	40	3	37	2	33		5	7	10	30
Dealer 58	15	2	13		15				2	13
Dealer 59	4		4		4					4
Dealer 60	19	2	17	1	16		2	3	5	14
Dealer 61	10	1	9		10				1	9
Dealer 62	2		2		2					2

	A	B	C=A-B	D	E	F	G	H=D+F+G	I=B+H	J=A-I
Dlr Name	Total BO	Long Aging	Active BO	Non duplication		Duplication		Active Inaccurate	Est. BO	
	Total	Total	Total	Wrong logic	Correct logic	Shop-around	Double		Non-Active	Accuracy
Dealer 63	5		5		5					5
Dealer 64	2		2		2					2
Dealer 65	3		3		3					3
Dealer 66	5		5		4		1	1	1	4
Dealer 67	20	3	17	2	16	2		4	7	13
Dealer 68	10	1	9		10				1	9
Dealer 69	2		2		2					2
Dealer 70	3		3		2	1		1	1	2
Dealer 71	25	3	22	1	20	2	2	5	8	17
Dealer 72	2		2		2					2
Dealer 73	4		4		4					4
Dealer 74	1		1		1					1
Dealer 75	3		3		3					3
Dealer 76	3		3		3					3
Dealer 77	18	2	16	1	16	1		2	4	14
Dealer 78	12	1	11		10	1	1	2	3	9
Dealer 79	10	1	9		10				1	9
Dealer 80	1		1		1					1
Dealer 81	15	1	14		14	1		1	2	13
Dealer 82	23	2	21	1	21	1		2	4	19
Dealer 83	13	1	12		10	2	1	3	4	9
Dealer 84	5		5		5					5
Dealer 85	3		3		3					3
Dealer 86	1		1		1					1
Dealer 87	25	6	19	2	22		1	3	9	16
Dealer 88	1		1		1					1
Dealer 89	8	1	7		8				1	7
Dealer 90	3		3		3					3
Dealer 91	1		1		1					1
Dealer 92	2		2		2					2
Dealer 93	13	1	12		13				1	12
Dealer 94	11		11		10	1		1	1	10
Dealer 95	3		3	1	2			1	1	2
Dealer 96	2		2		2					2
Dealer 97	10	2	8		10				2	8
Dealer 98	1		1		1					1
Dealer 99	1		1		1					1
Dealer 100	1		1		1					1
Dealer 101	6	1	5		6				1	5
Dealer 102	1		1		1					1
Dealer 103	5		5		5					5
Dealer 104	6		6		6					6
Dealer 105	12	1	11		12				1	11
Dealer 106	10	1	9	1	8	1		2	3	7
Dealer 107	1		1		1					1
Dealer 108	40	7	33	2	35	1	2	5	12	28
Dealer 109	7	1	6		7				1	6
Dealer 110	4		4		4					4
Dealer 111	7		7		6	1		1	1	6
Dealer 112	4		4		3	1		1	1	3
Dealer 113	8	2	6		8				2	6
Dealer 114	7		7		7					7
Dealer 115	10		10	1	7	1	1	3	3	7
Dealer 116	15	2	13	1	13		1	2	4	11
Dealer 117	6		6		6					6
Dealer 118	3		3		3					3
Dealer 119	4		4		3	1		1	1	3
Metro	1,779	189	1,590	49	1,464	154	112	315	504	1,275
Central	357	29	328	11	322	8	16	35	64	293
North	144	12	132	4	128	8	4	16	28	116
North-East	145	14	131	4	135	4	2	10	24	121
South	138	14	124	5	123	6	4	15	29	109
Grand Total	2,563	258	2,305	73	2,172	180	138	391	649	1,914

Table 4.13: Actual Verified Back Order as of December 17th, 2007

From Table 4.13, from the data of 17th Dec 2007, total Back Order is 2,563 units after verification, founded that there are 258 units of Long Aging Back Order, 73 units of

Wrong ID Logic, 180 units of total Customer Shop around, and 138 units of total of ID Duplication, then Total of estimated accuracy Back Order is 1,914 units which is shown in Figure 4.9

