PRODUCTION PLANNING AND PRODUCTION SHOP FLOOR CONTROL OF MEDIUM SIZED RESTAURANT: A CASE STUDY

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Thesis Advisor	Associate Professor Parames Chutima, Ph.D.

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งานวิจัยนี้ได้ทำการศึกษาร้านอาหารขนาดกลางเอบีซี ซึ่งตั้งอยู่ในประเทศไทย โดยมีจุดประสงค์ในการศึกษาเพื่อที่จะวางระบบการวางแผนการผลิตและควบคุมการปฏิบัติการรายวันของฝ่ายการผลิตให้เป็นไปอย่างมีประสิทธิภาพและไม่ต้องมีการลงทุนเพิ่มเติม การศึกษามุ่งเน้นไปที่การวางระบบภายในใหม่ เริ่มจากศึกษาปัญหาที่ระบบปฏิบัติการโดยอาศัยแผนภูมิก้างปลา เสาะหาสาเหตุที่แท้จริงเพื่อนำมาแก้ไข ผลจากการวิเคราะห์พบว่ามีปัญหาหลัก 6 ปัญหาที่ต้องดำเนินการแก้ไข

ทีมพัฒนาระบบได้ถูกเลือก โดยเริ่มวิเคราะห์จำนวนรายการอาหารที่ขาย (ศึกษาผลิตภัณฑ์) และคัดเลือกจำนวนรายการอาหารที่เหมาะสมโดยอาศัยแผนภูมิพาเรโต (Pareto analysis) เพื่อลดความยุ่งยากในระบบการปฏิบัติงานอันสืบเนื่องมาจากความหลากหลายของผลิตภัณฑ์ ได้มีการปรับเปลี่ยนวัฒนธรรมองค์กรในแผนกครัวเพื่อความสมดุลย์ในการทำงาน และเสริมสร้างการทำงานเป็นทีม รวมไปถึงลดปัญหาจากการพึ่งพาพนักงานรายคนมากเกินไป จากนั้นทำการวางระบบการจัดเก็บข้อมูลมาตรฐานของสูตรอาหารจากพ่อครัว เพื่อวางมาตรฐานของคุณภาพสินค้าที่จัดส่งแก่ลูกค้า มีการยกเลิกระบบซื้อจากผู้ขายในระบบการจัดซื้อ เพื่อนำจุดแข็งของร้านที่ตั้งอยู่ในละแวกเดียวกับร้านค้าท้องถิ่นมาใช้ ทั้งยังนำระบบการวางแผนการจัดซื้อวัตถุดิบ (MRP) มาใช้เพื่อการจัดซื้อที่แม่นยำยิ่งขึ้น การวิเคราะห์ฝ่ายปฏิบัติการการผลิตทั้งในหน่วยบริการและหน่วยครัวพบว่ามีจุดที่อาจนำไปสู่ความผิดพลาดในการผลิต และได้มีการวางมาตรการป้องกันล่วงหน้าทั้ง 3 จุด รวมถึงจัดการฝึกอบรมพนักงานทั้งใน 2 หน่วยการผลิตอีกด้วย

ผลการพัฒนาเบื้องต้นพบว่าทำการเพิ่มอัตราส่วนยอดขายกับต้นทุนวัตถุดิบได้ 29.05% ลดปัญหารายการอาหารหมดได้ 100% ลดข้อตำหนิจากลูกค้าได้ 94.29% ทั้งยังมีผลประโยชน์โดยอ้อมในการลดรายจ่ายจากการปฏิบัติงานได้ 43,000 บาทต่อเดือน ทั้งยังเพิ่มระดับความพึงพอใจจากพนักงาน

ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต ลายมือชื่อนิสิต……...……
สาขาวิชา การจัดการทางวิศวกรรม ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก……...…..
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PUNJAPORN CHINCHANACHOKCHAI: PRODUCTION PLANNING AND PRODUCTION SHOP FLOOR CONTROL OF MEDIUM SIZED RESTAURANT: A CASE STUDY. THESIS ADVISOR: ASSOC. PROF. PARAMES CHTIMA, Ph.D., 196 pp.

This thesis studies a medium sized restaurant called ABC, located in Bangkok. The objective is to study the production system and daily production operation for more effectiveness without higher investment. The study is focused on re-structuring of the internal organization, starting from in-depth analysis using fishbone diagram in finding the root causes. The results have shown 6 main problems, which needed to be solved.

The improvement team was selected from different departments. Team started with product selection process, by Pareto analysis, to eliminate „high variety" problem. There are changes in organization chart and cultures to gain higher stability and team work in production unit. This method also reduces problems of relying too much on individual staffs and increases efficiency of the unit. There are rearrangements of purchasing system and strategically allocate more suitable and flexible purchasing sources to gain more agility while utilizing advantages of the restaurant"s location. The restaurant also implemented MRP (Material Requirement Planning) in order to improve purchasing plans. Several points of risks in shop floor operations are identified and preventive actions suggested along with training for all staffs.

The result shows an increase of 29.05% in the revenue over raw material costs ratio, reduction of unavailability of products by 100%, reduction of customer"s complaints by 94.29% and the indirect benefits which reduced operational cost by 43,000 THB per month while gain higher satisfaction in work from all staffs.

The Regional Centre for Manufacturing Systems Engineering Student"s Signature……..

Field of Study :Engineering Management Advisor"s Signature.....

Academic Year : 2010

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CHAPTER I

INTRODUCTION

1.1 Introduction

Nowadays, economy of Thailand is not in a very good situation. Many people are now turning to SMEs and start-up of family business due to its low capital investment cost. The very popular businesses are dining business and coffee shops, which now can be seen at every corner in the street in Bangkok. This kind of business is now rapidly growing since it has potential in becoming enormous size in case the brand is strong enough to sell the franchises, and making profit from franchising strategy. The competitive rate is increasing and more challenges are revealed for restaurants in Bangkok. Many strategies are used to survive in the crisis; differentiation, franchising, or even Food center (the integration of many types of food stores in one area sharing dining areas and spaces, to attract customers seeking for variety of food).

Meanwhile, large numbers of restaurants cannot stand the crisis and shuts down for good. They cannot survive in high competitive situation and the lack of effective management in operation, marketing, finance or even simple business strategies is the main reason. Successful restaurants are now not only about having high quality of food and great tastes, it involves tactics and strong operation system. Many details are involved in restaurant management, administering, marketing techniques for example. The reasons of failure in surviving of many restaurants are mostly based on:

1. Lack of effective operation management, or lack of appropriate & suitable management style for the restaurant type (such as logistics, stock control, planning etc.).
2. Lack of financial management.
3. Human resource problem (lack of training or uncontrolled human resource system).

4. Lack of clear direction for differentiate or positioning.
5. Lack of standard for product and service quality control.

Supports and aids from engineering techniques and IE tools can be applied to solve, or at least foresee stated causes of problem, by increasing margin or reducing cost. The successful implementation of these tools and techniques leads to leading position in the business area. The possibility in long-term success is also to be achieved.

1.2 Background

ABC restaurant is a casual-dining restaurant, providing high variety for customers. It is located in the West of Bangkok, by the main road in the two-storied building. The first floor is for dining containing approximately 60 seats. The second story contains one medium-sized karaoke room (for 15-25 seats) and another large-sized karaoke room (30-50 seats). The restaurant pictures are shown in figure 1-1.

Figure 1-1. ABC Restaurant environment and catering service.

ABC restaurant started in 2008, and run as a family business. Due to its high variety of menu, the food can be categorized into 4 categories (figure 1-2);

1. Western Food (22 items): cooking processes for Western dish are mainly grill, bake and many kinds of salad served with various types of sauce.
2. Thai & Chinese Food (155 items): cooking process for Thai & Chinese dish are deep fry, fry, boil, salad mixing.
3. Drink (29 items): including fresh coffee, soft drink, smoothies and fruit juice.
4. Desserts (10 items): fresh fruits, cake, ice-cream and Thai desserts.

Figure 1-2. ABC‟s food examples.

Kitchen management has a clear border, categorized by the type of food as suggested, which is linked to responsibility in stock control, raw material purchasing and new menu launching in each section.

The restaurant opens from 11:00am to 11:00pm, 6 days a week (closed every Monday), which means it needs large amount of staffs to operate.

The director (owner of the restaurant) decided to hire a General Manager (GM) to mainly manage day-to-day operation in the restaurant; raw material purchasing, human resource managing, accounting etc., and reports directly to the director. The strategies and direction of the restaurant will be planned and decided by the director only. In the kitchen team, there are three cuisine chefs; one Western food cuisine chef, 2 Thai & Chinese cuisine chefs, each of which have one sous chef to assist them. There are one dishwasher and two more kitchen assistants. The cuisine chefs take care of raw material stock level in their own specialty, and report to GM to purchase. The organization chart will be shown in chapter 3.

While in the service section, Floor Manager takes charge and controls all of three main positions; waiters and waitresses, cashier and two baristas at the drink corner. Baristas at the drink corner also takes care of desserts serving in the restaurant. Most of the desserts are not made by our chefs, they are ordered from other sources.

Responsible areas in the restaurant can be divided into 3 main groups;

1. Kitchen area: where Cuisine chefs take control in daily stock checking, raw material storage, arranging responsibility for staff in kitchen team etc.
2. Serving area: where Floor manager takes control, including servicing customers, cashiering, drink & dessert stock checking etc.
3. Administration: where General Manager takes control in raw material purchasing, human resource, staff"s scheduling rotation etc.

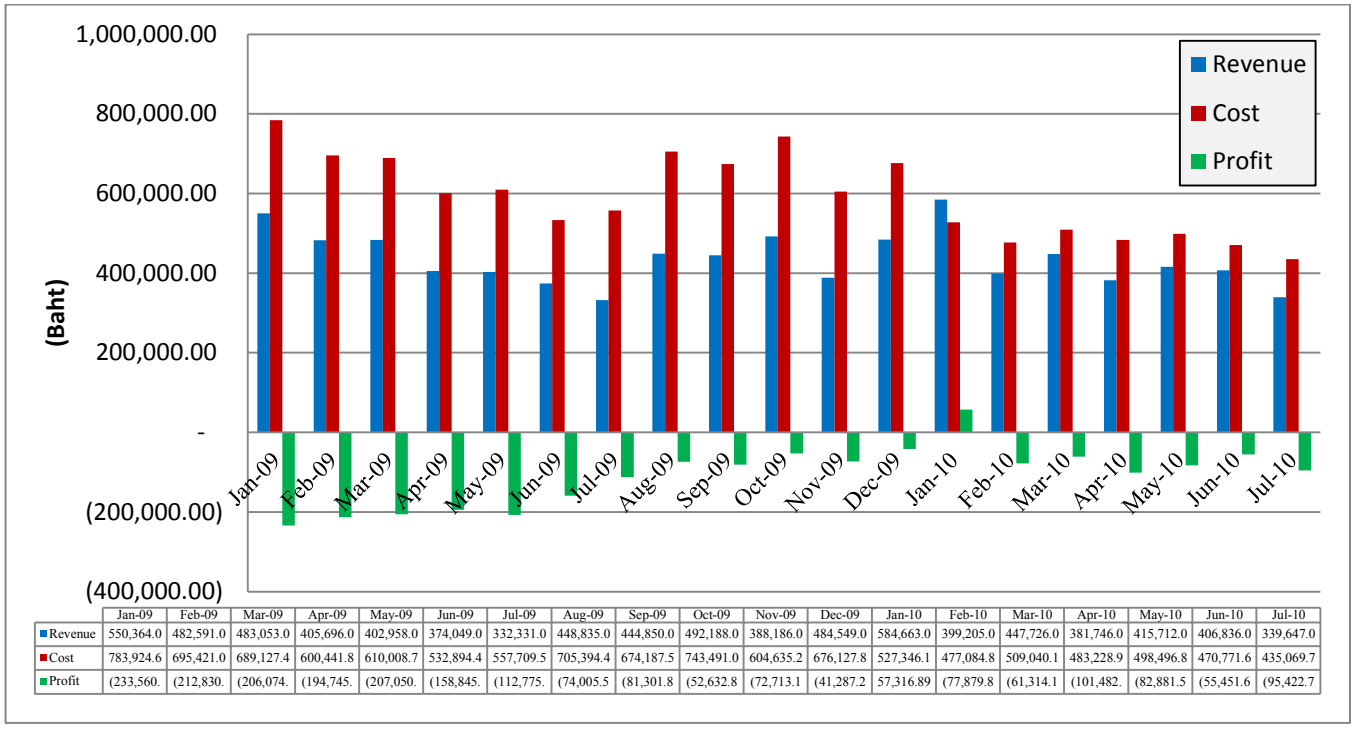
All of which will report to the director to adjust new rules or strategies for the restaurant. The restaurant targets the customers in the nearby area, since the location is exactly by the main road, which is easy to notice, and positions itself as a family restaurant. Not only for dining, we also have karaoke and have catering service for customers reserving in advance.