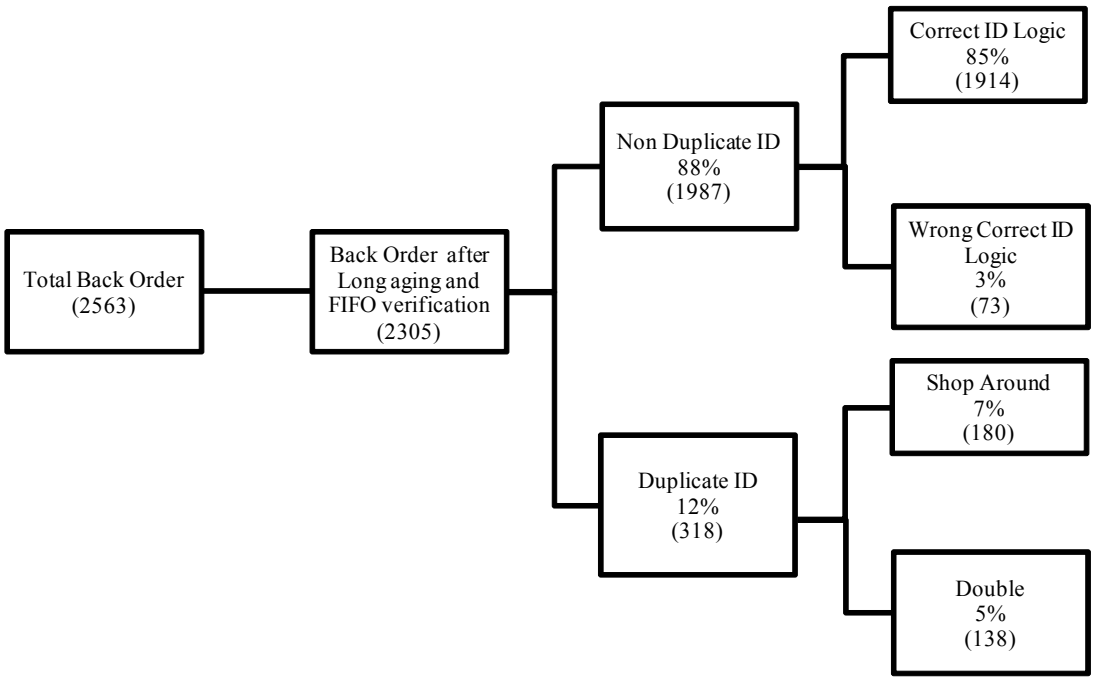


Figure 4.9: Model A Back Order Data Structure of January 2008

Then, Accuracy Back Order and all data that need to use will be used to calculate allocation by filling in table of proposed allocation format, see in Table 4.13.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
									Demand								Supply					
DEALER	Back Order Verification at 17 Dec	Booking Record (verification)				Seasonal Index				Seasonal Dec	Booking Plan in Dec	Booking Dec 1-17	Booking Remain 18-31	Seasonal Jan	Booking Plan in Jan	Total Demand	Remain Supply Stock as 17 Dec	Supply Remain 18-31	Total Supply	Back Order Remain	Back Order Remain Ratio	Allocation Jan
		Sep	Oct	Nov	Average	Sep	Oct	Nov	Average													
Dealer 1	91	55	102	60	72	181.9%	128.0%	87.0%	132.3%	123.5%	67	30	37	119.6%	65	193	38	11	49	144	4.8%	**47**
Dealer 2	20	23	38	65	42	90.6%	124.0%	145.9%	120.2%	108.7%	38	17	21	78.2%	27	68	14	4	18	50	1.7%	**16**
Dealer 3	22	19	20	21	20	123.0%	103.6%	99.3%	108.6%	120.9%	22	10	12	95.0%	17	51	10	3	13	38	1.3%	**12**
Dealer 4	25	9	18	21	16	106.7%	121.2%	140.6%	122.8%	128.5%	17	8	9	53.3%	7	41	8	2	10	31	1.0%	**10**
Dealer 5	52	29	38	35	34	116.7%	105.6%	112.5%	111.6%	158.3%	48	30	18	75.0%	23	93	20	6	26	67	2.2%	**22**
Dealer 6	58	21	24	33	26	107.6%	98.3%	127.5%	111.1%	181.3%	42	19	23	86.0%	20	101	20	6	26	75	2.5%	**25**
Dealer 7	204	222	246	142	203	115.9%	118.4%	91.7%	108.7%	142.4%	266	120	146	100.8%	188	538	106	32	138	400	13.3%	**132**
Dealer 8	53	113	123	73	103	128.8%	111.1%	91.2%	110.4%	145.7%	136	61	75	108.1%	101	229	45	13	58	171	5.7%	**57**
Dealer 9	50	71	120	103	98	102.9%	111.4%	105.8%	106.7%	126.4%	116	52	64	100.1%	92	206	40	12	52	154	5.1%	**51**
Dealer 10	70	46	62	38	49	117.8%	102.0%	94.9%	104.9%	126.6%	59	27	32	57.1%	27	129	25	8	33	96	3.2%	**32**
Dealer 11	11	5	7	11	8	94.6%	84.6%	129.5%	102.9%	149.4%	12	5	7	119.5%	9	27	5	2	7	20	0.7%	**7**
Dealer 12	47	33	24	48	35	94.2%	75.9%	121.7%	97.3%	198.9%	72	32	40	48.4%	17	104	20	6	26	78	2.6%	**26**
Dealer 13	34	15	9	14	13	112.9%	89.1%	133.7%	111.9%	240.6%	28	15	13	50.5%	6	53	11	3	14	39	1.3%	**13**
Dealer 14	14	16	11	6	11	89.4%	137.9%	100.6%	109.3%	141.6%	14	6	8	82.0%	8	30	6	2	8	22	0.7%	**7**
Dealer 15	67	56	67	41	55	92.0%	110.2%	94.2%	98.8%	121.2%	67	25	42	91.2%	51	160	30	9	39	121	4.0%	**41**
Dealer 16	22	19	8	20	16	155.4%	72.7%	112.4%	113.5%	135.5%	19	9	10	66.1%	9	41	8	2	10	31	1.0%	**10**
Dealer 17	35	32	41	27	33	144.8%	124.8%	146.5%	138.7%	129.8%	31	14	17	79.9%	19	71	14	4	18	53	1.8%	**17**
Dealer 18	17	11	10	10	10	104.7%	148.4%	109.1%	120.7%	148.4%	12	5	7	56.7%	5	29	6	2	8	21	0.7%	**7**
Dealer 19	19	14	23	12	16	107.6%	143.5%	75.0%	108.7%	133.7%	20	9	11	62.0%	9	39	8	2	10	29	1.0%	**10**
Dealer 20	26	6	19	5	10	98.0%	177.6%	98.0%	124.5%	165.3%	13	6	7	55.1%	4	37	7	2	9	28	0.9%	**9**
Dealer 21	41	20	8	15	14	90.9%	73.2%	117.6%	93.9%	124.2%	19	8	11	110.9%	17	69	13	4	17	52	1.7%	**17**
Dealer 22	20	11	18	9	13	75.6%	111.8%	114.9%	100.8%	163.2%	21	9	12	96.7%	12	44	9	3	12	32	1.1%	**11**
Dealer 23	11	9	15	6	10	119.1%	146.6%	96.2%	120.6%	160.3%	13	6	7	68.7%	6	24	5	1	6	18	0.6%	**6**
Dealer 24	23	17	24	34	25	67.1%	104.6%	132.6%	101.4%	195.1%	48	18	30	84.3%	21	74	14	4	18	56	1.9%	**18**
Dealer 25	20	13	17	23	18	111.2%	82.8%	131.9%	108.6%	230.2%	38	17	21	46.6%	8	49	9	3	12	37	1.2%	**12**
Dealer 26	68	22	36	30	29	103.6%	109.9%	111.2%	108.2%	224.8%	60	27	33	79.6%	21	122	24	7	31	91	3.0%	**30**
Dealer 27	17	9	12	12	11	124.9%	138.3%	93.7%	119.0%	124.9%	12	5	7	98.1%	9	33	6	2	8	25	0.8%	**8**
Dealer 28	27	9	19	13	14	68.2%	130.9%	103.6%	100.9%	207.3%	29	13	16	54.5%	8	51	10	3	13	38	1.3%	**12**
Dealer 29	11	9	13	11	11	141.7%	150.6%	106.3%	132.8%	84.1%	7	3	4	70.8%	6	21	4	1	5	16	0.5%	**5**
Dealer 30	2	14	15	13	14	108.7%	92.6%	128.9%	110.1%	124.8%	16	7	9	64.4%	8	19	4	1	5	14	0.5%	**5**
Dealer 31	26	16	20	9	15	154.6%	104.2%	144.5%	134.5%	154.6%	17	8	9	53.8%	6	41	8	2	10	31	1.0%	**10**
Dealer 32	24	12	13	6	10	105.1%	140.1%	100.7%	115.3%	105.1%	9	4	5	127.0%	11	40	8	2	10	30	1.0%	**10**
Dealer 33	48	9	5	17	10	88.9%	88.9%	278.8%	152.2%	97.0%	6	3	3	68.7%	5	56	11	3	14	42	1.4%	**14**
Dealer 34	3	7	9		8	134.4%	153.6%	86.4%	124.8%	105.6%	7	3	4	105.6%	7	14	3	1	4	10	0.3%	**3**
Dealer 35	6	11	5	4	7	107.9%	67.4%	87.6%	87.6%	222.5%	18	8	10	67.4%	5	21	4	1	5	16	0.5%	**5**
Dealer 36	2	5	4		5	161.2%	125.4%	0.0%	95.5%	35.8%	2	1	1	71.6%	4	7	1	0	1	6	0.2%	**2**
Dealer 37	9	3	10	2	5	84.6%	114.5%	74.7%	91.3%	164.3%	9	4	5	69.7%	4	18	4	1	5	13	0.4%	**4**
Dealer 38	6	5	4	3	4	100.8%	183.2%	100.8%	128.2%	174.0%	5	2	3	73.3%	2	11	2	1	3	8	0.3%	**3**
Dealer 39	2	2	3		3	121.3%	134.8%	121.3%	125.8%	94.4%	2	1	1	134.8%	3	6	1	0	1	5	0.2%	**2**
Dealer 40	4	1	5	4	3	188.8%	161.8%	148.3%	166.3%	53.9%	1	0	1	40.4%	1	6	1	0	1	5	0.2%	**2**
Dealer 41	3		2		2	120.0%	96.0%	96.0%	104.0%	192.0%	4	2	2	96.0%	2	7	1	0	1	6	0.2%	**2**
Dealer 42	10	8	2	7	6	144.5%	94.2%	144.5%	127.7%	75.4%	4	2	2	75.4%	4	16	3	1	4	12	0.4%	**4**
Dealer 43	12	1	2	2	2	136.1%	136.1%	74.2%	115.5%	160.8%	3	1	2	74.2%	1	15	3	1	4	11	0.4%	**4**
Dealer 44	14	10	13	14	12	106.8%	136.7%	175.1%	139.5%	119.6%	10	5	5	85.4%	7	26	5	2	7	19	0.6%	**6**
Dealer 45	4	6	7	9	7	116.8%	95.6%	244.2%	152.2%	138.1%	6	3	3	53.1%	2	9	2	1	3	6	0.2%	**2**
Dealer 46	17	5	10	7	7	94.7%	126.3%	145.3%	122.1%	126.3%	7	3	4	69.5%	4	25	5	1	6	19	0.6%	**6**
Dealer 47	16	5	5	5	5	139.1%	60.9%	113.0%	104.3%	130.4%	6	3	3	69.6%	3	22	4	1	5	17	0.6%	**6**
Dealer 48	14	5	5	1	4	173.3%	133.3%	120.0%	142.2%	120.0%	3	1	2	66.7%	2	18	4	1	5	13	0.4%	**4**
Dealer 49	4	6	4	1	4	140.3%	187.0%	77.9%	135.1%	46.8%	1	0	1	62.3%	2	7	1	0	1	6	0.2%	**2**
Dealer 50	15	3	3	3	3	126.8%	97.6%	107.3%	110.6%	136.6%	4	2	2	126.8%	3	20	4	1	5	15	0.5%	**5**
Dealer 51	4	5	8		7	150.0%	150.0%	75.0%	125.0%	62.5%	4	2	2	75.0%	4	10	2	1	3	7	0.2%	**2**
Dealer 52	1	4	4	5	4	124.1%	75.9%	82.8%	94.3%	103.4%	4	2	2	62.1%	3	6	1	0	1	5	0.2%	**2**
Dealer 53	2	4	2	3	3	186.2%	41.4%	82.8%	103.4%	165.5%	5	2	3	82.8%	2	7	1	0	1	6	0.2%	**2**
Dealer 54	7	8	7	4	6	139.5%	111.6%	97.7%	116.3%	104.7%	5	2	3	90.7%	5	15	3	1	4	11	0.4%	**4**
Dealer 55	28	11	9	6	9	110.2%	102.3%	110.2%	107.5%	118.0%	10	5	5	98.4%	8	41	8	2	10	31	1.0%	**10**
Dealer 56	38	21	18	13	17	124.0%	124.0%	80.6%	109.6%	114.7%	18	10	8	127.1%	20	66	13	4	17	49	1.6%	**16**
Dealer 57	30	11	24	14	16	105.2%	142.9%	132.1%	126.7%	110.6%	14	6	8	97.1%	12	50	10	3	13	37	1.2%	**12**
Dealer 58	13	5	6	7	6	76.7%	118.6%	153.5%	116.3%	118.6%	6	3	3	76.7%	4	20	4	1	5	15	0.5%	**5**
Dealer 59	4	4	5	6	5	98.0%	146.9%	318.4%	187.8%	146.9%	4	3	1	73.5%	2	7	2	0	2	5	0.2%	**2**
Dealer 60	14	5	4	2	4	242.3%	103.8%	69.2%	138.5%	103.8%	3	1	2	57.7%	2	18	4	1	5	13	0.4%	**4**
Dealer 61	9	3	5	1	3	125.2%	93.9%	114.8%	111.3%	125.2%	3	1	2	104.3%	3	14	3	1	4	10	0.3%	**3**
Dealer 62	2		1	2	1	100.0%	133.3%	66.7%	100.0%	133.3%	3	1	2	233.3%	5	9	2	1	3	6	0.2%	**2**
Dealer 63	5	9	5	4	6	111.1%	55.6%	88.9%	85.2%	94.4%	7	3	4	66.7%	5	14	3	1	4	10	0.3%	**3**
Dealer 64	2	3	0		2	369.2%	92.3%	0.0%	153.8%	92.3%	1	1	0	0.0%	0	2	1	0	1	1	0.0%	**1**
Dealer 65	3	3	3	11	6	101.7%	71.2%	172.9%	115.3%	122.0%	6	3	3	132.2%	7	13	3	1	4	9	0.3%	**3**
Dealer 66	4	2	1	4	2	122.0%	142.4%	183.1%	149.2%	81.4%	1	0	1	81.4%	1	6	1	0	1	5	0.2%	**2**
Dealer 67	13	5	4	1	3	115.4%	150.0%	92.3%	119.2%	184.6%	5	2	3	46.2%	1	17	3	1	4	13	0.4%	**4**
Dealer 68	9		4	1	3	61.0%	162.7%	101.7%	108.5%	183.1%	5	2	3	101.7%	3	15	3	1	4	11	0.4%	**4**
Dealer 69	2	3	5	4	4	61.0%	264.4%	81.4%	135.6%	142.4%	4	2	2	81.4%	2	6	1	0	1	5	0.2%	**2**
Dealer 70	2	1	1	3	2	76.6%	127.7%	153.2%	119.1%	76.6%	1	0	1	153.2%	3	6	1	0	1	5	0.2%	**2**
Dealer 71	17	8	7	7	7	93.4%	165.3%	122.2%	126.9%	115.0%	6	3	3	64.7%	4	24	5	1	6	18	0.6%	**6**
Dealer 72	2	1	3	1	2	24.0%	168.0%	72.0%	88.0%	48.0%	1	0	1	48.0%	1	4	1	0	1	3	0.1%	**1**
Dealer 73	4	3	1	1	2	153.2%	76.6%	76.6%	102.1%	153.2%	3	1	2	51.1%	1	7	1	0	1	6	0.2%	**2**
Dealer 74	1		0	1	1	85.7%	85.7%	171.4%	114.3%	257.1%	2	1	1	257.1%	2	4	1	0	1	3	0.1%	**1**
Dealer 75	3	1	0	3	1	80.0%	40.0%	240.0%	120.0%	80.0%	1	0	1	80.0%	1	5	1	0	1	4	0.1%	**1**
Dealer 76	3	2	2	1	2	81.4%	122.0%	61.0%	88.1%	20.3%	0	0	0	142.4%	3	6	1	0	1	5	0.2%	**2**
Dealer 77	14	12	8	15	12	118.9%	147.2%	141.5%	135.8%	192.5%	17	8	9	45.3%	4	27	5	2	7	20	0.7%	**7**
Dealer 78	9	5	6	5	5	132.1%	121.1%	99.1%	117.4%	88.1%	4	2	2	121.1%	5	16	3	1	4	12	0.4%	**4**
Dealer 79	9	7	9	5	7	110.5%	142.1%	157.9%	136.8%	126.3%	6	3	3	78.9%	4	16	3	1	4	12	0.4%	**4**
Dealer 80	1	1	0	2	1	80.0%	0.0%	160.0%	80.0%	160.0%	2	1	1	0.0%	0	2	0	0	0	2	0.1%	**1**
Dealer 81	13	7	5	4	5	157.1%	214.3%	142.9%	171.4%	157.1%	5	2	3	28.6%	1	17	3	1	4	13	0.4%	**4**
Dealer 82	19	11	9	11	10	126.5%	126.5%	97.6%	116.9%	133.7%	11	5	6	104.8%	9	34	7	2	9	25	0.8%	**8**
Dealer 83	9	8	9	8	8	144.6%	122.9%	115.7%	127.7%	115.7%	7	3	4	108.4%	7	20	4	1	5	15	0.5%	**5**
Dealer 84	5	2	1	2	2	138.5%	184.6%	161.5%	161.5%	138.5%	2	1	1	69.2%	1	7	1	0	1	6	0.2%	**2**
Dealer 85	3		3	1	2	184.6%	184.6%	92.3%	153.8%	138.5%	2	1	1	138.5%	2	6	1	0	1	5	0.2%	**2**
Dealer 86	1	1	0	1	1	30.8%	215.4%	92.3%	112.8%	0.0%	0	0	0	153.8%	1	2	0	0	0	2	0.1%	**1**
Dealer 87	16	6	6	2	5	163.3%	81.6%	89.8%	111.6%	122.4%	5	2	3	146.9%	7	26	5	2	7	19	0.6%	**6**
Dealer 88	1		2	2	2	77.4%	193.5%	193.5%	154.8%	193.5%	3	1	2	193.5%	3	6	1	0	1	5	0.2%	**2**
Dealer 89	7	7	4	4	5	133.3%	121.2%	97.0%	117.2%	181.8%	8	4	4	36.4%	2	13	3	1	4	9	0.3%	**3**
Dealer 90	3		1	2	2	0.0%	54.5%	109.1%	54.5%	381.8%	14	5	9	0.0%	0	12	2	1	3	9	0.3%	**3**
Dealer 91	1	3	1	3	2	259.5%	97.3%	162.2%	173.0%	97.3%	1	0	1	32.4%	0	2	0	0	0	2	0.1%	**1**
Dealer 92	2		2		2	96.0%	96.0%	144.0%	112.0%	48.0%	1	0	1	0.0%	0	3	1	0	1	2	0.1%	**1**
Dealer 93	12	9	20	10	13	127.9%	142.9%	131.7%	134.2%	124.1%	12	5	7	75.2%	7	26	5	2	7	19	0.6%	**6**
Dealer 94	10	4	9	6	6	101.9%	192.5%	181.1%	158.5%	135.8%	5	2	3	45.3%	2	15	3	1	4	11	0.4%	**4**
Dealer 95	2	2	2	4	3	42.1%	42.1%	84.2%	56.1%	21.1%	1	0	1	147.4%	8	11	2	1	3	8	0.3%	**3**
Dealer 96	2	1	1	1	1	230.8%	184.6%	46.2%	153.8%	138.5%	1	1	0	46.2%	0	2	1	0	1	1	0.0%	**1**
Dealer 97	8	6	9	12	9	114.7%	123.5%	185.3%	141.2%	114.7%	7	3	4	52.9%	3	15	3	1	4	11	0.4%	**4**
Dealer 98	1	2	2	1	2	171.4%	128.6%	42.9%	114.3%	171.4%	3	1	2	85.7%	2	5	1	0	1	4	0.1%	**1**
Dealer 99	1	2	3		3	92.3%	253.8%	46.2%	130.8%	92.3%	2	1	1	138.5%	3	5	1	0	1	4	0.1%	**1**
Dealer 100	1	1	2	2	2	85.7%	85.7%	171.4%	114.3%	42.9%	1	0	1	171.4%	3	5	1	0	1	4	0.1%	**1**
Dealer 101	5	2	4	4	3	84.2%	189.5%	126.3%	133.3%	84.2%	2	1	1	42.1%	1	7	1	0	1	6	0.2%	**2**
Dealer 102	1		1	4	3	0.0%	192.0%	240.0%	144.0%	96.0%	2	1	1	48.0%	1	3	1	0	1	2	0.1%	**1**
Dealer 103	5		1		1	96.0%	48.0%	192.0%	112.0%	192.0%	2	1	1	144.0%	1	7	1	0	1	6	0.2%	**2**
Dealer 104	6	2	2	1	2	120.0%	160.0%	40.0%	106.7%	160.0%	3	1	2	0.0%	0	8	2	0	2	6	0.2%	**2**
Dealer 105	11	4	3	2	3	114.9%	76.6%	114.9%	102.1%	140.4%	4	2	2	89.4%	3	16	3	1	4	12	0.4%	**4**
Dealer 106	7	4	3	6	4	78.4%	62.7%	117.6%	86.3%	133.3%	6	3	3	86.3%	4	14	3	1	4	10	0.3%	**3**
Dealer 107	1	1	1		1	94.7%	63.2%	0.0%	52.6%	63.2%	1	0	1	126.3%	2	4	1	0	1	3	0.1%	**1**
Dealer 108	28	10	7	18	12	87.0%	79.8%	184.9%	117.2%	126.9%	13	6	7	90.6%	9	44	9	3	12	32	1.1%	**11**
Dealer 109	6	3	3		3	184.6%	153.8%	61.5%	133.3%	153.8%	3	1	2	61.5%	1	9	2	1	3	6	0.2%	**2**
Dealer 110	4	2	1	2	2	90.6%	67.9%	135.8%	98.1%	135.8%	3	1	2	113.2%	2	8	2	0	2	6	0.2%	**2**
Dealer 111	6	3	5	8	5	145.9%	64.9%	137.8%	116.2%	129.7%	6	3	3	48.6%	2	11	2	1	3	8	0.3%	**3**
Dealer 112	3	2	5	2	3	133.3%	333.3%	133.3%	200.0%	133.3%	2	1	1	0.0%	0	4	1	0	1	3	0.1%	**1**
Dealer 113	6	6	4	11	7	146.9%	98.0%	195.9%	146.9%	61.2%	3	1	2	98.0%	5	13	3	1	4	9	0.3%	**3**
Dealer 114	7	2	3	4	3	105.3%	84.2%	126.3%	105.3%	105.3%	3	1	2	105.3%	3	12	2	1	3	9	0.3%	**3**
Dealer 115	7	8	3	7	6	132.7%	88.5%	132.7%	118.0%	127.2%	6	4	2	127.2%	6	15	3	1	4	11	0.4%	**4**
Dealer 116	11	10	5	12	9	94.6%	69.7%	139.4%	101.2%	104.6%	9	3	6	64.7%	6	23	4	1	5	18	0.6%	**6**
Dealer 117	6	3	0	3	2	150.0%	60.0%	90.0%	100.0%	120.0%	2	1	1	120.0%	2	9	2	1	3	6	0.2%	**2**
Dealer 118	3	1	2		2	200.0%	200.0%	0.0%	133.3%	160.0%	2	1	1	160.0%	2	6	1	0	1	5	0.2%	**2**
Dealer 119	3	2	2	1	2	160.0%	160.0%	120.0%	146.7%	80.0%	1	0	1	120.0%	2	6	1	0	1	5	0.2%	**2**
Total	**1914**	**1352**	**1617**	**1336**	**1459**	**118.5%**	**121.4%**	**117.9%**	**119.2%**	**130.3%**	**1801**	**808**	**993**	**84.9%**	**1128**	**4035**	**793**	**229**	**1022**	**3013**	**100.0%**	**1000**