Due to the changing environment around the restaurant, one large organization is now setting up the headquarter next to the restaurant. Some arrangements have been done from this organization that ABC will support most of the catering service and also provide entertainment and dining facility for the organization. This means that

load of customers tends to increase rapidly at the beginning of February 2011. This is a very good opportunity for the restaurant to gain benefit.

1.3 Statement of Problem

As stated that many restaurants are facing lack of efficiency and effectiveness operation and lack of surviving tactics in real world, ABC is also facing the crisis. Even though the monthly revenue is in high, but there is a small gap between cost and revenue. Since business is done for profit, this is not a good situation for the restaurant. The director (owner) and staff are not familiar with restaurant business. Cost and unnecessary waste from operation in the kitchen and serving area are high compared to revenue.



	Jan-09	Feb-09	Mar-09	Apr-09	May-09	Jun-09	Jul-09	Aug-09	Sep-09	Oct-09	Nov-09	Dec-09	Jan-10	Feb-10	Mar-10	Apr-10	May-10	Jun-10	Jul-10
Revenue	550,364.0	482,591.0	483,053.0	405,696.0	402,958.0	374,049.0	332,331.0	448,835.0	444,850.0	492,188.0	388,186.0	484,549.0	584,663.0	399,205.0	447,726.0	381,746.0	415,712.0	406,836.0	339,647.0
Cost	783,924.6	695,421.0	689,127.4	600,441.8	610,008.7	532,894.4	557,709.5	705,394.4	674,187.5	743,491.0	604,635.2	676,127.8	527,346.1	477,084.8	509,040.1	483,228.9	498,496.8	470,771.6	435,069.7
Profit	(233,560.	(212,830.	(206,074.	(194,745.	(207,050.	(158,845.	(112,775.	(74,005.5	(81,301.8	(52,632.8	(72,713.1	(41,287.2	57,316.89	(77,879.8	(61,314.1	(101,482.	(82,881.5	(55,451.6	(95,422.7

Figure 1-3. Bar chart comparing Revenue, cost and profit from January 2009 to July 2010.

The bar chart (figure 1-3) shows monthly revenue, cost and profit from January 2009 to July 2010. The average revenue for 19 months is approximately 435,000 baht, but there is no profit for each month. The situation started to get better at the end of 2009, when ABC had smaller amount of loss compared to the first 6

months of the year. Due to accounting system, the cost is divided into 3 types; Raw material, Supplies material and Operation cost. The proportion of averaged cost from each category in 19 months is shown.

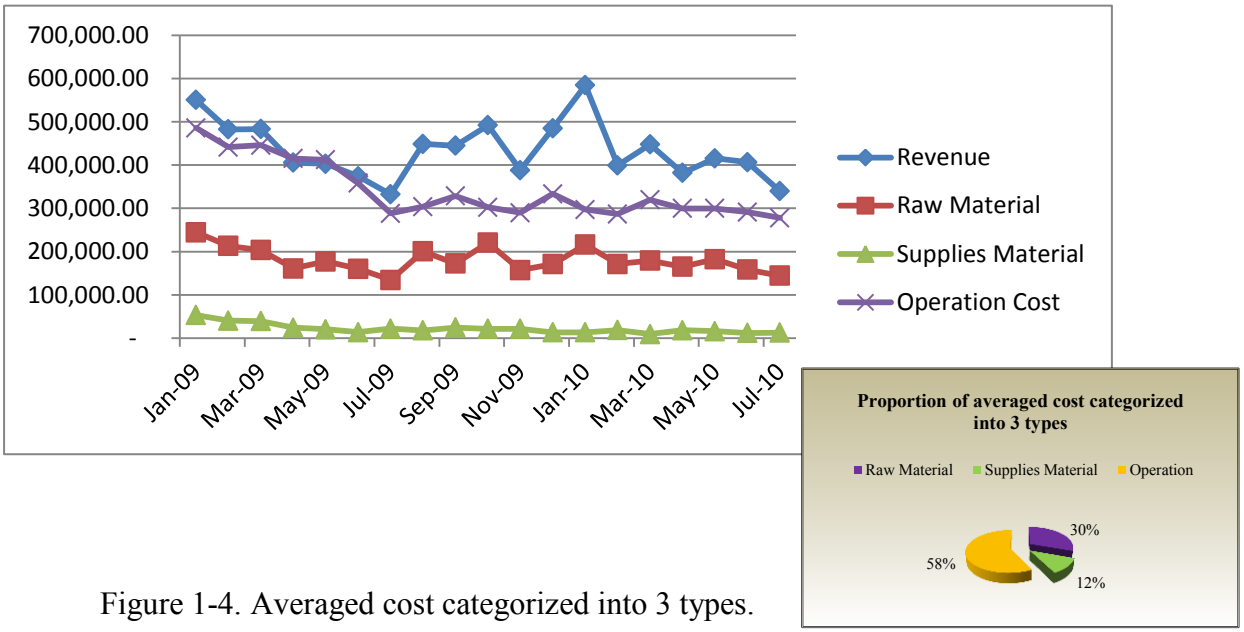


Figure 1-4. Averaged cost categorized into 3 types.

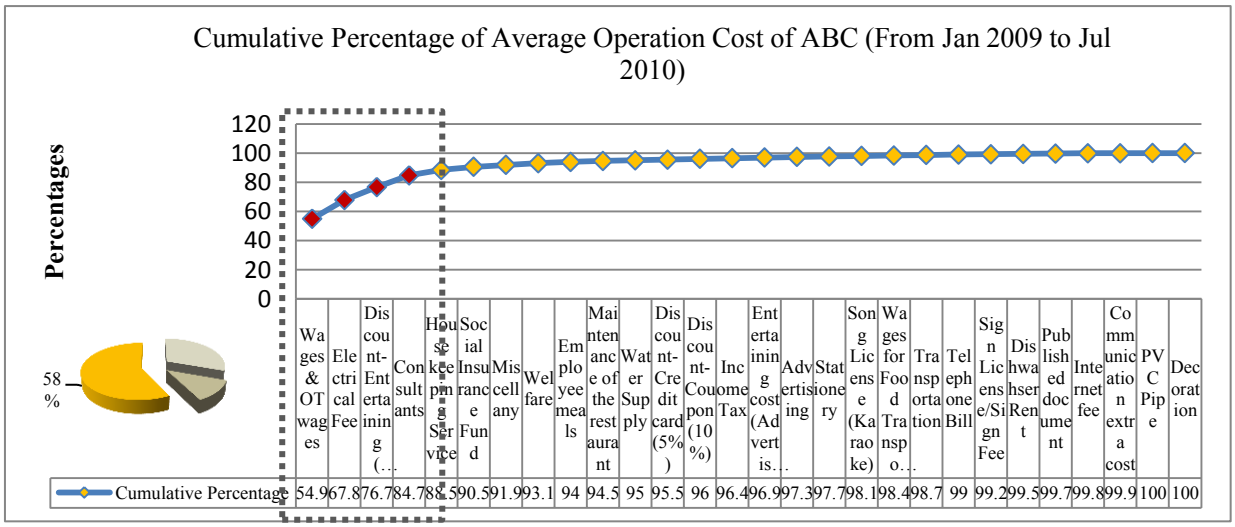


Figure 1-5. Cumulative percentage of average operation cost of ABC (From Jan2009 to Jul2010).

The highest cost is the operation cost, followed by the raw material, from figure 1-4 and figure 1-5. The 58% of operation cost is to be categorized into several

topics, but from cumulative plotting, the results show that 84% of operation cost falls into 4 categories:

1. Wages & Over Time wages (54.91% of operation cost)
2. Electrical Fee (12.86% of operation cost)
3. Discount-Entertaining-20% (8.89% of operation cost) – is the discount for management team or advertising entertaining service.
4. Consulting (8.02% of operation cost) – fixed cost, 15,000 baht per month.

The overtime is mostly from inappropriate staff scheduling, from excessive work in stock management and kitchen cleaning. Electricity usage is one must-have of every business, but the improper use and not suitable machines, mostly from excessive refrigerators for keeping raw material, can cause high cost from electricity than it"s supposed to be. If these two categories of cost can be reduced, ABC will save about 60% of its operation cost and can provide profit to the restaurant.

For the raw material, it is categorized by purchasing into 7 categories. The average cost of raw material in each category is shown in proportion in the line graph below (figure 1-6).

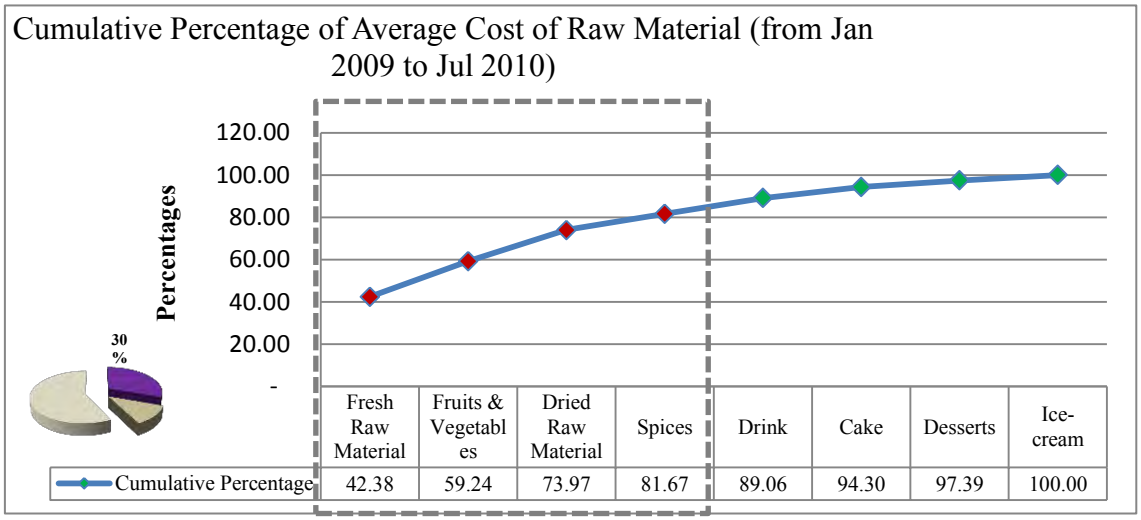


Figure 1-6. Cumulative percentage of average cost of raw material (from Jan2009 to Jul 2010).