Table 4.14: Proposed Format of Vehicle Allocation with Actual Data of Jan08

4.5 Comparison of the Existing Method and Proposed Allocation Method

- **Method Comparison**

Comparison	Existing Method		Proposed Method	
		Responsibility		Responsibility
Factors for Allocation	Nenkei ratio (Annual and monthly Sales Plan ratio)	Retail sales Development Depatment	Verification Back Order	Sales Planning Department (Sales System Development Section)
Using Data	Production Plan	Production Control Department	Production Plan	Production Control Department
	Nenkei and Monthly Nenkei	Retail sales Development Department	Verification Back Order	Sales Planning Department (Sales System Development Section)
			Daily and Past Record of Booking	
			Daily Stock	
			Seasonal Booking Index	
Distribution Method	Distribution from South to Metro	Sales Planning (Distribution Section)	Distribution by Aging of Back Order	Sales Planning (Distribution Section)

Table 4.15: Method Comparison between Existing and Proposed Method

In Table 4.15, the comparison between Existing and Proposed Method is shown in terms of factors for allocation, data usage, and responsibility. The Data for calculation of the Existing Method is Nenkei ratio which Nenkei of each dealer is completed by Retail Sales Development at the end of the year and then they will pass the data to Sales planning Department.

For Proposed method, the verified Back Order is used to calculate the allocation which this data will be completed by Sales System Development Section in Sales planning department and then they will pass the information to Distribution Section at the end of 17^{th} of every month. Past record of Booking and Stock of each series in

each dealer are also provided by Sales System Development Section. They will generate this data from SMCDS system everyday and then make a report. Example of this report is shown in Table 4.16. The actual data reports as stated in Table 4.14 are created on the timely basis in the routine work of Sales planning department except verified Back Order which is newly created for this proposed allocation method. However, there are only two data reports of production plan and Nenkei and monthly Nenkei which are used for the existing method.

AS OF : SSD/SALES PLANNING DEPT.

Dealer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total
Dealer 1		1	2	57	2		4	3	1	2	3	1		4	2		3	1		1	4	4	1	2				2	2	4	12	118
Dealer 2									1	1	3					1	1						1	2	4			2	2		3	21
Dealer 3														1				1				2							1	4	1	10
Dealer 4											5			1	2		1	1			4	2	1		3			5	1		3	29
Dealer 5			1	1			1				2			1	3	2	3				2		2	1		1		4		4	9	37
Dealer 6		1				1	1		1	1		1			1	3	1				1	3			4	1		2	2	1		25
Dealer 7		1	3	2	2		2	6	11	8	3	4	1	6	10	3	7	5	1		7	4	4	9	9	10	1	1	6	6	7	139
Dealer 8			2	4	2	2	1	2	2	2	8	1		2	4	2	1	2		2		5	4		2	2		3	2	1		58
. . .																																
GRAND TOT		11	24	74	19	4	125	38	55	44	56	31	3	45	74	112	105	26	20	7	67	45	46	46	45	24	2	55	53	51	112	1419

Table 4.16: Example of Daily Booking by Dealers Report

- **Result Comparison**

The results of Existing and Proposed method implementation are shown in the form of Demand and Supply of each dealer nationwide in January 2008 which the actual data can be seen in Table 4.17. Total Demand and Supply amount of all dealers for both Existing method and Proposed method are the same but Demand and Supply of each Dealer are different since Supply is depended on the Allocation Method. For Demand Side, Back Order Verification is used for Both Existing and Proposed Allocation Method.