From the cumulative plot line, the first 81.67% of cost from raw material is from purchasing;

1. Fresh raw material (42.38% of overall raw material cost).
2. Fruits & vegetables (16.86% of overall raw material cost).
3. Dried raw material (14.72% of overall raw material cost).
4. Spices (7.71% of overall raw material cost).

The history shows that the cause of high cost from the first two categories is that they become rotten before being used due to inappropriate stock management of low-experienced kitchen team. The second reason is also from the small buying unit, when sudden shortage of raw material occurs.

The conclusion of main problems, that ABC is facing, is stated.

1. **Lack of production plan:** The historical sales data and statistics are hardly collected and not used for forecasting. Ignorance of production planning leads to many consequences which cause problems to the restaurant. Current operating system struggles from unplanned highly swing of customer‟s demand and menu launched.
2. **High purchasing cost of raw material**: The loss of raw material is caused from lacking of the annual plan for launching new menu and catering service planning. High amount of waste of expired/rotten raw material and sometimes lack of raw material for cooking. Sudden raw material shortage is one of the big problems. Last-minute purchase of specific raw material usually happens, which also leads to small purchasing unit (more expensive than larger size).
3. **Production and purchasing management relies on employees**: The director doesn‟t have direct experience in cooking or restaurant system management. The kitchen team plays important role in quality control and operation. Most of core competences rely on staff, which leads to a very big problem of controlling power of the director since most staffs are part time and have low loyalty for the business. Most effective cost savings in the kitchen area rely on staffs. The poor raw material stock control is managed by the kitchen staffs, which have poor performance in cost savings issues.
4. **Customer’s complaints about unavailability of some food items**: which caused by lacking of raw material. Sometimes there are complaints about long

waiting time before the food is served, especially during weekends or public holidays.

The restaurant faced the high amount of unnecessary waste which requires high amount of resources to solve. It is the situation which the way to prevent loss and stable system are in urgent need. To overcome these problems is a challenge to achieve, at least, balance of annual cost & profit.

1.4 Objective of Thesis

The objective is to develop systematic production planning and shop floor control for a medium sized restaurant, in order to reduce raw material expenditure and increase production efficiency for the restaurant.

1.5 Scope of Thesis

The thesis will be developed based on systems relevant to production planning and production shop floor management for ABC restaurant.

Although there is no timeframe for the reconstructing of restaurant management, the ability to handle larger numbers of customers, which tends to happen when the organization nearby opens, cannot be neglected.

1.6 Expected Benefits

ABC has been operated for 20 months, and it faced loss in every month. This crisis has to be overcome as soon as possible. Although the scale of the restaurant is relatively small, but effective working procedures and methods are important in running a successful business. The aims of benefits to be achieved from this thesis are as follows.

1. Increase monthly profit while maintaining same amount of resources.
2. Reduce unnecessary raw material waste: at least the waste from the raw material storage and excess purchases should be reduced, with more effective procedures.
3. Eliminate customer‟s complaints of unavailable menu items caused by shortage of raw material.

4. Reinforce restaurant‟s competitive advantage of providing high variety of food while reducing problems from it.
5. Reduce operation cost relevant to stock control and purchasing procedures such as overtime wages and electrical fees.
6. Increase consistency of product‟s quality by standardizing production processes.

More systematic stock control and purchasing management will surely reduce restaurant‟s current problems. Monthly profit can be achieved with effective raw material storage knowledge and purchasing procedures. Effective management systems can help reducing waste and working errors from humans, and also build strong reputation of ABC restaurant in customer‟s perspectives.

1.7 Methodology

The methods to be proceeded in this thesis will follow these steps:

1. Information gathering & Problem identification.
    a. Study of historical sales of the restaurant.
    b. Investigation of current raw material planning.
    c. Identify raw material break down for each menu.
    d. Exploration of current shop floor management in the kitchen.
2. Literature review & Study of relevant theories.

    Relevant theories and management tools are to be thoroughly studied in this step, in order to allocate them to relevant problems to be solved.
3. Planning for applying useful techniques & tools.
    a. Categorize the problems based on responsibility areas and similar solving method.
    b. Match techniques and tools from research to solve the problem in each category.
4. Implementation & Analysis.
    a. Implement the solving methods and techniques to shop floor, kitchen area and administration.
    b. Monitor the implementation results and conclude the improvement.

5. Conclusion of improved results & further studies.

Summarize overall improvement and suggest further possible studies to achieve better management system for higher profit and lower cost

CHAPTER II

LITERATURE REVIEW

Production planning is a sub-set of supply chain management. Supply chain functions, from upstream to downstream, include purchasing, inventory, production, scheduling, facility location, transportation, and distribution. (Russell and Taylor, 2006). However, those functions relevant to the scope of this thesis are as bulleted in "Production planning" subject below. Theories relevant to foodservice industry to achieve the goal of this thesis are to be studied and implemented. The literature review covers many aspects stated below;

2.1 Foodservice industry
- 2.1.1. Menu & recipe
- 2.1.2. Forecasting sales & production scheduling
- 2.1.3. Ingredient purchasing
- 2.1.4. Ingredient inventory
- 2.1.5. Measure of restaurant efficiency & control

2.2 Production Planning
- 2.2.1. Production Forecasting
- 2.2.2. Production Scheduling
- 2.2.3. Procurement
- 2.2.4. Inventory control
- 2.2.5. Shop-floor monitoring & control

2.3 Risk management

2.4 Conclusion

The effective integration and engineering-based knowledge applied to ABC management system will surely improve the restaurant‟s efficiency.

2.1 Foodservice industry

The production strategies of a restaurant should be considered based on its type and service criteria. ABC restaurant is justified as an independent restaurant, run

as a family business. Competitive advantages and disadvantages of independent restaurant are as stated in table 2-1 (Ball and Roberts, 2003).

Table 2-1. Competitive advantages and disadvantages of an independent restaurant.

Competitive Advantages	Competitive Disadvantages
1) Flexibility **2)** Specialized offering **3)** Direct control of strategy **4)** Consistency and independence **5)** Entrepreneurial drive **6)** Close to customer	1) Bargaining power 2) Few economics of scale 3) Over-dependence on owner 4) Limited planning 5) Inertia 6) Often lack specialist retail expertise and capital to expand 7) Offer greatest risk

The production planning in the future should be established to support and wisely use competitive advantages to provide more profit to the restaurant, while reducing disadvantages. Some of the risk to be taken as the independent restaurant should be revised in „Risk management", which to be discussed.

Manufacturing production planning of any kinds is to be under concerned but foodservice perspectives are not to be ignored. Internal control and planning surely improves production efficiency, however, the external effects must be accounted. The systems model of foodservice is the open system (Payne-Palacio & Theis , 2009), which environmental factors impact production demand. Effective and accurate production plan should cover as many aspects as possible. ABC restaurant is classified as a modern conventional medium-sized restaurant, which all menu items are prepared in a kitchen in the same facility where the meals are served and held in a short time.

2.1.1 Menu & Recipe

Menu is the most important part of the restaurant concept. It also plays important role in raw material planning. Since ABC is not chef-owner restaurant,

menu adjustment must be done based on standard and raw material concern. Adding new items to the menu can be risky, and have effects on production planning. Therefore most restaurants following these steps for creating new item as a special and, if it‟s popular, add it to the main menu (Walker and Lundberg, 2001).

1) Create an objective and a timetable.
2) Develop a list of possible menu ideas.
3) Narrow that list down.
4) Test those ideas with consumers.
5) Build prototypes.
6) Internally narrow the prototypes down.
7) Test and renew the prototypes in selected restaurants.
8) Put the prototypes on the menu.

If these steps are too complex, ABC can skip some of them since it‟ll save a lot of time in real operation. Menu generation can also be based on “Five rights” concept as stated in table 2-2 (Sanders et al., 2008).

Table 2-2. Five rights.

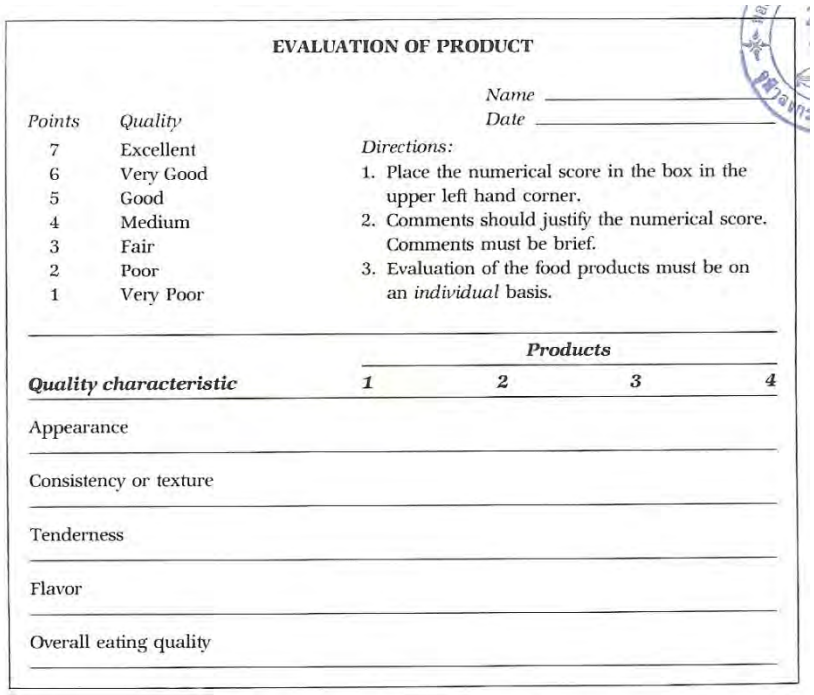
Here‟s what to do	Here‟s how to do it
1. Sell the *Right* menu items	Offer the right menu selection.
2. At the *Right* portion cost	Determine standard portion cost.
3. At the *Right* selling price	Choose a standard menu pricing method.
4. At the *Right* sales volume	Forecast sales and food cost.
5. To produces the *Right* profit	Use Menu analysis to analyze the sales mix for maximum profitability.

The primary customers and target group should be clearly identified to create new menu items, followed by calculation of a portion cost in order to set up profitable selling price. ABC might need new document system stating steps in launching new items. The system should be standardized and focused on seasonal aspects of raw

material as well. The menu selection leads to the next step, “Standardized recipe”, which is the backbone of the restaurant.

“A Standardized Recipe is the recipe that has been tested, adjusted, and retested again and again until it produces a menu item as management wants the item produced.” (Sanders et al., 2008)

Each item needs to be evaluated before standardized. Form for panel evaluation of recipes is shown in figure 2-1 (Spears and Vaden, 1985).