Dealer	Total Demand			Existing Mthod								Propose Method							
				Total Supply			Match		Back Order	Back Order Remaining		Total Supply			Match		Back Order	Back Order Remaining	
	B/O Lst.Mth	New Booking Jan	(A)	Stock Lst.Mth	Alloc. Jan (B)	(C)	Ratio (C)/(A)	Diff from Avg	Remain (A)-(C) = (D)	Month (D)/(B) = (E)	Diff from Avg	Stock Lst.Mth	Alloc. Jan (B)	(C)	Ratio (C)/(A)	Diff from Avg	Remain (A)-(C) = (D)	Month (D)/(B) = (E)	Diff from Avg
Dealer 1	79	61	140	21	52	73	52.1%	0.2	67	1.29	1.23	21	47	68	48.6%	0.0	72	1.53	0.51
Dealer 2	23	54	77	22	29	51	66.2%	0.2	26	0.90	1.62	22	16	38	49.4%	0.0	39	2.44	0.39
Dealer 3	21	30	51	8	13	21	41.2%	0.0	30	2.31	0.21	8	12	20	39.2%	0.1	31	2.58	0.54
Dealer 4	24	7	31	9	14	23	74.2%	0.3	8	0.57	1.94	9	10	19	61.3%	0.2	12	1.20	0.85
Dealer 5	44	34	78	5	27	32	41.0%	0.0	46	1.70	0.81	5	22	27	34.6%	0.1	51	2.32	0.27
Dealer 6	55	43	98	8	16	24	24.5%	0.2	74	4.63	2.11	8	25	33	33.7%	0.1	65	2.60	0.55
Dealer 7	212	218	430	28	156	184	42.8%	0.0	246	1.58	0.94	28	132	160	37.2%	0.1	270	2.05	0.00
Dealer 8	70	137	207	7	56	63	30.4%	0.1	144	2.57	0.06	7	57	64	30.9%	0.2	143	2.51	0.46
Dealer 9	62	170	232	31	59	90	38.8%	0.1	142	2.41	0.11	31	51	82	35.3%	0.1	150	2.94	0.89
Dealer 10	69	35	104	17	35	52	50.0%	0.1	52	1.49	1.03	17	32	49	47.1%	0.0	55	1.72	0.33
Dealer 11	11	20	31	3	6	9	29.0%	0.2	22	3.67	1.15	3	7	10	32.3%	0.1	21	3.00	0.95
Dealer 12	61	25	86	38	21	59	68.6%	0.2	27	1.29	1.23	38	26	64	74.4%	0.3	22	0.85	1.20
Dealer 13	33	11	44	0	11	11	25.0%	0.2	33	3.00	0.49	0	13	13	29.5%	0.2	31	2.39	0.34
Dealer 14	14	16	30	13	8	21	70.0%	0.3	9	1.13	1.39	13	7	20	66.7%	0.2	10	1.43	0.62
Dealer 15	70	44	114	51	30	81	71.1%	0.3	33	1.10	1.41	51	41	92	80.7%	0.3	22	0.54	1.51
Dealer 16	22	14	36	4	10	14	38.9%	0.1	22	2.20	0.31	4	10	14	38.9%	0.1	22	2.20	0.15
Dealer 17	34	37	71	16	23	39	54.9%	0.1	32	1.39	1.12	16	17	33	46.5%	0.0	38	2.24	0.19
Dealer 18	16	10	26	2	8	10	38.5%	0.1	16	2.00	0.51	2	7	9	34.6%	0.1	17	2.43	0.38
Dealer 19	20	12	32	11	9	20	62.5%	0.2	12	1.33	1.18	11	10	21	65.6%	0.2	11	1.10	0.95
Dealer 20	24	4	28	6	5	11	39.3%	0.0	17	3.40	0.89	6	9	15	53.6%	0.1	13	1.44	0.60
Dealer 21	35	45	80	33	17	50	62.5%	0.2	30	1.77	0.75	33	17	50	62.5%	0.2	30	1.77	0.28
Dealer 22	20	26	46	5	9	14	30.4%	0.1	32	3.56	1.04	5	11	16	34.8%	0.1	30	2.73	0.68
Dealer 23	12	11	23	8	7	15	65.2%	0.2	8	1.14	1.37	8	6	14	60.9%	0.1	9	1.50	0.55
Dealer 24	35	34	69	1	19	20	29.0%	0.2	49	2.58	0.06	1	18	19	27.5%	0.2	50	2.78	0.73
Dealer 25	29	16	45	2	10	12	26.7%	0.2	33	3.30	0.79	2	12	14	31.1%	0.1	31	2.58	0.54
Dealer 26	70	41	111	8	27	35	31.5%	0.1	76	2.82	0.30	8	30	38	34.2%	0.1	73	2.43	0.39
Dealer 27	16	14	30	4	7	11	36.7%	0.1	19	2.71	0.20	4	8	12	40.0%	0.1	18	2.25	0.20
Dealer 28	30	16	46	7	11	18	39.1%	0.1	28	2.55	0.03	7	12	19	41.3%	0.0	27	2.25	0.20
Dealer 29	10	12	22	9	8	17	77.3%	0.3	5	0.63	1.89	9	5	14	63.6%	0.2	8	1.60	0.45
Dealer 30	6	10	16	2	9	11	68.8%	0.2	5	0.56	1.96	2	5	7	43.8%	0.0	9	1.80	0.25
Dealer 31	25	9	34	5	10	15	44.1%	0.0	19	1.90	0.61	5	10	15	44.1%	0.0	19	1.90	0.15
Dealer 32	19	19	38	13	8	21	55.3%	0.1	17	2.13	0.39	13	10	23	60.5%	0.1	15	1.50	0.55
Dealer 33	37	14	51	2	9	11	21.6%	0.2	40	4.44	1.93	2	14	16	31.4%	0.1	35	2.50	0.45
Dealer 34	3	9	12	4	4	8	66.7%	0.2	4	1.00	1.51	4	3	7	58.3%	0.1	5	1.67	0.38
Dealer 35	11	5	16	3	3	6	37.5%	0.1	10	3.33	0.82	3	5	8	50.0%	0.0	8	1.60	0.45
Dealer 36	2	10	12	3	2	5	41.7%	0.0	7	3.50	0.99	3	2	5	41.7%	0.0	7	3.50	1.45
Dealer 37	9	8	17	7	7	14	82.4%	0.4	3	0.43	2.09	7	4	11	64.7%	0.2	6	1.50	0.55
Dealer 38	6	7	13	3	2	5	38.5%	0.1	8	4.00	1.49	3	3	6	46.2%	0.0	7	2.33	0.29
Dealer 39	2	8	10	0	2	2	20.0%	0.2	8	4.00	1.49	0	2	2	20.0%	0.3	8	4.00	1.95
Dealer 40	4	2	6	0	2	2	33.3%	0.1	4	2.00	0.51	0	2	2	33.3%	0.1	4	2.00	0.05
Dealer 41	4	3	7	1	1	2	28.6%	0.2	5	5.00	2.49	1	2	3	42.9%	0.0	4	2.00	0.05
Dealer 42	8	12	20	5	6	11	55.0%	0.1	9	1.50	1.01	5	4	9	45.0%	0.0	11	2.75	0.70
Dealer 43	10	4	14	2	3	5	35.7%	0.1	9	3.00	0.49	2	4	6	42.9%	0.0	8	2.00	0.05
Dealer 44	12	17	29	5	8	13	44.8%	0.0	16	2.00	0.51	5	6	11	37.9%	0.1	18	3.00	0.95
Dealer 45	4	4	8	3	3	6	75.0%	0.3	2	0.67	1.85	3	2	5	62.5%	0.2	3	1.50	0.55
Dealer 46	15	9	24	1	4	5	20.8%	0.2	19	4.75	2.24	1	6	7	29.2%	0.2	17	2.83	0.79
Dealer 47	14	7	21	0	4	4	19.0%	0.3	17	4.25	1.74	0	6	6	28.6%	0.2	15	2.50	0.45
Dealer 48	11	2	13	1	3	4	30.8%	0.1	9	3.00	0.49	1	4	5	38.5%	0.1	8	2.00	0.05
Dealer 49	4	3	7	0	3	3	42.9%	0.0	4	1.33	1.18	0	2	2	28.6%	0.2	5	2.50	0.45
Dealer 50	12	4	16	2	3	5	31.3%	0.1	11	3.67	1.15	2	5	7	43.8%	0.0	9	1.80	0.25
Dealer 51	3	3	6	3	3	6	100.0%	0.6	0	0.00	2.51	3	2	5	83.3%	0.4	1	0.50	1.55
Dealer 52	2	9	11	0	4	4	36.4%	0.1	7	1.75	0.76	0	2	2	18.2%	0.3	9	4.50	2.45
Dealer 53	4	3	7	0	1	1	14.3%	0.3	6	6.00	3.49	0	2	2	28.6%	0.2	5	2.50	0.45
Dealer 54	6	9	15	0	5	5	33.3%	0.1	10	2.00	0.51	0	4	4	26.7%	0.2	11	2.75	0.70
Dealer 55	23	15	38	4	9	13	34.2%	0.1	25	2.78	0.26	4	10	14	36.8%	0.1	24	2.40	0.35
Dealer 56	29	35	64	6	9	15	23.4%	0.2	49	5.44	2.93	6	16	22	34.4%	0.1	42	2.63	0.58
Dealer 57	25	23	48	5	9	14	29.2%	0.2	34	3.78	1.26	5	12	17	35.4%	0.1	31	2.58	0.54
Dealer 58	11	6	17	0	3	3	17.6%	0.3	14	4.67	2.15	0	5	5	29.4%	0.2	12	2.40	0.35
Dealer 59	3	3	6	0	2	2	33.3%	0.1	4	2.00	0.51	0	2	2	33.3%	0.1	4	2.00	0.05
Dealer 60	11	5	16	2	3	5	31.3%	0.1	11	3.67	1.15	2	4	6	37.5%	0.1	10	2.50	0.45
Dealer 61	7	0	7	2	3	5	71.4%	0.3	2	0.67	1.85	2	3	5	71.4%	0.3	2	0.67	1.38
Dealer 62	1	3	4	3	2	5	125.0%	0.8	1	0.50	2.01	3	2	5	125.0%	0.8	1	0.50	1.55
Dealer 63	5	8	13	0	4	4	30.8%	0.1	9	2.25	0.26	0	3	3	23.1%	0.2	10	3.33	1.29
Dealer 64	1	0	1	1	0	1	100.0%	0.6	0	0.00	2.51	1	1	2	200.0%	1.5	1	1.00	1.05
Dealer 65	2	6	8	2	3	5	62.5%	0.2	3	1.00	1.51	2	3	5	62.5%	0.2	3	1.00	1.05
Dealer 66	4	4	8	0	2	2	25.0%	0.2	6	3.00	0.49	0	2	2	25.0%	0.2	6	3.00	0.95
Dealer 67	12	3	15	5	2	7	46.7%	0.0	8	4.00	1.49	5	4	9	60.0%	0.1	6	1.50	0.55
Dealer 68	8	4	12	2	2	4	33.3%	0.1	8	4.00	1.49	2	4	6	50.0%	0.0	6	1.50	0.55
Dealer 69	3	4	7	0	1	1	14.3%	0.3	6	6.00	3.49	0	2	2	28.6%	0.2	5	2.50	0.45
Dealer 70	2	4	6	0	1	1	16.7%	0.3	5	5.00	2.49	0	2	2	33.3%	0.1	4	2.00	0.05
Dealer 71	14	3	17	0	5	5	29.4%	0.1	12	2.40	0.11	0	6	6	35.3%	0.1	11	1.83	0.21
Dealer 72	2	1	3	0	1	1	33.3%	0.1	2	2.00	0.51	0	1	1	33.3%	0.1	2	2.00	0.05
Dealer 73	5	2	7	4	2	6	85.7%	0.4	1	0.50	2.01	4	2	6	85.7%	0.4	1	0.50	1.55
Dealer 74	1	3	4	1	1	2	50.0%	0.1	2	2.00	0.51	1	1	2	50.0%	0.0	2	2.00	0.05
Dealer 75	3	2	5	1	1	2	40.0%	0.0	3	3.00	0.49	1	1	2	40.0%	0.1	3	3.00	0.95
Dealer 76	2	2	4	0	2	2	50.0%	0.1	2	1.00	1.51	0	2	2	50.0%	0.0	2	1.00	1.05
Dealer 77	16	6	22	2	7	9	40.9%	0.0	13	1.86	0.66	2	7	9	40.9%	0.1	13	1.86	0.19
Dealer 78	7	5	12	3	4	7	58.3%	0.1	5	1.25	1.26	3	4	7	58.3%	0.1	5	1.25	0.80
Dealer 79	8	5	13	4	4	8	61.5%	0.2	5	1.25	1.26	4	4	8	61.5%	0.2	5	1.25	0.80
Dealer 80	2	1	3	0	1	1	33.3%	0.1	2	2.00	0.51	0	1	1	33.3%	0.1	2	2.00	0.05
Dealer 81	12	2	14	0	4	4	28.6%	0.2	10	2.50	0.01	0	4	4	28.6%	0.2	10	2.50	0.45
Dealer 82	16	16	32	5	7	12	37.5%	0.1	20	2.86	0.34	5	8	13	40.6%	0.1	19	2.38	0.33
Dealer 83	8	9	17	1	5	6	35.3%	0.1	11	2.20	0.31	1	5	6	35.3%	0.1	11	2.20	0.15
Dealer 84	5	3	8	2	2	4	50.0%	0.1	4	2.00	0.51	2	2	4	50.0%	0.0	4	2.00	0.05
Dealer 85	3	3	6	1	1	2	33.3%	0.1	4	4.00	1.49	1	2	3	50.0%	0.0	3	1.50	0.55
Dealer 86	1	3	4	1	2	3	75.0%	0.3	1	0.50	2.01	1	1	2	50.0%	0.0	2	2.00	0.05
Dealer 87	12	7	19	6	4	10	52.6%	0.1	9	2.25	0.26	6	6	12	63.2%	0.2	7	1.17	0.88
Dealer 88	2	3	5	1	1	2	40.0%	0.0	3	3.00	0.49	1	2	3	60.0%	0.1	2	1.00	1.05
Dealer 89	7	3	10	1	4	5	50.0%	0.1	5	1.25	1.26	1	3	4	40.0%	0.1	6	2.00	0.05
Dealer 90	9	1	10	0	1	1	10.0%	0.3	9	9.00	6.49	0	3	3	30.0%	0.2	7	2.33	0.29
Dealer 91	2	1	3	0	1	1	33.3%	0.1	2	2.00	0.51	0	1	1	33.3%	0.1	2	2.00	0.05
Dealer 92	2	0	2	0	1	1	50.0%	0.1	1	1.00	1.51	0	1	1	50.0%	0.0	1	1.00	1.05
Dealer 93	12	11	23	6	8	14	60.9%	0.2	9	1.13	1.39	6	6	12	52.2%	0.1	11	1.83	0.21
Dealer 94	9	4	13	2	4	6	46.2%	0.0	7	1.75	0.76	2	4	6	46.2%	0.0	7	1.75	0.30
Dealer 95	0	7	7	0	3	3	42.9%	0.0	4	1.33	1.18	0	3	3	42.9%	0.0	4	1.33	0.71
Dealer 96	1	1	2	0	2	2	100.0%	0.6	0	0.00	2.51	0	1	1	50.0%	0.0	1	1.00	1.05
Dealer 97	8	5	13	1	4	5	38.5%	0.1	8	2.00	0.51	1	4	5	38.5%	0.1	8	2.00	0.05
Dealer 98	2	2	4	1	1	2	50.0%	0.1	2	2.00	0.51	1	1	2	50.0%	0.0	2	2.00	0.05
Dealer 99	1	5	6	2	2	4	66.7%	0.2	2	1.00	1.51	2	1	3	50.0%	0.0	3	3.00	0.95
Dealer 100	1	4	5	3	1	4	80.0%	0.4	1	1.00	1.51	3	1	4	80.0%	0.3	1	1.00	1.05
Dealer 101	5	5	10	2	2	4	40.0%	0.0	6	3.00	0.49	2	2	4	40.0%	0.1	6	3.00	0.95
Dealer 102	1	1	2	1	1	2	100.0%	0.6	0	0.00	2.51	1	1	2	100.0%	0.5	0	0.00	2.05
Dealer 103	5	1	6	0	1	1	16.7%	0.3	5	5.00	2.49	0	2	2	33.3%	0.1	4	2.00	0.05
Dealer 104	6	0	6	0	1	1	16.7%	0.3	5	5.00	2.49	0	2	2	33.3%	0.1	4	2.00	0.05
Dealer 105	9	7	16	4	2	6	37.5%	0.1	10	5.00	2.49	4	4	8	50.0%	0.0	8	2.00	0.05
Dealer 106	6	7	13	7	5	12	92.3%	0.5	1	0.20	2.31	7	3	10	76.9%	0.3	3	1.00	1.05
Dealer 107	1	4	5	0	1	1	20.0%	0.2	4	4.00	1.49	0	1	1	20.0%	0.3	4	4.00	1.95
Dealer 108	23	17	40	11	7	18	45.0%	0.0	22	3.14	0.63	11	11	22	55.0%	0.1	18	1.64	0.41
Dealer 109	5	1	6	1	1	2	33.3%	0.1	4	4.00	1.49	1	2	3	50.0%	0.0	3	1.50	0.55
Dealer 110	4	5	9	1	2	3	33.3%	0.1	6	3.00	0.49	1	2	3	33.3%	0.1	6	3.00	0.95
Dealer 111	6	5	11	1	3	4	36.4%	0.1	7	2.33	0.18	1	3	4	36.4%	0.1	7	2.33	0.29
Dealer 112	3	4	7	0	2	2	28.6%	0.2	5	2.50	0.01	0	1	1	14.3%	0.3	6	6.00	3.95
Dealer 113	4	7	11	0	3	3	27.3%	0.2	8	2.67	0.15	0	3	3	27.3%	0.2	8	2.67	0.62
Dealer 114	6	4	10	0	2	2	20.0%	0.2	8	4.00	1.49	0	3	3	30.0%	0.2	7	2.33	0.29
Dealer 115	5	20	25	2	6	8	32.0%	0.1	17	2.83	0.32	2	4	6	24.0%	0.2	19	4.75	2.70
Dealer 116	12	12	24	1	5	6	25.0%	0.2	18	3.60	1.09	1	6	7	29.2%	0.2	17	2.83	0.79
Dealer 117	4	3	7	0	1	1	14.3%	0.3	6	6.00	3.49	0	2	2	28.6%	0.2	5	2.50	0.45
Dealer 118	3	2	5	0	1	1	20.0%	0.2	4	4.00	1.49	0	2	2	40.0%	0.1	3	1.50	0.55
Dealer 119	3	1	4	0	1	1	25.0%	0.2	3	3.00	0.49	0	2	2	50.0%	0.0	2	1.00	1.05
Grand Total	**1885**	**1736**	**3621**	**553**	**1000**	**1553**	**44.2%**	**20.3**	**2070**	**2.51**	**145.76**	**553**	**1000**	**1553**	**46.0%**	**17.2**	**2070**	**2.05**	**76.53**

Table 4.17: Result Comparison of Existing Method and Proposed Method

Total Nationwide Demand for January 2008 is 3,621 units which 1,885 units is Back Order at the end of December 2007 plus 1,736 units of New Booking in January 2008. Total Nationwide supply is 1,553 units which 553 units is Stock at the end of December 2007 plus with 1,000 units of New allocation in January 2008, then the Total Remaining of Back Order after allocation is 2,070 units The summary of the results are shown in Table 4.18.

	Existing Method	**Proposed Method**	**Diff %**
Total Nationwide Demand (units)	3621	**3621**	
Total Nationwide Supply (units)	1553	**1553**	
Average of Match Ratio	44.20%	**46.00%**	4.07%
Average of Retail Sales Ratio	64.00%	**66.61%**	4.07%
Sum of Percentage Error of Matching Ratio	20.30	**17.20**	-15.27%
Total Remaining of Back Order after Allocation of Nationwide (units)	2070	**2070**	
Back Order Remaining month (Month)	2.51	**2.05**	15 Days
Sum of Percentage Error of Back Order Remaining Month	145.8	**76.5**	-47.50%

Table 4.18: The Summary of Existing and Proposed Methods Result of January 2008

From the result of the proposed method, it can be seen that the Average Matching ratio of all dealers is 46.00% which is improved from the Existing method by 4.07%. Similarly, Average of Retail Sales Ratio is 66.61% which is improved from the Existing method by 4.07% in proportion with the Matching ratio. Also, for the sum of

percentage error of all dealers is improved from the Existing method by 15.27%. The percentage error calculated from Match ratio of each dealer minus Match ratio Nationwide Average then divided by Match ratio of each dealer, in absolute value as below in Eq1, Accepted value is the Average matching ratio of all Dealers.

$$\text{Percentage Error} = \frac{\left|\text{Measured - Accepted Value}\right|}{\text{Accepted Value}} \times 100\% \quad \text{--------- (Eq.1)}$$

This reflects that the balance of Demand and Supply of the allocation is improved and it may imply that the higher matching ratio, the higher opportunity to sales in each Dealer which is mentioned in Chapter 3, in another word, the better the balance of Demand and Supply, the higher opportunity to sales. In fact, when Supply is higher than Demand, the problem of inventory stock involving with cost concerns including holding cost and in opposite, when Demand exceeds the available supply on hand, customer delivery lead time will be longer. It will have the direct impact to Customer Satisfaction. Customer delivery lead time can be seen from the figure of the remaining of Back Order ratio which reflects how long dealer will use to clear all back order and also may imply that how long the next customer have to wait for the vehicle. For the existing model, Dealers need around 2 month and a half to clear the back order for the average of all dealers but if Proposed Method is implemented, it shows that dealers will only need 2 months for clearance with the reduction or improvement of around 15 days. The sum of percentage error of all dealers is lower than the Existing method by a hefty 47.5%.

From an addition of new distribution method, it enables greater efficiency than the existing model since aging of back order is considered as the key factor for distribution queuing. Thus, this will improve the reduction of customer delivery lead time as one more benefit of the new proposed model.

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

In this chapter, the conclusion, thesis support and constraint, and recommendation are demonstrated. The conclusion including methods of both current and proposed system of allocation, data accuracy and strengths and weaknesses of the current and proposed allocation methods are concluded in section 5.1. Finally, the recommendation for further system development is explained in section 5.2.

5.1 Conclusions

Sales planning department is located in national division. Sales planning department is comprises of sales planning team, distribution team, and sales system development team. Sales planning team is responsible for sales & production planning and local vehicle distribution and allocation to 119 dealers in Thailand. In The past, the team allocates the vehicle upon the data generated by the computer system and relies on only one or two factors without the consideration of the accuracy of data and trend of the market which may mislead the whole organization

The objective of this thesis study is to increase the retail sales ratio by improving the current Allocation Method for an automobile manufacture. There are three major chapters in this thesis. It begins with literature and theory survey by searching, studying and reviewing techniques and factors from textbooks, researches, journals, web sites, and etc. Then the current allocation method for sales planning department is examined, analyzed and implemented. Finally, the proposed allocation method is created and implemented and both models are compared at the end.

5.1.1 Current Allocation Method

In the past until now, the allocation method currently employed by Company A is to consider on different sets of factors case by case for each series of vehicle. Those factors are Dealer order, Dealer order ratio, and Nenkei ratio. In this thesis, in the case of Vehicle Supply is less than Dealer order is studied since it is the critical part of the

allocation method which needs to be improved therefore Current allocation method in this thesis is the method of Nenkei ratio usage as a factor for dealer vehicle allocation. Nenkei ratio was calculated and assigned at the beginning of the current year following with the corporate objective to gain no.1 market share nationwide. Nenkei ratio is employed to make sure that the market share estimation of the current year of all provinces are targeted to be No.1 in the market especially for the losing provinces which will be targeted higher than the actual market share result from the previous year to win the market back in the current year**.** Thus, the allocated supply may not effectively meet the real demand.

The current allocation method has been tested and analyzed with the actual data of January 2008 following the calculation steps of market volume estimation, market share estimation, Nenkei calculation, and allocation which is carried out after Nenkei calculation has been calculated, sales planning department uses these ratios namely yearly and monthly Nenkei to calculate allocation by series to each dealers nationwide.

It has been found that the existing model of allocation of January 2008 caused many dealers with the matching ratio less than the average of nationwide which means that Dealers have very low supply comparing with their Demand and balance of the demand and supply level among all suppliers are out. If Good allocation is in place, each dealer nationwide shall have the similar situation of Demand and Supply which means that average of Matching Ratio nationwide must be achieved in balance.

- **Weaknesses of the Current Allocation Method**

When the allocation does not meet with the real demand of customer, it affects directly to dealer management tasks and impact customer satisfaction.

Retail Sales Result will be affected when the dealer who has booking from customer but shorts of supply, sales opportunity is damaged which can be seen from the matching ratio as the indicator for sales opportunity. If matching ratio between Demand and supply is reaching 100%, it reflects the high opportunity of sale respectively. It can be proved from the past that the higher matching ratio, the higher retail sales. Some dealers may have many customers but manage to receive very few

supplies therefore this creates long delivery timing for customers which is the key indicator of customer satisfaction to the delivery scheduling.

Shortage cost will also incur when demand exceeds the available supply on hand. It includes cost for keeping track of a back order and income lost when customer purchases the product from the competitors. Moreover, the shortage cost could not be measured when the customer goodwill is lost.

From an ineffective allocation, supply may have been allocated to the wrong location where there is no demand which will impact inventory stock building up causing the occurrence of holding cost.

Effective allocation in this case should refer to each dealer having the same level of both delivery lead time and Back Order Remaining Month which reflects that customer can go to any dealer and expect to have the same delivery lead time balance then good customer satisfaction can be expected.

5.1.2 Proposed Allocation Method

For Proposed method, the verified Back Order is used to calculate the allocation. Past record of Booking and Stock of each series in each dealer are also considered to make sure that the real demand can be estimated to enhance the accuracy of the allocation.

The proposed allocation method has been tested and analyzed with the actual data of January 2008 following the calculation steps of Back Order Verification, New Booking Forecast by Moving Average methodology with Seasonal index in consideration, Back order and Back order ratio calculation, allocation, and new distribution method considering back order aging. From the result of proposed allocation method, it can be seen that the Average Matching ratio of all dealers is improved comparing Existing allocation method. This reflects that the balance of Demand and Supply of the allocation is improved and it may imply that the higher matching ratio, the higher opportunity to sales leading to higher retail sales ratio, in another word, the better the balance of Demand and Supply, the higher opportunity to sales or higher retail sales ratio. Customer delivery lead time can be seen from the

result of remaining of Back Order ratio which reflects how long dealer will use to clear all back order and also may imply that how long the next customer have to wait for the vehicle. For the existing model, Dealers need longer period of time to clear the back order than the proposed allocation method after model has been tested.

- **Strengths of the Proposed Allocation Method**

1. The proposed allocation method enables Sales Planning to proper allocate vehicles to meet with the real demand from an improvement of the method of Back Order verification newly employed. This leads to the increment of sales opportunity of each dealers, better overall retail sales and larger market share nationwide can also be expected.
2. The proposed allocation method can help to proper manage the Delivery Lead time in terms of Lead time equalization in all dealers for better customer satisfaction, e.g. customer can go to any dealers and expect to have the similar delivery lead time for their vehicles nationwide. This strength can also help reducing the error of booking for Shop around customers since the level of delivery Lead time is the same in all dealers.
3. Dealer can save cost on stock holding in the case of the dealer overestimation causing Oversupply.
4. The method is more systematic and effective comparing to the existing method

5.2 Recommendations

The proposed allocation method can help improving the corporate in terms of effective allocation to fulfill the demand of customers leading to the increment of retail sales ratio and dealers to get rid of the obstacles namely inaccurate real demand, lengthy delivery lead time, low customer satisfaction, and unnecessary costs such as holding cost and shortage cost. Thus, the corporate can start the implementation of this new system right away with the vehicle series which have higher demand than the actual production capacity of the company once it is approved by the top management of the company since this proposed allocation system is very clear, simple, effective and especially there is no extra cost and man power requirement for this

implementation which will help the corporate to allocate the right amount of vehicles to the right location of dealers at the right time.

In the further development of this system, the company shall study to add-on the function of automatic logic verification in SMCDS system to further simplify the proposed allocation method in this thesis. The education to dealer for demand and supply situation for allocation is also necessary in the long run for the company to help strengthen the supply chain in term of real or more accurate demand shall come from the dealer directly without sophisticated system for verification of the company. This is the win-win situation between company and dealer since if company get to know the real demand of dealer to the market, company will be able to plan the production to support the dealer accordingly therefore allocation can be done easily for the best of customer satisfaction.

REFERENCES

Apostol, Tom M. Introduction to Analytic Number Theory. New York-Heidelberg: Springer-Verlag, 1976.

Asanuma, B. Nihon no Kigyou-Soshiki Kakushin-teki Tekio. The Mechanism of Innovative Adaptation of The Company Organization in Japan, Toyo-keizai-Shinpousha, 1997.

Blumenfield, D.E. Impact of Manufacturing Response Time on Retailer Delivery. International Journal of Operations & Production Management 19, 8 (1999) : 797-811.

Bressolle, Françoise et al. Validation of Liquid Chromatographic and Gas Chromatographic Methods Applications to Pharmacokinetics. Journal of Chromatography Biomedical Sciences and Applications 686, 1 (1996) : 3-10.

Christopher, M. and Towill, D. An Integrated Model for the Design of Agile Supply Chain. International Journal of Physical Distribution & Logistics Management 34, 4 (2001) : 235-246.

Department of Health (United Kingdom). The White Paper Trust, Assurance and Safety: The Regulation of Health Professionals. http://www.dh.gov.uk/en-/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_065946, [15 May 2008].

Drucker, P. The Concept of the Corporation. New York: John Day, 1946.

El Eman, Khaled et al. Evaluating Predictors of Geographic Area Population Size Cut-offs to Manage Re-identification Risk. Journal of the American Medical Informatics Association 16, 2 (2009) : 256-266

Fine, Leon G. et al. How to Evaluate and Improve the Quality and Credibility of an Outcomes Database: Validation and Feedback Study on the UK Cardiac Surgery Experience. http://www.bmj.com/cgi/content/abstract/326/7379/25, [3 June 2008].

Forrester, J. W. Industrial Dynamics: A Major Breakthrough for Decision Makers. Harvard Business Review 36, 4 (1958) : 37-66.

Franceschini,N. Forecasting. http://www.uoguelph.ca/~dsparlin/forecast.htm#-SIMPLE%20MOVING%20 AVERAGE, [3 April 2009].