EVALUATION OF PRODUCT

Name _____

Date _____

Points	*Quality*
7	Excellent
6	Very Good
5	Good
4	Medium
3	Fair
2	Poor
1	Very Poor

Directions:

1. Place the numerical score in the box in the upper left hand corner.
2. Comments should justify the numerical score. Comments must be brief.
3. Evaluation of the food products must be on an *individual* basis.

	Products			
Quality characteristic	***1***	***2***	***3***	***4***
Appearance				
Consistency or texture				
Tenderness				
Flavor				
Overall eating quality				

Figure 2-1. Form for panel evaluation of recipes. (Spears and Vaden, 1985)

The recipe adjustment is followed to create standardized recipe. Three procedures have been developed for the adjustment as bulleted (Spears and Vaden, 1985):

a) Factor Method: the ingredients are changed from measurements to weights and multiplied by the conversion factor, and converted to whole numbers and decimal equivalents rather than being stated as fractions (examples in figure 2-2).

Table 10.1. *Decimal conversions for weights and measures*

Weight measure			*Volume measure*			*Weight measure*			*Volume measure*	
oz	*lb*	*Decimal unit*	*cup*	*qt*	*gal*	*oz*	*lb*	*Decimal unit*	*cup*	*qt*
½		.03125	½			8½		.53125	8½	
1		.0625	1	¼		9		.5625	9	2¼
1½		.093	1½			9½		.59375	9½	
2	⅛	.125	2	½		10	⅝	.625	10	2½
2½		.156	2½			10½		.65625	10½	
3		.1875	3	¾		11		.6875	11	2¾
3½		.218	3½			11½		.71785	11½	
4	¼	.25	4	1	¼	12	¾	.75	12	3
4½		.281	4½			12½		.78125	12½	
5		.3125	5	1¼		13		.8125	13	3¼
5½		.343	5½			13½		.84375	13½	
6	⅜	.375	6	1½		14	⅞	.875	14	3½
6½		.40625	6½			14½		.90625	14½	3½
7		.4375	7	1¾		15		.9375	15	3¾
7½		.46875	7½			15½		.96875	15½	
8	½	.5	8	2	½	16	1	1	16	4

Source: Buchanan, P. W.: *Quantity Food Preparation: Standardizing Recipes and Controlling Ingredients.* Chicago: Amer. Dietet. A., 1983, p. 26.

Figure 2-2. Decimal conversions for weights and measures. (Spears and Vaden, 1985)

b) Percentage Method: the measurements for ingredients are converted to weights and then the percentage of each ingredient of the total weight is computed (figure 2-3). This method allows adjustment to the portion size.

Ingredients	***Amount***
Eggs	12
Sugar	2 lb.
Fat, Melted	1 lb.
Vanilla	¼ C.
Cake Flour	12 oz.
Cocoa	8 oz.
Baking Powder	4 t.
Salt	2 t.
Nuts, Chopped	12 oz.

Percent	***Ingredients***	***Measure***	***pounds***
20.34	Eggs	12	1.32 lb.
30.82	Sugar	2 lb.	2.00 lb.
15.41	Fat, Melted	1 lb.	1.00 lb.
1.70	Vanilla	¼ C.	0.11 lb.
11.56	Cake Flour	12 oz.	0.75 lb.
7.71	Cocoa	8 oz.	0.50 lb.
0.49	Baking Powder	4 t.	0.0316 lb.
0.41	Salt	2 t.	0.127 lb.
11.56	Nuts, Chopped	12 oz.	0.75 lb.
100%			6.4886 lb.

Figure 2-3. Original recipe, Brownies compared to Calculate percent, Brownies. (Spears and Vaden, 1985)

c) Direct Reading Measurement Tables: Direct reading measurement tables are used for simple and quick adjustment, without mathematical calculation. Tables have been developed for both measured and weighed ingredients.

One of these methods can be chosen for ABC recipe standardization. The reason why recipe is important to production planning aspect is that it tells the raw material amount per portion, and types of raw material needed. It also controls the quality of food served in the restaurant. “Plate card” suggested as a control tool on the line for servers and cooks. It is also an important training tool for kitchen staff recruitment (Sanders et al., 2008).

Various types of menu are introduced in “Introduction to Foodservice” (Payne-Palacio and Theis, 2009), including “they cycle menu”, a planned set of menus that rotate at definite intervals of a few weeks or months. There are many advantages of the cycle menu, from standards of preparation procedures and in efficient use of equipment, ability to meet changing needs, to availability of food items. The method is widely applied to Fine-dining restaurant, but for ABC, the cycle menu could be apply for a long-term cycle, in months or quarters, due to its high variety of food and fixed main menu.

2.1.2 Forecasting Sales & Production Scheduling

Sales forecasting for a restaurant is calculated work. The external factors are over control for the restaurant: economic factors, weather, and other influences. Sales volume prediction can be done with a high degree of accuracy if a budget forecast is completed. Sales volume has two components (Walker and Lundberg, 2001):

1) Average guest check: Total sales divided by the number of guests.
2) Average guest count: Actual numbers of customers using service.

ABC restaurant does have actual sales of menu items, but not number of guests. The sales forecasting based on customers is also important, since it determines requirement of employees, amount of raw material, ingredient types and so on. Record of menu item sold can be applied.

When another week of business is to be prepared, sales history, forecasts, purchase orders, and menu specials must be reviewed, “production schedules” need to be developed. The complete production process involves the following steps (Dopson et al., 2008):

1) Maintain sales histories.
2) Forecast future sales levels.
3) Purchase and store needed food and beverage supplies.
4) Plan daily production schedules.
5) Issue needed products to production areas.
6) Manage the food and beverage production process.

Planning daily production schedules is important because you will want to have both the products and the staff needed to properly service your guests. The equation to approximate how much of each menu item to prepare on a given day would look as follows:

Prior-Day Carryover + Today‟s Production = Today‟s Sales Forecast ± Margin of Error

To minimize chance of running out of an important menu item, most restaurants tend to prepare a small amount they anticipate selling each day. Example of production sheet is shown in figure 2-4.

Unit Name: Scotto's Supper Club Date: 1/1

Menu Item	Sales Forecast	Prior-Day Carryover	New Production	Total Available	Number Sold	Carryover
1. Prime Rib	85	15	75	90		
2. Broccoli	160	0	170	170		
3. Coconut Cream Pie	41	70	0	70		
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						

Special Instructions: Thaw turkeys for Sunday preparation

Production Manager: S. Antony

Figure 2-4. Production schedule. (Dopson et al., 2008)

For some menu items that do not maintain their quality well when they are carried over, there is another option of transferring them into ingredients of different dish. Some foodservice managers preprint their production sheets listing all menu items and, thus, ensure that production levels for each major menu item are considered on a daily basis.

2.1.3 Ingredient Purchasing

Ingredient purchasing is one of the subsystems in every restaurant, which once installed can be set in motion, repeating itself (Walker and Lundberg, 2001). Steps of putting purchasing together are stated:

1) Determine food standards, based on menu.
2) Develop product specifications.
3) Gather product availability, in detail, and select supplier(s).
4) Have alternate suppliers in mind for comparison.
5) Select person(s) to order and receive supplies.

6) Set up storage spaces for maximum utilization.
7) Establish the amount needed to be stocked (par stock) for each item.
8) Set up an inventory control system.
9) Decide on optimal delivery size to reduce cost of delivery and handling.
10) Check all deliveries for quality and quantity or weight.
11) Tie inventory control and cost control systems together.

ABC restaurant‟s current purchasing system is not much different from the procedures stated. The manager is given full authority in receiving and rejecting decision. However, ABC still lacks of clear purchasing procedures, which leads to high waste from purchasing function. Purchasing cycle can be set up that rolls along efficiently, a system that repeats itself with minimal demands on the operator (figure 2-5).

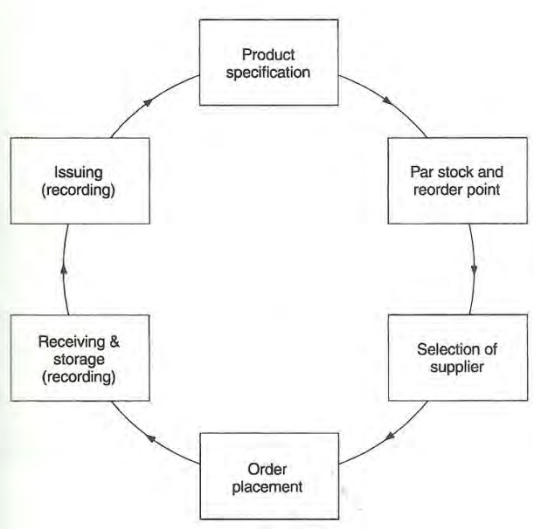
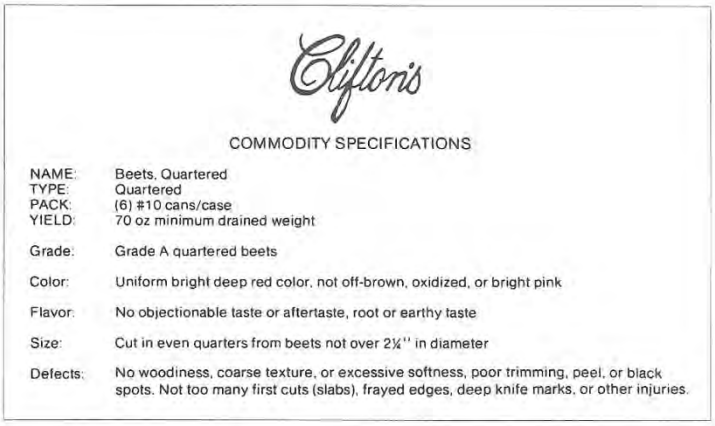


Figure 2-5. The purchasing cycle. (Walker and Lundberg, 2001)

Apart from buying the right amount, quality of food is also another vital part which cannot be neglected. Specifications of ingredient are not officially documented in ABC restaurant purchasing system, but it is stated as a vital part in purchasing (Walker and Lundberg, 2001). Clifton‟s Cafeterias, located in Southern California, have studied its fruit and vegetable needs and drawn up specifications for each product (figure 2-6). Walker and Lundberg (2001) also conclude that “best quality” is

not always the most costly ingredient, but using appropriate grade of ingredient that fits particular purpose.



Clifton's

COMMODITY SPECIFICATIONS

NAME:	Beets, Quartered
TYPE:	Quartered
PACK:	(6) #10 cans/case
YIELD:	70 oz minimum drained weight
Grade:	Grade A quartered beets
Color:	Uniform bright deep red color, not off-brown, oxidized, or bright pink
Flavor:	No objectionable taste or aftertaste, root or earthy taste
Size:	Cut in even quarters from beets not over 2¼'' in diameter
Defects:	No woodiness, coarse texture, or excessive softness, poor trimming, peel, or black spots. Not too many first cuts (slabs), frayed edges, deep knife marks, or other injuries.

Figure 2-6. Example of best specifications by Clifton's. (Dopson et al., 2008)

2.1.4 Ingredient Inventory

Quality and nutritive value of food can be retained by storing only the kinds and amounts of food you can store properly (Kendall and Dimond, 1990). Proper storage means maintaining clean refrigerator and freezer. Practical methods and appropriate temperatures for storing ingredients are introduced in the journal. The method can be adjusted for varied climates, especially in Thailand, where the average temperature is above 27 degree Celsius.