Groupe Novasep. Prospective Validation. http://www.novasep.com/misc/-glossary.asp?defId=169&lookfor=&search=P, [25 February 2008].

Groupe Novasep. Retrospective validation. http://www.novasep.com/misc/-glossary.asp?defId=185&lookfor=&search=R, [25 February 2008].

Holweg, M. and Pil, F. The Second Century: Reconnecting Customer and Value Chain through Build-to-Order, Cambridge, MA and London, UK: The MIT Press, 2004.

Karabakal, N., Gunal, A. and Ritchie, W. Supply Chain Analysis at Volkswagen of America. Interfaces 30, 4 (2000) : 46-55.

Kiff, J. S. Supply and Stocking Systems in the UK Car Market. International Journal of Physical Distribution and Logistics Management 27, 34 (1997) : 226-243.

Lee, H. L. and Billington, C. Managing Supply Chain Inventory: Pitfalls and Opportunities. Sloan Management Review 33, 3 (1992) : 65-73.

Merkur, Sherry Physician Revalidation in Europe, Royal College of Physicians. http://www.ingentaconnect.com/content/rcop/cm/2008/00000008/00000004/art00005, [11 February 2008].

Peptisyntha S.A. Commercial Scale Production. http://www.peptisyntha.com/-processdevelopment/commercialscaleproduction/0,,3660-2-0,00.htm., [3 April 2009].

Ramcharran, H. Interfirm Linkages and Profitability in the Automotive Industry: The Implications for Supply Chain Management. Journal of Supply Chain Management Winter 37 : 11-17.

Sterman, J. D. Modeling Managerial Behavior: Misperceptions of Feedback in a Dynamic Decision Making Experiment, United Kingdom: Management Science Research Center 35, 3 (1989) : 321-339.

Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to Algorithms, Second Edition. The United States of America: MIT Press and McGraw-Hill, 2001.

Tomino, T., Park, Y., Hong, P., and Roh, J. J. Marker Flexible Customizing System (MFCS) of Japanese Vehicle Manufacturers: An Analysis of Toyota, Nissan and Mitsubishi. International Journal of Production Economic 118, 2 (2009) : 375-386.

U.S. Food and Drug Administration, Process Validation in Medical Device Quality Systems Manual, http://www.fda.gov/cdrh/qsr/04valid.html, [25 February 2008].

Validation-online.net, Retrospective Validation Rationale, http://www.validation-online.net/retrospective-validation.html, [25 February 2008].

Van Geest-Daalderop, Johanna H. H. et al. Improvement in the Regulation of the Vitamin K Antagonist Acenocoumarol after a Standard Initial Dose Regimen: Prospective Validation of a Prescription Model. Journal of Thrombosis and Thrombolysis (Springer) 27, 2 (2009) : 207-214

Ya-lun Chou. Statistical Analysis. The United States of America: Holt International, 1975.

Appendix A

SCOPE OF WORK

SALES PLANNING DEPARTMENT

JOB DESCRIPTION

Position _____ (System & Process Development)		Dept. **Sales Planning Dept.** Section **Sales System Development** Line -	
Initiator …...…….. (Chief Engineer)	Authorized …… (Manager)	Revision 1 Issued Date Oct. 1, 2007	Page 1 of 1

1. Major Duties

1.1) To develop internal working process

1.2) To be reponsible for extraordinary projects

2. Activities & Responsibilities

2.1) Demand-Supply Improvement

2.2) Monitoring process and system

2.3) Performance Evaluation, Visualization and reporting

2.4) Departmental Assignment

2.5) Develop and support TBR System, EOPD Project, Registration and DCC

2.6) Special Assigned Projects and works

3. Authority at work Concerning to Quality

- **Quality**

3.1) Establish and verify the improvement on TBR System

3.2) Initial check and approve performance evaluation report

3.3) Initial check and approve launched reports

- **Occupational Health and Safety**

none

4. Job Specification

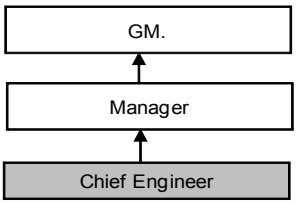
4.1) Education : Bachelor degree in Engineering (System, Computer, ITC)

4.2) Skill : Logical and systematic, English language, Good human relation

4.3) Experience : 3-5 years experiened in system development

5. Line of Command

5.1) Report to : Mgr. / GM.



Source: Sales Planning Department

Figure A.1: Job Description of Sales System Development Section

JOB DESCRIPTION

Position _____		Dept. **Sales Planning Dept.** Section **Distribution** Line -	
Initiator …...…….. (Engineer)	Authorized …… (Manager)	Revision 3 Issued Date Oct. 1, 2007	Page 1 of 1

1. Major Duties

1.1) Study and analysis possibility of vehicle situation that it their reponsibilities

1.2) Plan production in each model to meet demend

1.3) Follow up sales situation and co-operate with other section every month

2. Activities & Responsibilities

2.1) Collect dealer order and plan to sales in each series that their responsibilities

2.2) Discussion with Regional to meet optimum supply and demand in Sales Division Meeting

2.3) Negotiate with plant and concern function to make production plan in Order Entry Meeting

2.4) Allocate vehicle to dealer

2.5) Consider color order to factory and improve color order plan in each weekly

2.6) During the month follow up and co-operate with other function to make supply on assignment schedule

2.7) Study information and analysis sales situation in each series

3. Authority at work Concerning to Quality

- **Quality**

3.1) Follow up information from other concerned section to market sales and production plan

3.2) Control vehicle allocation to dealer by the rule

3.3) Co-operate with factory to meet optimum supply requirement

- **Occupational Health and Safety**

none

4. Job Specification

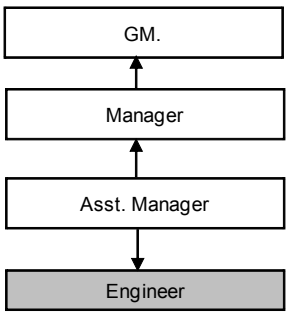
4.1) Education : Bachelor Degree in marketing or related

4.2) Skill : Basic skill in computerize, Fluent in english language, Capable in negotiation and good human relation

4.3) Experience : 0-3 years experiened in automobile business

5. Line of Command

5.1) Report to : Asst. Mgr. / Mgr. / GM.



Source: Sales Planning Department

Figure A.2: Job Description of Distribution Section

JOB DESCRIPTION

Position _____		Dept. **Sales Planning Dept.** Section **Sales Planning** Line -	
Initiator …...…….. (Assistant Manager)	Authorized …… (GM)	Revision 3 Issued Date Oct. 1, 2007	Page 1 of 1

1. Major Duties

1.1) Forecast market and Toyota sales plan for over all company
1.2) Monitoring sales, market and economic situation
1.3) Set sales target in each month
1.4) Coordinate demand analysis to meet supply

2. Activities & Responsibilities

2.1) Long term plan
2.2) Annual sales plan
2.3) Moving sales plan
2.4) Evaluate sales result
2.5) Economic & over all market analysis
2.6) Demand Analysis Research

3. Authority at work Concerning to Quality

- **Quality**

3.1) Propose plan and suggestion to get approval
3.2) Improve information system to support concern function
3.3) Evaluate sales & market situation
3.4) Conduct market research in terms of demand analysis

- **Occupational Health and Safety**

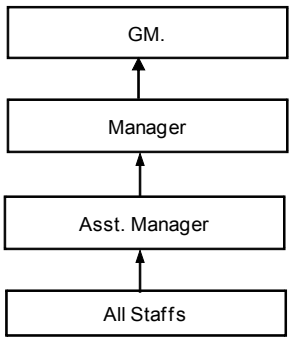
none

4. Job Specification

4.1) Education : Master or Bachelor Degree in Engineering, Marketing or Related)
4.2) Skill : - Fluent in computerize and system analysis, Fluent in english language
- Capable in negotiation and good human relation
4.3) Experience : 2 Years experience in automobile market analysis

5. Line of Command

5.1) Report to : Mgr. / GM.



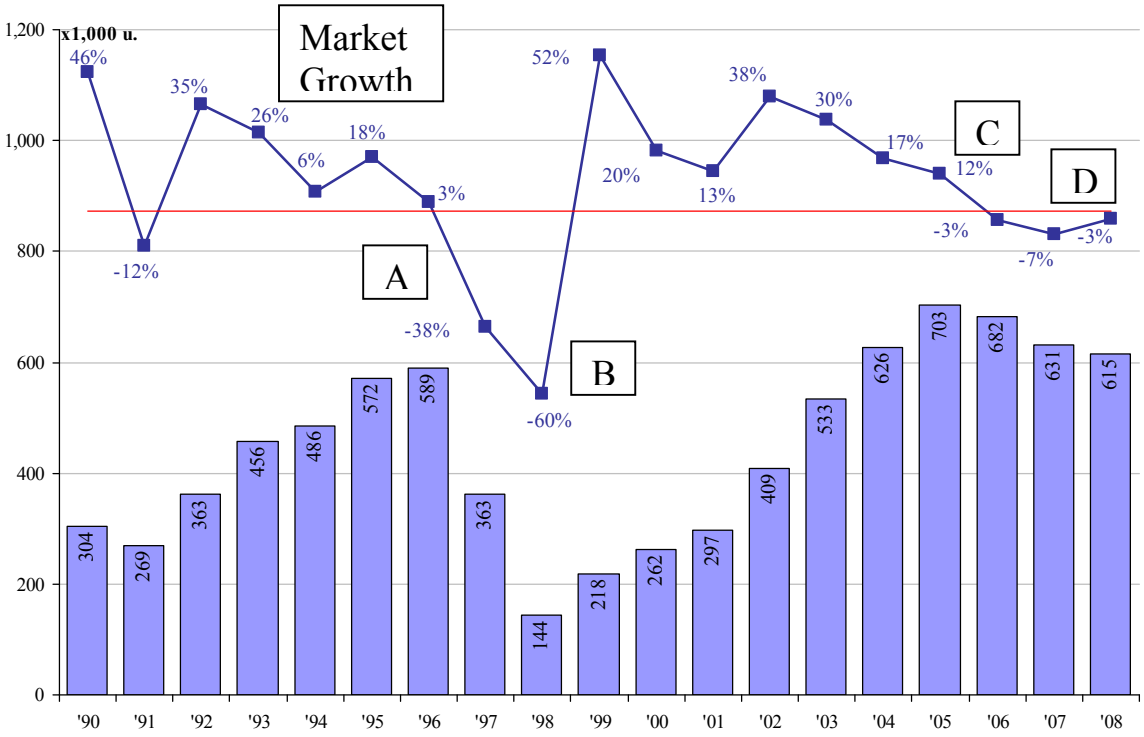
Source: Sales Planning Department

Figure A.3: Job Description of Sales Planning Section

Appendix B

PAST RECORD OF AUTOMOBILE MARKET AND COMPANY A SALES

History of Thailand's Automobile Market



A: In 1996, Tom Yum Kung Economic Crisis started to hit Thailand

B: In 1998, Tom Yum Kung Economic Crisis spread over the whole regions and also affected in all markets including Automobile

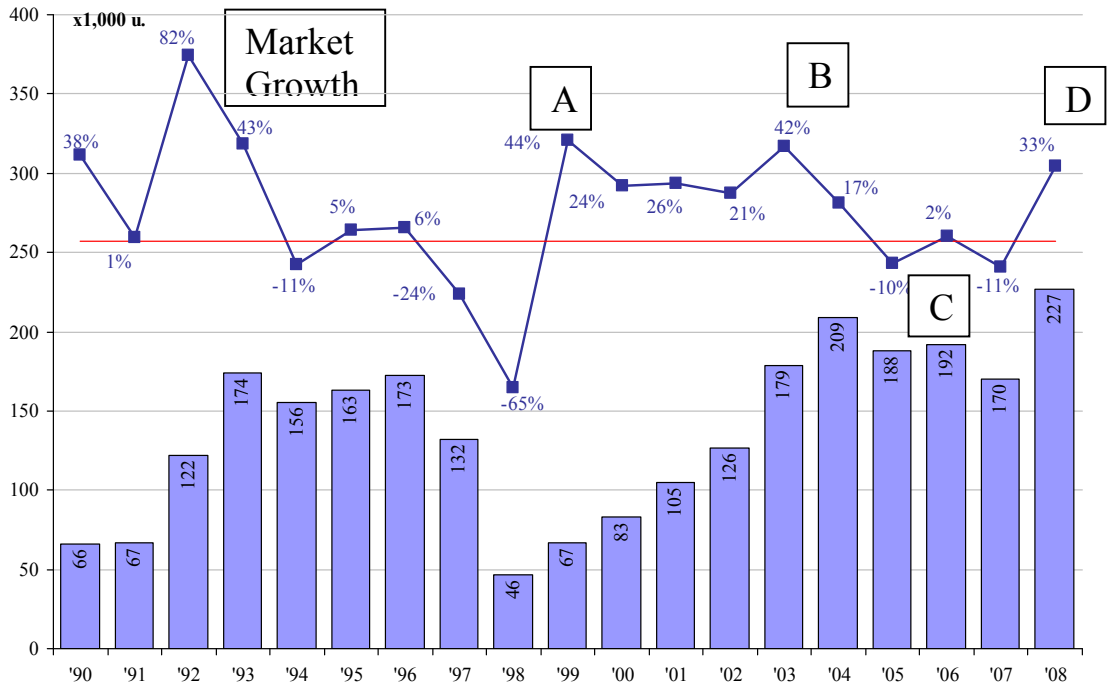
C: In 2006, Tsunami disaster affected the Automobile market

D: In 2007 and 2008, Fuel Price Crisis and Economic Crisis affected the whole world including Thailand's Automobile market

Source: Sales Planning Department

Figure B.1: History of Thailand's Automobile Market from 1990-2008

History of Thailand's Passenger Car Market



A: Excise Tax Reduction from 37.5% to 35%

B: Excise Tax Reduction from 35% to 30%

C: Customers are waiting for E20 which Excise Tax Reduction from 30% to 25%

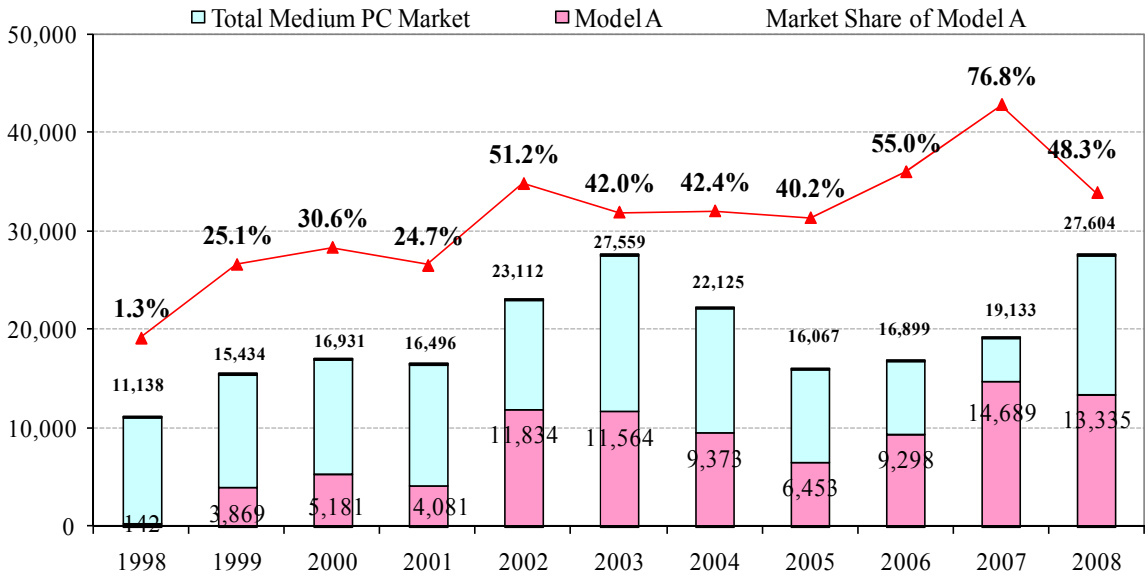
D: Start to sales Vehicle that applied E20

Source: Sales Planning Department

Figure B.2: History of Thailand's Passenger Car Market from 1990 to 2008

Past Record of Medium Passenger Car Market

and Model A Sales from 1998-2008



Source: Sales Planning Department

Figure B.3: Past Record of Medium Passenger Car Market and Model A Sales in Thailand from 1998-2008

Past Record of Thailand's Automobile Market and Company A Sales

Market Sales Record		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total Market		**144,065**	**218,330**	**262,189**	**297,052**	**409,362**	**533,176**	**626,026**	**703,432**	**682,161**	**631,251**	**615,270**
	Large	2,786	2,642	4,864	6,137	5,644	5,745	6,198	4,927	4,463	4,185	3,674
	Med	11,138	15,434	16,931	16,496	23,112	27,559	22,125	16,067	16,899	19,133	27,604
	Small	32,376	48,555	59,070	77,712	91,794	139,073	156,202	151,352	160,294	138,997	188,589
Total Passenger Car		46,300	66,858	83,106	104,502	126,353	179,005	209,110	188,211	191,763	170,118	226,805
	1 Ton	81,263	129,904	151,703	168,639	241,266	309,114	368,911	469,657	449,796	405,865	334,282
Total Commercial Car		97,765	151,472	179,083	192,550	283,009	354,171	416,916	515,221	490,398	461,133	388,465

Company A Sales Record		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total Company A Sales		42,661	74,619	71,300	83,514	130,052	188,748	234,177	277,955	289,108	282,088	262,210
	Model D					2,442	46,139	48,732	47,128	35,964	45,032	45,304
	Model C									18,466	9,926	11,499
	Model B	5,054	9,117	9,705	19,009	22,970	23,580	25,091	25,530	20,900	16,650	31,923
	Model A	142	3,869	5,181	4,081	11,834	11,564	9,373	6,453	9,298	14,689	13,335
Total Passenger Car		15,116	24,278	27,298	35,448	50,734	82,734	103,464	90,298	92,566	92,530	106,853
Total Commercial Car		27,545	50,341	44,002	48,066	79,220	105,984	130,713	187,657	196,542	189,558	155,357

Source: Sales Planning Department

Table B.1: Past Record of Thailand's Automobile Market and Company A Sales from 1998-2008

Appendix C

RETAIL SALES OF MODEL A BY DEALERS

2007-2008

Retail Sales of Mode A by Dealers of 2007

2007 SSD / Sales Planning Dept.

Dealer	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Dealer 1	51	46	69	53	37	35	58	73	69	68	43	28	630
Dealer 2	31	30	50	26	27	21	32	56	41	36	45	14	409
Dealer 3	18	18	27	18	19	14	22	19	13	18	11	7	204
Dealer 4	14	16	24	15	15	17	20	22	20	18	20	6	207
Dealer 5	19	29	39	30	26	27	35	39	32	30	37	8	351
Dealer 6	22	12	35	20	21	16	22	24	30	25	24	14	265
Dealer 7	104	141	266	145	131	142	206	211	179	214	162	62	1963
Dealer 8	36	60	102	67	60	56	76	71	88	86	62	61	825
Dealer 9	64	97	89	63	69	72	96	105	90	83	77	36	941
Dealer 10	21	29	50	27	32	20	37	45	31	37	34	21	384
Dealer 11	9	6	10	6	6	6	6	9	5	10	6	2	81
Dealer 12	30	41	31	21	27	15	29	25	25	24	30	26	324
Dealer 13	3	10	20	11	10	9	16	16	15	13	10	25	158
Dealer 14	9	11	17	11	11	8	13	13	13	9	10	6	131
Dealer 15	54	52	53	36	50	33	42	63	55	61	42	26	567
Dealer 16	8	15	21	12	9	8	14	16	19	11	14	5	152
Dealer 17	24	26	31	23	17	15	25	30	31	32	33	12	299
Dealer 18	4	13	14	7	10	8	11	14	9	10	13	2	115
Dealer 19	14	9	12	8	14	20	16	18	11	8	10	9	149
Dealer 20	6	8	7	4	6	3	7	10	6	5	4	9	75
Dealer 21	38	36	33	29	12	16	19	18	16	16	11	2	246
Dealer 22	11	10	16	9	9	7	10	16	11	9	10	21	139
Dealer 23	14	12	13	12	10	6	11	13	7	9	8	2	117
Dealer 24	12	21	29	14	22	18	22	35	19	24	28	7	251
Dealer 25	9	15	26	13	9	16	19	14	19	9	21	4	174
Dealer 26	20	35	45	33	24	23	32	39	29	26	30	15	351
Dealer 27	8	9	16	10	9	6	15	10	11	13	10	2	119
Dealer 28	12	14	18	14	11	13	15	18	15	14	15	7	166
Dealer 29	7	11	8	7	7	6	8	13	12	8	8	2	97
Dealer 30	7	8	18	8	14	11	11	16	16	12	5	8	134
Dealer 31	7	7	16	10	10	10	13	13	16	16	12	13	143
Dealer 32	15	10	16	7	8	9	8	12	13	12	10	3	123
Dealer 33	12	29	28	11	6	8	8	15	6	6	14	2	145
Dealer 34	5	6	4	5	3	3	4	4	2	6	2	2	46
Dealer 35	2	5	7	4	3	4	3	8	7	3	4	3	53
Dealer 36	2	4	4	3	2	1	2	2	1	3	3	1	28
Dealer 37	9	9	9	6	5	7	6	6	5	11	1	2	76
Dealer 38	3	6	6	5	4	3	2	7	3	3	5	1	48
Dealer 39	3	4	4	1	2	3	3	3	2	4	1	1	31
Dealer 40	1	1	3	3	1	2	3	3	5	4	1	2	29
Dealer 41	2	2	2		3		2	2		1		2	16
Dealer 42	10	13	5	6	6	4	6	5	10	1	5	1	72
Dealer 43	4	2	6	3	2	3	3	3	3	4	2	3	38
Dealer 44	9	7	10	5	8	5	8	11	8	6	10	3	90
Dealer 45	7	6	3	5	2	3	3	3	3	3	4	3	45
Dealer 46	3	8	10	2	8	5	6	8	8	8	4	3	73
Dealer 47	1	9	6	6	4	2	5	5	7	4	2	5	56
Dealer 48	1	4	3	4	4	2	4	3	3	2	6	1	37
Dealer 49	2	2	7	1	2	5	3	3	5	2	4	2	38
Dealer 50	4	4	5	3	2	4	5	5	5	3	2	2	44
Dealer 51	1	6	4	4	3	6	2	2	2	7	2		39
Dealer 52	2	5	8	4	5	7	4	10	2	6	4	1	58
Dealer 53	2	2	1	2	2	1	3	3	3	3	2	2	26
Dealer 54	3	6	9	7	6	5	5	10	7	6	6	4	74
Dealer 55	6	10	11	9	7	7	11	11	8	12	7	5	104
Dealer 56	12	9	16	12	13	10	13	15	13	13	12	5	143
Dealer 57	9	11	21	9	10	10	14	13	16	13	9	13	148
Dealer 58	1	5	7	3	4	4	3	5	5	5	5	3	50
Dealer 59		3	1	2	1	2	1	3	3	3	4	3	26
Dealer 60	4	4	7	6	2	1	2	2	4	5		3	40
Dealer 61	4	4	4	3	3	2	5	6	3	7	1	1	43
Dealer 62	4		1	1	2		3	1		1			13
Dealer 63	3	6	10	5	4	3	6	7	9	6	3	6	68
Dealer 64								1	3				4
Dealer 65	1	6	2	3	7	3	3	6	2	3	6	6	48
Dealer 66	1	1	4	2	3		5	3	2	3	1	2	27
Dealer 67	6	4	3	5	3	1	8	2	4	5	3	1	45
Dealer 68	3	2	1	2	4		3	1	2	1	3	2	24
Dealer 69		2	2	3	1	1		3	1	3	4	2	22
Dealer 70	1		4			3	2	4		1	3		18
Dealer 71	3	4	9	2	6	2	6	5	7	8	5	2	59

(Second half of the table is to be continued in the page)