"Right amount" and "Re-order point" of inventory should be carefully calculated, and frequently reviewed. The best reorder point is one that provides some safety stock but not overfill freezer (Farsad and LeBruto, 1993). Overstocking and under stocking inventory may be avoided by developing systematic inventory management with the following two objectives:

1) Achieve an optimum (not a minimum) level of inventory ("HOW MUCH" to purchase).
2) Reduce operating costs associated with inventory such as cost of ordering, storage, and maintaining an excess supply ("WHEN" to order).

Control of requisition of “ingredient room” is vital. Time consuming and too complicated requisition system in inventory management lead to difficulties to both managers and workers. A few principles are introduced for inventory control (Dopson et al., 2008):

1) Food, beverages, and supplies should be requisitioned only as needed based on production schedules.
2) Required items (issues) should be issued only with management approval.
3) If a written record of issues is to be kept, each person removing food, beverages, or supplies from the storage area must sign, acknowledging receipt of the products.
4) Products that do not ultimately get used should be returned to the storage area, and their return recorded.

Forms for ingredient or food acquisition should be set up for ABC restaurant, and acknowledge the new system to employees in relevant functions.

2.1.5 Measure of restaurant efficiency & control

Kitchen management and kitchen layout determine production efficiency. The layout from the first set is vital, but for improvement, changing all the fixed equipment can be too costly. The improvement of existing kitchen layout for faster and smoother production is possible. The work flow within various typical kitchen layouts is shown in figure 2-7.

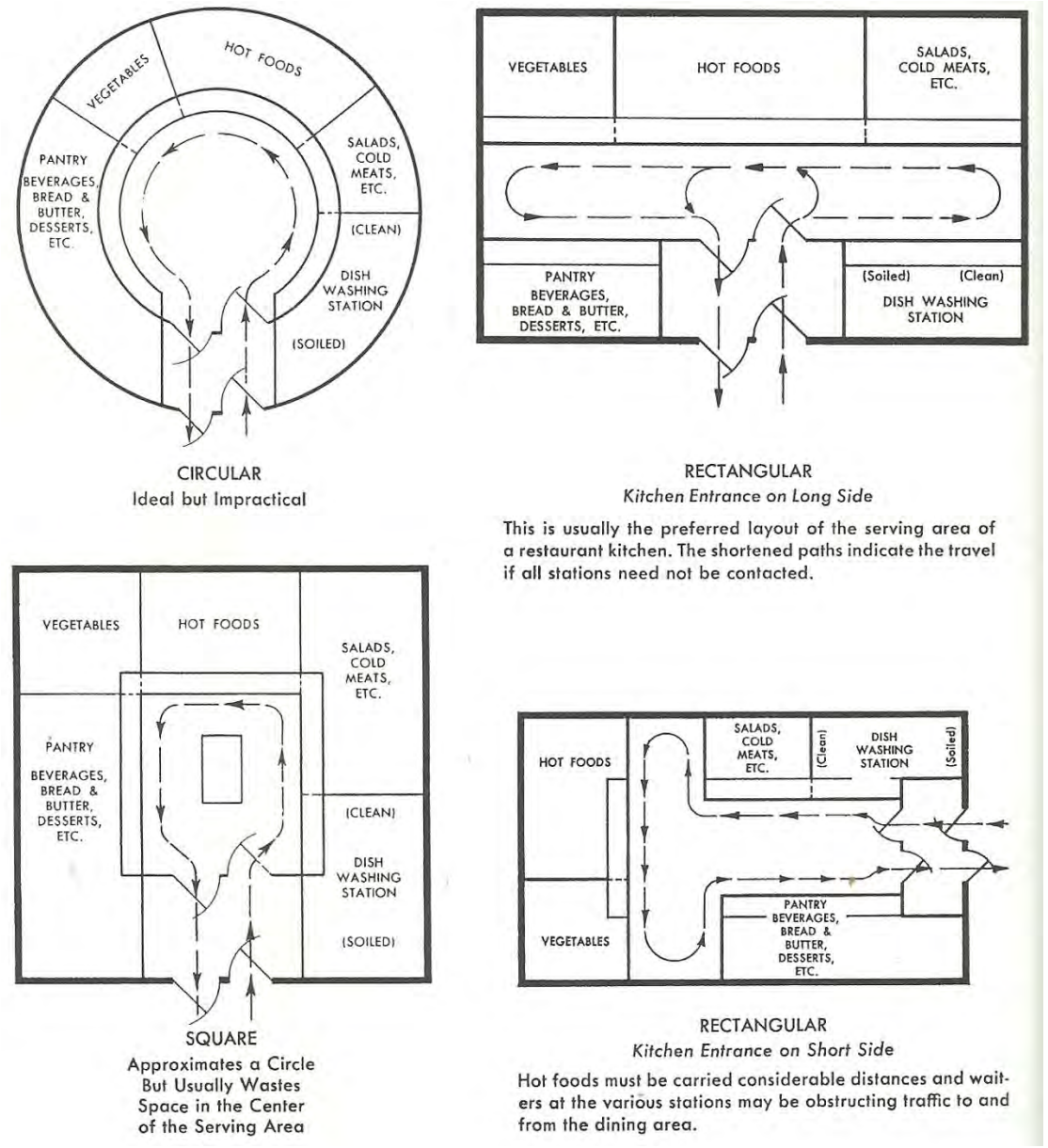


Figure 2-7. Serving area. Courtesy American Gas Association (Walker and Lundberg, 2001)

Full-service restaurant is mostly laid out so that the kitchen flow is from the receiving area to the cold and dry storage spaces to the pre-prep area (where bulk ingredients are measured and cans opened), then to the prep area (where the vegetables are washed and meat is cut). The flow continues to the cooking area before ending up at the final prep (finishing cooking and get platting for pickup by staff).

Shortest path from one place to another is always what the server follows. The efficiency and comfort of the staff is important to the operation.

Type of company organization is also vital to any change in shop-floor operation. There are 4 main types of organization culture, illustrated in figure 2-8. (Warwick WMG Course, 2009).

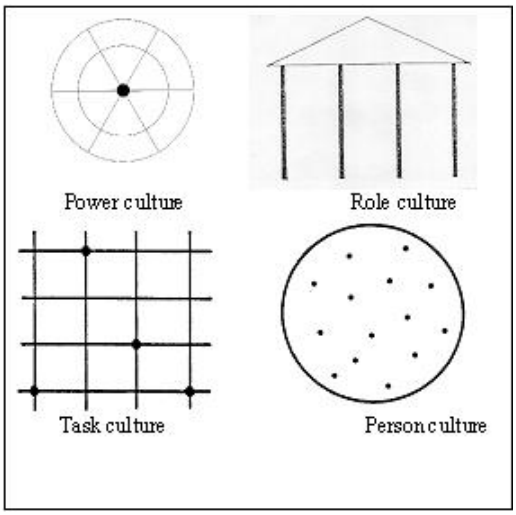


Figure 2-8. Four cultures categories.

1. The Role Culture: is controlled and coordinated by senior management. The functions are defined by roles or job descriptions.
2. The Power Culture: has a single source of power and is based on hierarchical structure.
3. The Person Culture: a group of individual band together to achieve their own goals. Each person has their own expertise and barely listens to others.
4. The Task Culture: has diffused power which is located in interstices and based on expertise. It is job or project-orientated. The emphasis of the task culture is to get the job/task done.

Each type is suitable for different kind of business. Each of them can be effective and useful if they are compatible with the business strategy, the organization and the individuals involved in it.

2.2 Production Planning

Accurate plans can be created when current production burdens can be identified. Several tools for problem identification and process analysis in production process stated here may be useful for production planning improvement:

a. *Ishikawa/Fishbone diagram* is used widely to figure root causes of the problem. It provides various causes, but not solving methods.
b. *8 Disciplines (8D)* is a problem management tool popularly used in responding to customer returns or issues, also providing output of the 8D report, the format of the steps of the 8D process shown in figure 2-9.

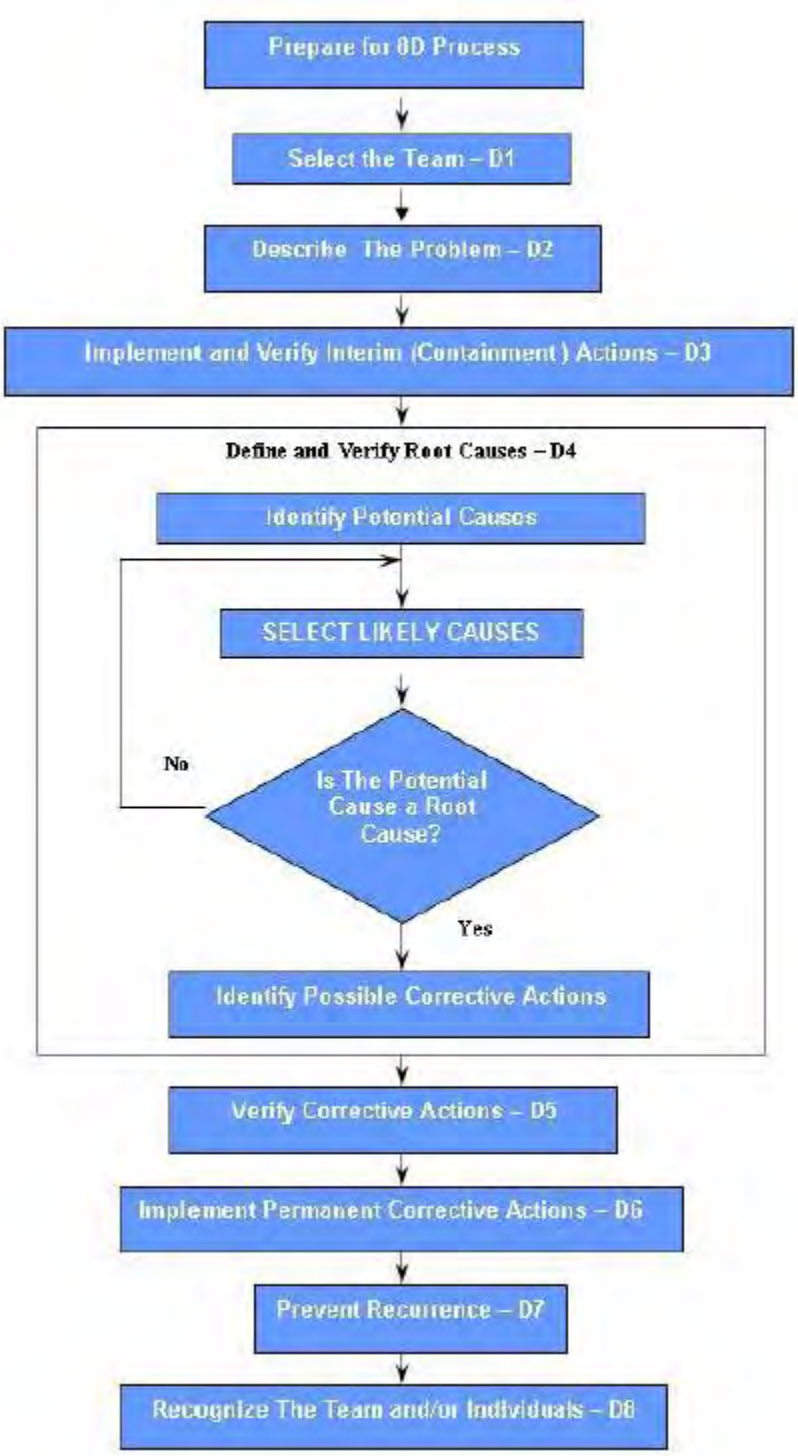


Figure 2-9. 8 Disciplines process. (TubeSolution)

c. *Workflow diagram*. A workflow consists of a sequence of connected steps. It may be seen as abstract of real work under a chosen aspect.

Each step is represented by different kinds of symbols, examples are shown in figure 2-10 below.

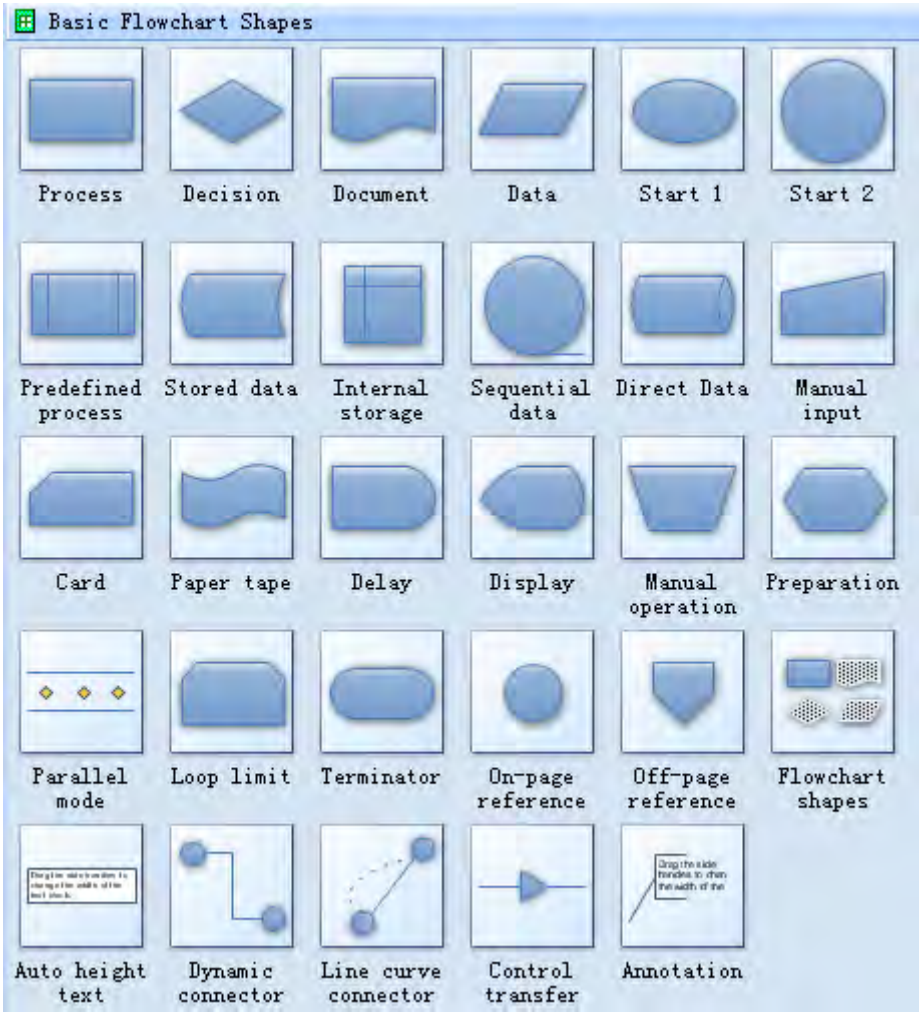


Figure 2-10. Basic shapes for constructing workflow diagram. (EdrawSoft)

Workflow diagram is very useful for analysis of each process and how the processes are linked together.

The objective of food production planning is the preparation of menu items in the needed quantity with the desired quality and at a cost appropriate to the particular service (Spears and Vaden, 1985). Today, production is no longer considered as “cooking in the kitchen” but has evolved into planning, control of ingredients, production method, quality of food, labor productivity, and energy consumption.

Therefore, an effective production is linked between several functions in the restaurant as seen in diagram below (figure 2-11).

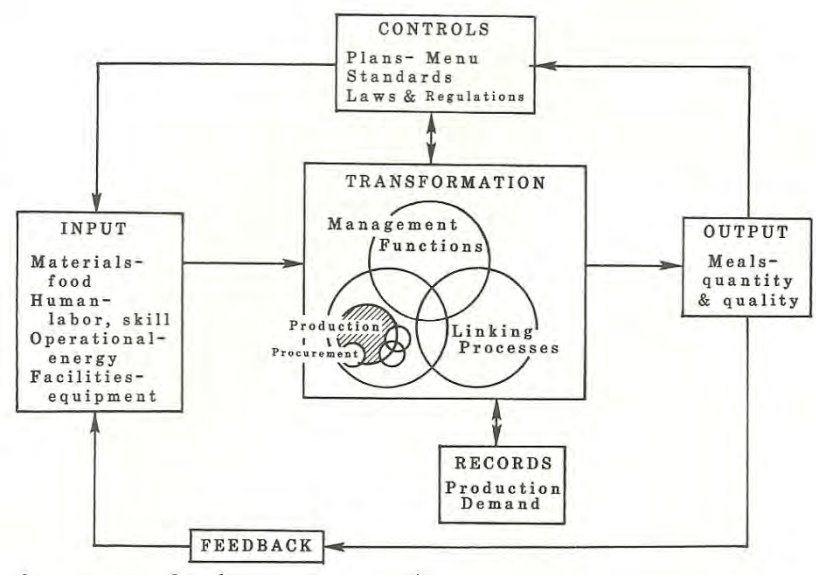


Figure 2-11. Foodservice systems model with the production function highlighted. (Spears and Vaden, 1985)

The highlighted function, production, is the subsystem of „transformation" unit – process of transforming „input" to „output". Despite of its size in the model, the production is the most important part in delivering product to the customers. The overlapping section of management functions and production makes the planning vital. Sub-functions in production planning are divided into 4 main headings.

2.2.1 Production Forecasting

Accurate demand planning for all kinds of manufacturing business can be achieved by forecasting. Mathematical models are widely used in demand prediction. However, demand planning for restaurant seems to be unreachable, since numbers of customers entering the restaurant are varied through times. Qualitative forecasting methods are used when past data are not reliable indicators of future conditions (Schroeder, 2007). Several methods are introduced:

1) Delphi: forecast developed by a panel of experts answering a series of questions on successive rounds.

2) Market surveys: sales can be predicted using questionnaires, panels, or test markets based on market demand.
3) Life-cycles analogy: prediction based on the introduction, growth, and saturation phases of similar products, using the S-shaped sales growth curve.
4) Informed judgment: forecast is made by a group on the basis of experience, hunches, or facts about the situation.

Some of these methods might be useful for demand prediction of the restaurant. The forecasting method should be chosen wisely, some of the reasons for ineffective forecasting are found in table 2.3.

Table 2-3. Some reasons for ineffective forecasting. (Gaither, 1980: 99)

1. Failure of the organization to involve a broad cross section of people in the forecasting system.
2. Failure to recognize that forecasting is integral to business planning.
3. Failure to recognize that forecasts will always be wrong. Estimates of future demand are bound to be subject to error, and the magnitude of error tends to be greater for forecasts that cover longer spans of time.
4. Failure to forecast the right things.
5. Failure to select an appropriate forecasting method.
6. Failure to track the performance of the forecasting models so that the forecast accuracy can be improved. The forecasting model can be modified as needed to control the performance of the forecasts.

Production demand in a restaurant may be able to stabilize its demand by having a particular specialty of food. Two main outcomes from failure in forecasting are stated (Spears and Vaden, 1985).

1) *Overproduction* generates costs because salvage of excess food items is not always feasible. Even though some ingredients can be stored, but the quality eventually drops. Using leftovers in low-cost menu is not the solution.

2) *Underproduction* can be just as much a cost-raiser as overproduction, since customer"s satisfaction is one of the most important indicators of a restaurant success.

In summary, several aspects should be concern for selecting forecasting method; data, time span, nature of products and services, and impulse response.

Time series models, where trends and seasonality in the data must be considered, are also suggested in forecasting procedures. Two procedures are introduced.

1) *Moving Average*: The procedure can be used for ingredients of the same kind. Taking average of a group of five or ten data for the first point on a forecast line (figure 2-12). Then plot the averaged data on the graph illustrating the smoothing effect of the method.

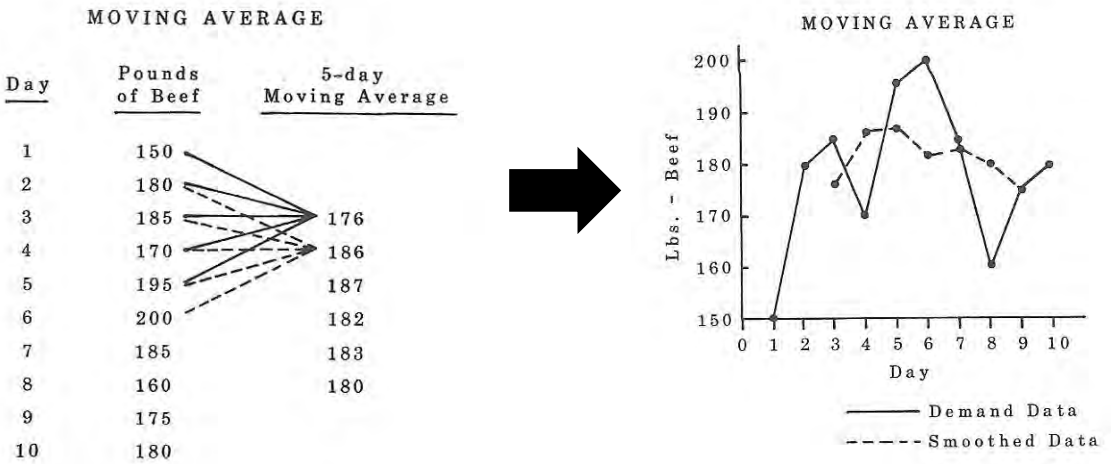


Figure 2-12. Example of moving average and graph illustrating moving average smoothing effect. (Spear et al., 1985)

2) *Exponential Smoothing*: A current value and the immediate preceding value are used to compute a new smoothing value. This new value is the beginning item for the next time interval. The older data have a lesser influence on the

trend curve in this method. The mathematical expression for this smoothing method is

$S_t = A_t + (1 - a) S_{t-1}$

Where a = a constant usually between 0.1 and 0.3

S_t = Smoothed value at time t

A_t = actual observed value at time t

S_{t-1} = preceding smoothed value

Comparison of two methods of smoothing indicates that the effect of the exponential technique is somewhat more rapid that of the moving average.

2.2.2 Production Scheduling

Restaurant production is considered to be “Jobbing production process”, which produces small batches but wide variety from its menu (Waters, 2006). Jobbing production is defined as each product goes through a different sequence of operations, and uses different mix of equipment and resources. Low utilization of resources occurs due to delays of adjustment and set-up of every new job.