Retail Sales of Model A by Dealers of 2007

2007 SSD / Sales Planning Dept.

Dealer	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Dealer 72		2	2	1	1	2	2	2	3	3	2		20
Dealer 73	5	3	3	3	3	1	2	3	3	3		1	30
Dealer 74	1	1	1			1					1		5
Dealer 75	2	2		1	1	1	1				2	1	11
Dealer 76	1	2	4	2	2	2	3	2	3	2	1	1	25
Dealer 77	4	5	16	7	5	5	7	7	6	9	14	5	90
Dealer 78	3	5	3	5	5	3	6	5	1	4	6	3	49
Dealer 79	5	3	6	4	7	2	4	5	7	8	6	2	59
Dealer 80		1	1			1		1	1		1	1	7
Dealer 81	3	3	4	2	4	4	1	6	6	3	5		41
Dealer 82	8	5	12	9	4	8	8	12	5	10	9	2	92
Dealer 83	5	4	7	4	6	6	7	7	7	5	3	4	65
Dealer 84	1	1	3	1	2	1	3		2	1	2		17
Dealer 85	1		2		1		1			2		1	8
Dealer 86	1	2	3	1	2	1	3		1		1	1	16
Dealer 87	4	3	7	1	1	3	5	4	3	7	2	2	42
Dealer 88	2		3		1	2			1	2	2		13
Dealer 89	2	3	3	3	4	2	1	6	4	3	2	2	35
Dealer 90				1	2	4		1	1		2	4	15
Dealer 91	1		2	2		1	2		1	1	3		13
Dealer 92	1	1	1	1	2	2		1		1	1		11
Dealer 93	5	10	13	8	10	7	8	9	7	13	8	4	102
Dealer 94	4	6	6	3	5	4	6	5	4	4	6	4	57
Dealer 95	1	4	5	1	7	4	3	7	2	2	1	2	39
Dealer 96	1	1	2		1	2	2	1	2	1	1		14
Dealer 97	3	5	9	2	5	5	5	5	3	7	15	1	65
Dealer 98	1		1	1	1	1			1	2	1	2	11
Dealer 99	2	2	3		2	1	2	1	3	5		1	22
Dealer 100	1	1	2	1				2	1	1	1	1	11
Dealer 101		2	2	5	3	1	2	3	3	4	4	1	30
Dealer 102		2	1	1	2	1	2			1	3	1	14
Dealer 103	1		2	2			1	1		1			8
Dealer 104		2	2	2	1	1	1		1	1	1		12
Dealer 105	4	3	5	4	4	2	2	6	3	4	2	3	42
Dealer 106	9	4	9	2	3	6	5	7	9	5	3	5	67
Dealer 107	2	2	2	3	1	1	3	1	1	1			17
Dealer 108	13	9	10	9	6	8	5	8	6	10	7	7	98
Dealer 109	1	1	1	1	2	3		2	3	1	1		16
Dealer 110	1	2	1	2	3	1	2	4	1	2	2	1	22
Dealer 111	3	3	4	3	6	4	5	4	5	5	4	5	51
Dealer 112							1	2	1	5	2		11
Dealer 113	2	3	9	3	3	3	2	4	2	5	7	3	46
Dealer 114	1	1	2	1	1	2	2	3	1	2	2	1	19
Dealer 115	6	6	6	5	6	4	6	6	5	7	6	4	67
Dealer 116	3	6	6	9	9	7	10	9	7	9	9	4	88
Dealer 117	1		1	1	1		3		4	2		1	14
Dealer 118	2	2	1	1			1	2	1	1	1	1	13
Dealer 119			2	1		1	1		2	1	1	1	10
GRAND TOTAL	1006	1241	1722	1103	1106	1008	1336	1526	1346	1370	1211	714	14689

Source: Sales Planning Department

Table C.1: Past Record of Model A Retail Sales by Dealer of 2007

Retail Sales of Model A by Dealers of 2008

2008 SSD / Sales Planning Dept.

Dealer	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Dealer 1	41	55	98	26	60	67	45	57	35	29	27	46	586
Dealer 2	16	25	41	21	23	28	33	17	24	18	22	32	300
Dealer 3	4	11	18	9	8	16	10	12	8	13	6	10	125
Dealer 4	13	22	24	10	17	15	14	16	11	12	5	16	175
Dealer 5	21	33	33	22	36	40	24	23	18	19	14	25	308
Dealer 6	18	22	23	15	14	18	15	15	13	7	10	12	182
Dealer 7	135	191	222	166	169	179	158	165	141	164	98	111	1899
Dealer 8	50	49	89	81	60	53	57	50	45	42	38	53	667
Dealer 9	40	82	103	83	83	83	67	58	74	74	26	52	825
Dealer 10	19	32	47	30	43	65	41	36	39	28	28	29	437
Dealer 11	1	4	6	6	6	3	5	2	3		1	3	40
Dealer 12	10	40	38	23	49	39	27	33	17	30	20	45	371
Dealer 13	9	14	15	17	13	10	17	9	9	18	11	19	161
Dealer 14	4	5	9	10	9	8	6	6	3	5	2	5	72
Dealer 15	33	33	48	27	59	47	45	37	30	23	28	36	446
Dealer 16	4	15	15	9	10	14	17	6	9	12	9	18	138
Dealer 17	19	33	49	30	39	35	29	24	17	16	17	25	333
Dealer 18	3	11	19	6	12	8	14	12	8	8	18	13	132
Dealer 19	10	14	20	17	15	10	8	6	1	5	3	6	115
Dealer 20	4	5	9	5	2	6	3	2	2	8	6	3	55
Dealer 21	16	9	10	8	11	13	16	13	7	5	4	9	121
Dealer 22	7	14	18	14	9	12	7	12	6	14	8	9	130
Dealer 23	6	13	11	8	8	7	7	2	5	2	2	6	77
Dealer 24	9	19	25	25	16	18	18	18	25	8	15	27	223
Dealer 25	9	14	6	11	12	10	8	7	6	2	3	3	91
Dealer 26	24	22	37	33	36	36	22	25	22	32	12	27	328
Dealer 27	7	8	10	5	8	9	9	6	7	6	6	5	86
Dealer 28	15	10	13	9	14	9	12	15	20	8	14	9	148
Dealer 29	5	9	7	9	7	11	10	14	5	7	2	9	95
Dealer 30	9	12	19	9	8	11	14	10	14	10	5	13	134
Dealer 31	12	18	20	16	24	23	17	22	16	25	21	19	233
Dealer 32	6	10	14	11	10	8	11	9	6	6	4	8	103
Dealer 33	4	7	15	7	9	12	9	9	4	3	5	3	87
Dealer 34	1	3	5		4	2	4	4	3	2	2	2	32
Dealer 35	5	1	10	5	6	4	3	8	3	3	6	3	57
Dealer 36	2	2	3	4	2	1	2	1	3	1	3	2	26
Dealer 37	3	8	13	3	8	7	8	6	3	2	15	6	82
Dealer 38	5	4	6	4	4	3	3	2	1	3	1	3	39
Dealer 39	3	1	3	3	3	5	2	4	4	3	5	3	39
Dealer 40	1	2	5	1	3	1	2	2	1	2	2	1	23
Dealer 41	1		1	3	2	1	1	2	1	1	1	1	15
Dealer 42	2	9	5	5	5	8	4	6	3	2	3		52
Dealer 43	5	4	3	3	2	4	5	3	3	4	2	5	43
Dealer 44	4	16	14	9	8	11	10	8	4	5	8	8	105
Dealer 45	1	6	7	3	4	5	3	3	1	5	4	7	49
Dealer 46	2	9	11	9	7	3	8	7	4	4	1	3	68
Dealer 47	2	5	6	4	2	6	4	3	1	7	1	17	58
Dealer 48	1	4	6	2	3	4	3	1	3	3		11	41
Dealer 49	1	3	3	3	6	2	1		2	2	2	1	26
Dealer 50	4	5	3	2	2	3	5		2	2	1	5	34
Dealer 51	2	3	7	7	3	2	2	1	2	3	1	3	36
Dealer 52	2	4	6	6	3	4	3	2		3	6	1	40
Dealer 53	1	3	3	3	1	1	3		1		1	3	20
Dealer 54	4	3	9	3	6	6	7	2	2	2	2	4	50
Dealer 55	12	13	13	6	14	13	11	10	10	9	9	13	133
Dealer 56	11	8	17	11	14	15	16	11	2	21	11	5	142
Dealer 57	7	19	18	13	16	10	15	14	11	7	13	14	157
Dealer 58	5	6	7	1	4	8	6	2	4	4	2	7	56
Dealer 59	2	3	6	2	2	2	1	6	3	4		5	36
Dealer 60	2	1	7	3	4	3	4	5	2	4	6	6	47
Dealer 61		10	7	5	7	8	6	5	6	5		4	63
Dealer 62	1	1	1		2	2	2	1	2		1	3	16
Dealer 63	4	5	8	7	7	4	6	2	7	5	1	7	63
Dealer 64			1			1				1			3
Dealer 65	2	3	4	5	6	3	5	4	3	4	4	3	46
Dealer 66	4	4	5	1	3	3	2	3	2	3	1	3	34
Dealer 67		3	8	2	6	7	4	5	2		2	6	45
Dealer 68	1		1	2	3	2	3	1			2	1	16
Dealer 69			2	1	3	2	2	1	3		1		15
Dealer 70			1	1	2	2	2	3	3	1			15
Dealer 71	9	9	9	6	8	7	9	7	6	8	3	5	86

(Second half of the table is to be continued in the page)

Retail Sales of Model A by Dealers of 2008

2008 SSD / Sales Planning Dept.

Dealer	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Dealer 72	1	2	3	3	4	1	2	3	2		1	5	27
Dealer 73	1	1	2	1	3	2	2	3			1		16
Dealer 74	1				1						1	1	4
Dealer 75				1	2		1			2		1	7
Dealer 76		2	1	7	3	2	3	1	1	1	2	5	28
Dealer 77	8	9	16	9	11	7	5	6	12	12	12	10	117
Dealer 78	2	5	5	4	3	4	3	2	5	5	1	2	41
Dealer 79	1	7	7	2	10	1	5	4	3	8	2	3	53
Dealer 80	1			1	1	2	1		1				7
Dealer 81		4	2	1									7
Dealer 82					5	4	4	2	7	3	4	5	34
Dealer 83	2	4	15	4	7	5	6	3	5	5	9	14	79
Dealer 84	4	3	6	6	8	6	4	4	7	1	3	2	54
Dealer 85	1	3	1	2	1	3	2	2			1	1	17
Dealer 86		1	2	1	4	3		1	1	2	1	3	19
Dealer 87				1		3	1		1	1		1	8
Dealer 88	2	1	1	1	2	1	4	3	2	3	3	8	31
Dealer 89	1	1	5	2	3	1	3		2	1		3	22
Dealer 90	1	2	6	2	2	4	1	1	1	2		4	26
Dealer 91		3	2	1	3	2	1				1	1	14
Dealer 92	3		1	2	4	2		5	2		2	3	24
Dealer 93		1		1		1		1		1			5
Dealer 94	3	11	11	14	12	7	6	4	5	7	8	7	95
Dealer 95		4	4	3	7	3	3	2	2	3	4	9	44
Dealer 96		3	8	2	3	4	2	2	4	2	2	3	35
Dealer 97	1	1	2	1	1	1	2	2	2	2		2	17
Dealer 98	2	2	3	6	6	1	3	2	4	3	4	7	43
Dealer 99		1	1		4	1	2		1	1		2	13
Dealer 100		1		1	2		2	1	1	2			10
Dealer 101	1	1	1	2	3	1			1	1	2	3	16
Dealer 102		1	2		3	3	5	2	1		3		20
Dealer 103	1	1	3	1	2	2	3	1		2		1	17
Dealer 104		1	1	2	1			1	1	1	2		10
Dealer 105		1	1	1	2	1			1			1	8
Dealer 106		1	4	10	4	3	5	1	7	6	4	3	48
Dealer 107	5	6	11	6	6	4	8	10	3	10	6	5	80
Dealer 108	1	3	1	3	3	3	3	1	3	1		2	24
Dealer 109	7	14	12	6	14	8	10	14	10	14	13	11	133
Dealer 110		2	3	1	3	3	3		3	3		3	24
Dealer 111	2	5	4	5	2	2	2	4	5	2	8	6	47
Dealer 112	5	6	11	5	8	2	5	4	3	4	5	5	63
Dealer 113		1	2	1	4	2	2	1	1		2	3	19
Dealer 114	1	4	7	4	3	3	1	4	3	10	3	4	47
Dealer 115	2	2	2	2	4	2	3	1	3	2		2	25
Dealer 116	3	5	13	12	5	4	6	7	7	4	3	6	75
Dealer 117	13	10	8	9	7	10	8	8	12	15	8	15	123
Dealer 118		2	3	1	2	5	2	4	2	2		2	25
Dealer 119	1	1	1	1	1	2	2		2	2		2	15
Dealer 120		2		1	3	2		4			1	1	14
GRAND TOTAL	807	1204	1650	1115	1320	1272	1159	1062	928	966	763	1090	13335

Source: Sales Planning Department

Table C.2: Past Record of Model A Retail Sales by Dealer of 2008

BIOGRAPHY

Nuttanee Bhuwatanavong was born in Bangkok on March 2, 1983. She completed her primary and secondary education at St. Joseph Convent School in 2000. Then, she studied at Sirinthorn International Institute of Technology, Thammasat University, and received a Bachelor Degree in Electrical Power Engineering in 2005.

Nuttanee started her career at Seagate Technology (Thailand) Co., Ltd. as a Facility Engineer before moving to Toyota Motor Thailand Co., Ltd and work in Sales Planning Department in 2006. At the same time, she also extends her graduate education profile by enrolling in the Master of Engineering in Engineering Management at Chulalongkorn University and the Master of Science in Engineering Business Management at University of Warwick.