2.2.2.2 Master Production Schedule Planning (MPSP)

A logic presentation of product data and product information plays important role in production planning and control (Orlicky, 1994). Functions representing the data and information are such as Material requirement planning (MRP), capacity requirements planning, operations scheduling and shop-floor control. “Production planners” or “Master schedulers” are responsible for performing Master Production Schedule Planning, which is the linkage between business planning function and material planning function (Gessner, 1986). It also represents relationship between those functions suggested (figure 2-13).

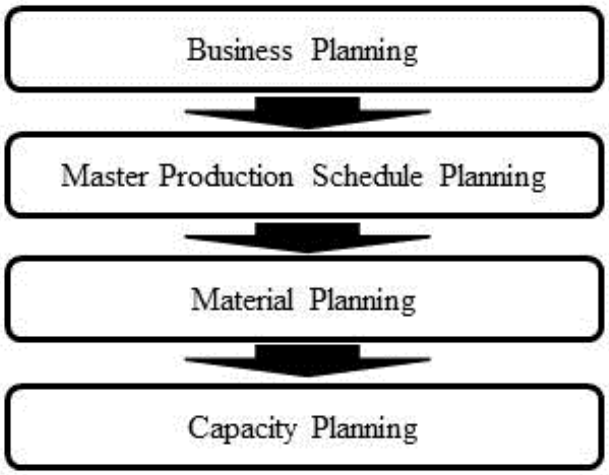


Figure 2-13. Overview of where MPSP fits. (Gessner, 1986)

Big picture of annual production can be drawn by MSPS, which is composed of four subfunctions, as shown in figure 2-14.

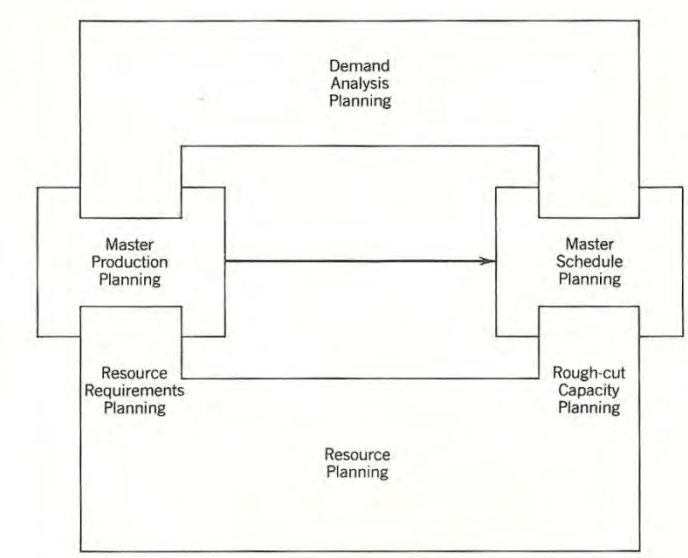


Figure 2-14. The function of MPSP (Gessner, 1986)

Each subfunction of ABC restaurant needs to be evaluated; engineering process improvement tools are to be applied in the system to yield better planning result. Four main subfunctions are:

1) Demand analysis planning: the process of identifying anticipated customer demand, period by period, across some horizon of time.

2) Master production planning (MPP): the aggregation of demand for items in groups or families, providing a planner with an “ease of use” capability.
3) Master schedule planning (MSP): MPP passes new family production plan to MSP, where the items are given lot sizes. These lot-sized quantities are called “planned orders”, which are passed to MRP in inventory management.
4) Resource planning: this function supports both MPP and MSP. Its purpose is to identify how much of what resources will be required and when.

Gessner (Gessner, 1986) also summarized general concept of capacity planning as existing at three different levels in a manufacturing company.

1) MPP resource planning: to determine the feasibility of producing the Family Production Plans.
2) MSP resource planning: Rough-cut capacity planning performed at an item level to determine if bottlenecks will occur in critical work centers when planned lot-sized orders are released.
3) Capacity requirement planning (CRP): It is normally performed after MRP (Material requirement planning, which to be discussed afterwards) processing is accomplished to determine if capacity exists to produce the planned item at a specific workcenter (Gessner, 1986).

MRP (Material requirement planning) is another successful way to deal with independent demand which require a set of components (Waters, 2006). Although in engineering terms, MRP finds demand directly from production plan, but this tool is also found to be useful for estimating item sales in the restaurant based on historical sales data, along with three main supporting tools:

1) Master schedules, give the number of every product to be made in each period.
2) Bill of materials, gives structured lists of the materials needed for each product.
3) Inventory records, show the current state of stocks, lead times, supplier reliability, costs, etc.

One of major strengths is that MRP can be used beyond controlling stocks. Apart from amount of ingredients estimation, MRP can briefly give a big picture of capacity needed for a period of time. Managers can adjust other resources such as people, equipment, facilities and so on, to fit demand estimation. The reverse thinking has led to "Closed-loop MRP system", illustrated in figure 2-15, which includes feedback from the MRP to the resource planning.

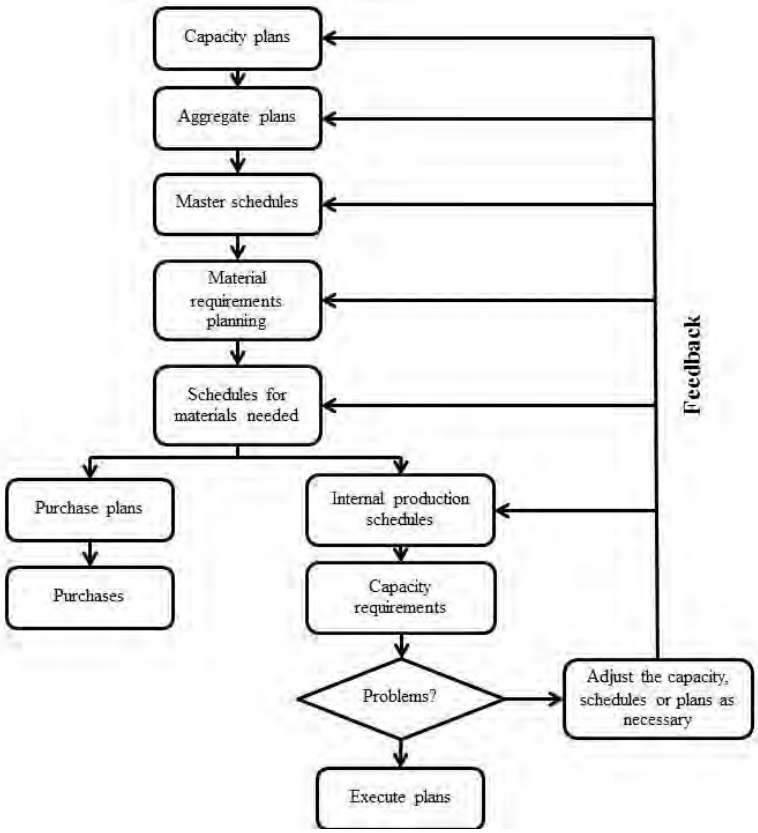


Figure 2-15. Closed-loop MRP system. (Waters, 2006)

MPSP philosophy can be applied to both make-to-stock and make-to-order manufacturing processes. ABC food production is considered to be make-to-order, which can apply these concepts in resource planning. However, most menu items are needed to be classified and, along with the aid from Bill of materials (BOM) tools, ingredients from each item can be grouped for easier purchasing and inventory management.

Some theories apply BOM to production of high variety of products, which fits ABC restaurant characteristics of containing wide range of product. Bill of material (BOM) is the list and quantity of raw materials and components required to produce a finished good, in restaurant‟s case, they are all the ingredients used for menu. Developing product families for similar product type can be useful to specify particular material and process needed for production. A data structure called generic Bill-of-Material-and-Operations (BOMO), by unifying Bills-of-Materials (BOM) and routing data into a single set in order to synchronize multiple perspectives on variety such as customer ordering, production engineering and operations planning, as well as integrated material and capacity planning, is presented to deal with high variety of product in manufacturing. (Jiao et al., 2000).

2.2.3 Purchasing and Lean concept

Procurement or purchasing is the process of securing the right product for a facility at the right time and in a form that meets pre-established standards for quantity, quality and price. It is a crucial function in restaurant production planning.

The ideal picture of smooth material flow between different facilities involves stocks control. Raw material for each menu items should be handled to minimize lost and cost of purchasing, whilst maintaining adequate amount that will not cause dissatisfaction to the customers. Just-in-time (JIT) uses “Pull system” to minimize amount of raw material storage. The ideal case is to have raw material ready when orders are placed from the customers, which will reduce raw material lost problem, but that cannot be achieved in real world. Reducing batch size of stored ingredients, or seeking for suppliers in nearby area can help reducing over-storage problem.

Lean is another idealized production concept. It was first applied to the Japanese automobile production, and succeeded eventually. Lean concept is now widely applied to all kinds of production, including food industries. The origins of Lean thinking can be found on the shop-floor of Japanese production. The removal of waste, both within and between companies, is fundamental of Lean. Increased productivity leads to leaner operations, which in turn helps to expose further waste

and quality problems in the system (Lehtinen and Torkko, 2005). The initial of lean can be defined and described by five key principles (Hicks, 2007).

1) Specify value – define value precisely from the perspective of the end customer.
2) Identify value streams – to eliminate waste from each product or product family.
3) Make value flow – make the remaining value creating steps flow.
4) Let the customer pull value – provide what the customers want.
5) Pursue perfection – continually removes layers of waste as they are uncovered.

In manufacturing system there exist seven wastes those need to be identified and eliminated (Womack, 1996).

Waste 1 Overproduction – resulting in an excess of products, products being made too early, and inventory.

Waste 2 Waiting – idle time in either upstream or downstream may lead to overproduction.

Waste 3 Transport – unnecessary movement or motion should be minimized since it adds time to production process.

Waste 4 Extra processing – or extra operations such as rework, re-processing, or storage.

Waste 5 Inventory – includes raw materials, work-in-progress, and finished goods.

Waste 6 Motion – refers to extra steps taken by employees and equipment, adding no value and consuming time.

Waste 7 Defects – finished goods or services that do not conform to the specification or customer‟s expectation.

Lean thinking in manufacturing system is shown in diagram below (figure 2-16).

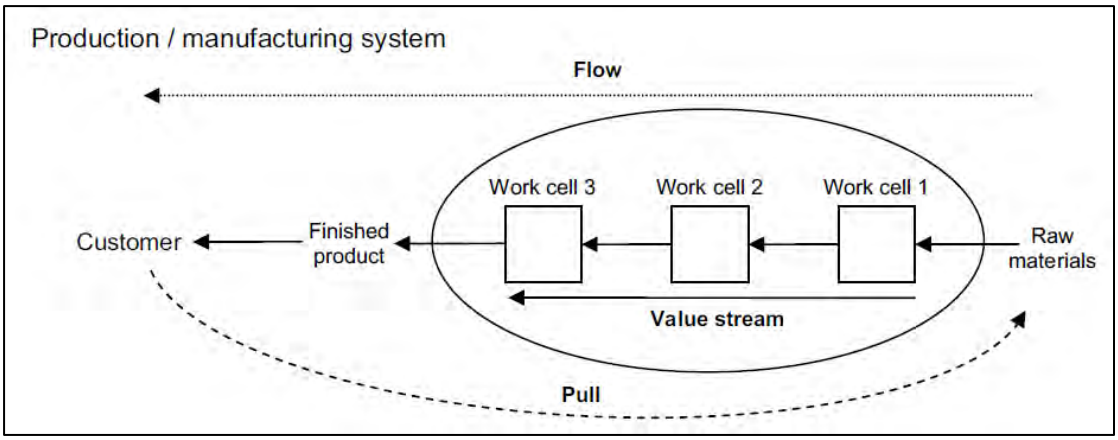


Figure 2-16. The value-flow model in production/manufacturing system. (Hicks, 2007: 238)

2.2.4 Inventory control

Storage of right amount for the right time is the purpose of restaurant inventory control. Restocking the inventory is critical if product shortages are to be avoided and if product necessary for menu item preparation is to be available. Therefore, monitoring movement of inventory levels is necessary. ABC restaurant is now facing time consuming and expensive cost in inventory system. When each ingredient, food product, and all supplies on an individual daily basis needs frequent observation, waste occurs. The effective foodservice manager knows that proper control involves spending time and effort where it is most needed and can do the most good. ABC method of inventory control is introduced to achieve such system. To fully understand ABC inventory method, physical and perpetual inventory should be understood (Dopson et al., 2008).

"Physical inventory" is a system in which an actual physical count and valuation of all inventory on hand is taken at the close of each accounting period. "Perpetual inventory" is one in which the entire inventory is counted and recorded, then additions to and deletions from total inventory are recorded as they occur. ABC restaurant is now applying "Physical inventory" which sometimes causes quality drop of some ingredients such as vegetables or fruits. Inventory sheet or a bin card is used to apply perpetual inventory. A bin card, in figure 2-17, is simply an index card additions to and deletions from a given product"s inventory level.

Product Name: Canadian Club Bottle Size: 750 ml
Balance Brought Forward: 24 Date: 12/31

Date	In	Out	Total on Hand
1/1	4		28
1/2		6	22
1/3		5	17
1/4	12	29	

Figure 2-17. Bin Card. (Dopson et al., 2008)

ABC inventory control separates inventory items into three main categories:

Category A items are those that require tight control and the most accurate record keeping. These are typically high-value items, which can make up 70 to 80% of the total inventory value.

Category B items are those that make up 10 to 15% of the inventory value and require only routine control and record keeping.

Category C items make up only 5 to 10% of the inventory value. These items require only the simplest of inventory control systems.

Various items which different values should not be treated the same for inventory purposes, since they are not equally critical to operation‟s success. Guide to managing ABC inventory items is also suggested as shown in figure 2-18.

Category	Inventory Management Techniques
A	1. Order only on an as-needed basis. 2. Conduct perpetual inventory on a daily or, at least, weekly basis. 3. Have clear idea of purchase point and estimated delivery time. 4. Conduct monthly physical inventory.
B	1. Maintain normal control systems; order predetermined inventory (par) levels. 2. Monitor more closely if sale of this item is tied to sale of an item in category A. 3. Review status quarterly for movement to category A or C. 4. Conduct monthly physical inventory.
C	1. Order in large quantity to take advantage of discounts if item is not perishable. 2. Stock constant levels of product. 3. Conduct monthly physical inventory.

Figure 2-18. Guide to managing ABC inventory system. (Dopson et al., 2008)

The system can be applied to the restaurant‟s inventory management in order to giving priority to high value ingredients.

After the inventory items are classified, inventory model for a particular business is needed to be set up. Five major components of inventory model are to be understood by food-service operators (Farsad and LeBruto, 1993).

1) Maximum inventory level on hand: the maximum level of inventory that can be held on premises.
2) Demand and deletion rate: the inventory decreases whenever the demand occurs. When the demand is the same from period-to-period, it is constant. The fluctuation demand is harder to be predicted, since it varies from time-to-time.
3) Reorder point: or "optimum inventory level", a replenishment order should be placed when an item"s quantity reaches the optimum inventory level.
4) Replenishment size, pattern, and lead time: Replenishment size refers to the quantity or size of the order to be received. Replenishment pattern refers to how the units are added to the inventory. Replenishment lead time is the length of time between the decision to replenish an item and its actual availability for production.
5) Safety-stock quantity: is usable when the actual demand is higher than the estimated demand.

The example of graphic representation of inventory management is shown in figure 2-19. This concept can be applied to any types of production.

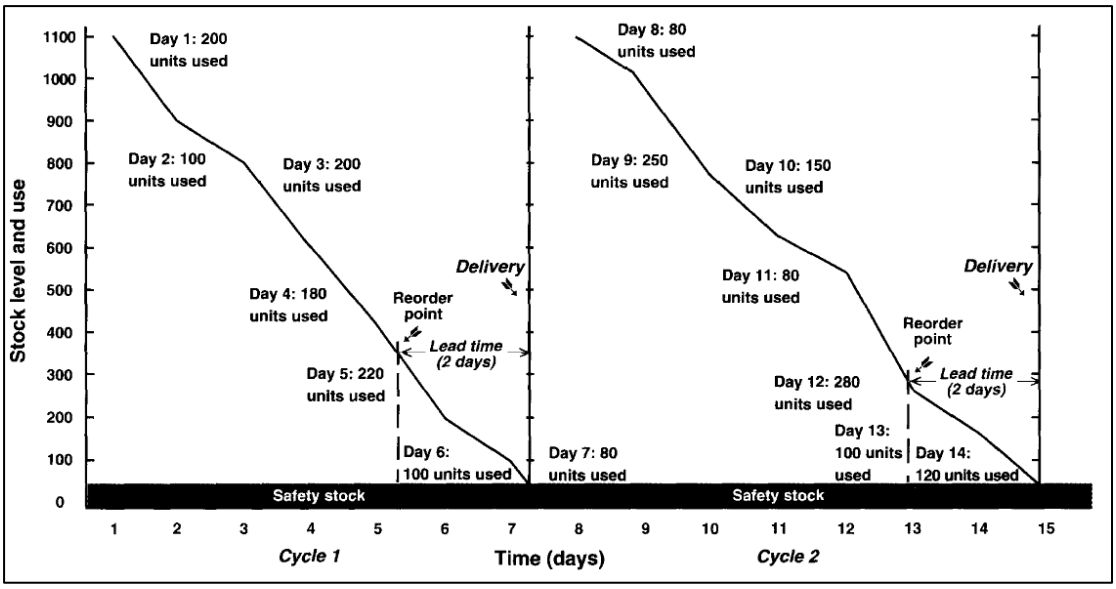


Figure 2-19. Graphic representation of inventory management. (Farsad and LeBruto, 1993)

Failure of inventory system can be caused by neglecting one of these components. ABC restaurant is required to put these components in inventory planning to achieve highest efficiency.

Determinants of the reorder point are described by one of the following four scenarios, shown in figure 2-20 below.

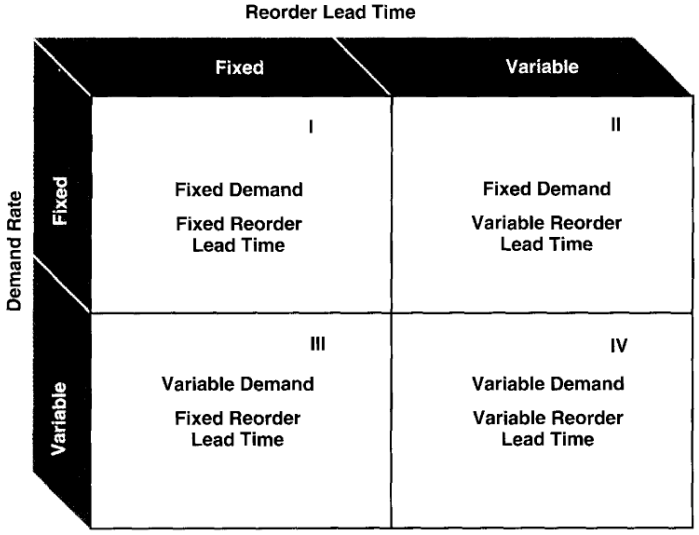


Figure 2-20. Demand rate and reorder lead time matrix. (Farsad and LeBruto,1993)

a) Cell 1, fixed demand and fixed reorder lead time, there"s no stockout risk. It is the easiest scenario to deal with.

b) Cell 2, fixed demand but fluctuate reorder lead time.

c) Cell 3, variable demand and fixed reorder lead time, this is the most usual type of many food-service operations. Most vendors agree to deliver at a particular day of a week. The demand is assumed to vary over the week, but still falls in normal distribution statistically. Various mathematical models are suggested for this scenario, to help predicting the demand rate of the week. Each product‟s reorder point (ROP) can be computed by taking the average daily demand (D) of each product multiplied by the product reorder lead time (LT).

$$ROP = D \times LT$$

d) Cell 4, both demand and reorder lead time fluctuate, this is the unusual case of many food-service companies.

2.2.5 Shop-floor monitoring & control

Effective production area, or shop-floor, of a manufacturing business is to be reached for better production efficiency. Continuous monitoring and control are also vital, to maintain and improve efficiency of any production process. A shop floor control system (SPC) is suggested as a tool used to link the pre-production planning to shop floor execution. (TEAM, 1995). SFC must meet the requirements of a multi-facility corporation, where control must be maintained between co-located facilities down to individual work stations. Top three levels, out of five, from a hierarchical architecture (figure 2-21) are required to be focused.

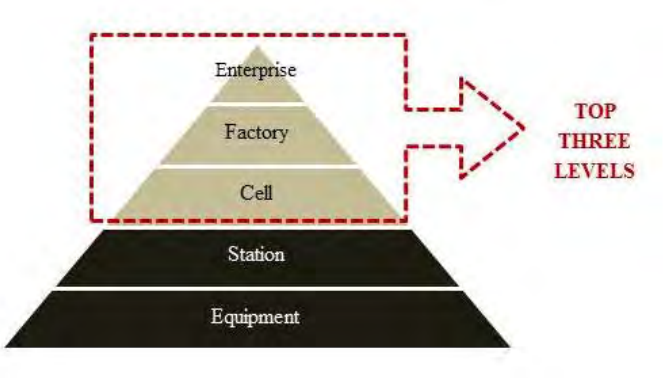


Figure 2-21. Five levels of a hierarchical architecture.

Table 2-4. Description and suggested techniques of top three levels.

Level	Description	Suggested Techniques
Enterprise	• The planning horizon is measured in years or months. • Accept new-products orders from Macro planning. • Allocate production tasks to factories.	• MRP I • MRP II • Capacity-constrained resource planning
Factory	• Decides inter-cell routing, resource allocation, and lot sizes using finite-capacity techniques.	• Discrete-Event simulation • Optimization
Cell	• Responsible for job sequencing with a time horizon of typical days or a few weeks.	• Optimization • Control Theory

Each level, as described in table 2-4, can be divided into three basic functions:

1. Scheduler: Accepts production requirement, and develop schedule which determines the precise use of the resources at the next level, then release the schedule to Dispatcher.
2. Dispatcher: Takes inputs of schedule from Scheduler, and status from Monitor, and tries to meet the schedule as best as possible. The position is critical at Cell or Factory level, where real-time decisions must be made.

3. Monitor: Collect status information from the monitor functions at the next lower level, and send to Dispatcher at the same level and Monitor at the next higher level.

The shop floor control functional diagram illustrates the main functions of shop floor control and the relationships between major modules.

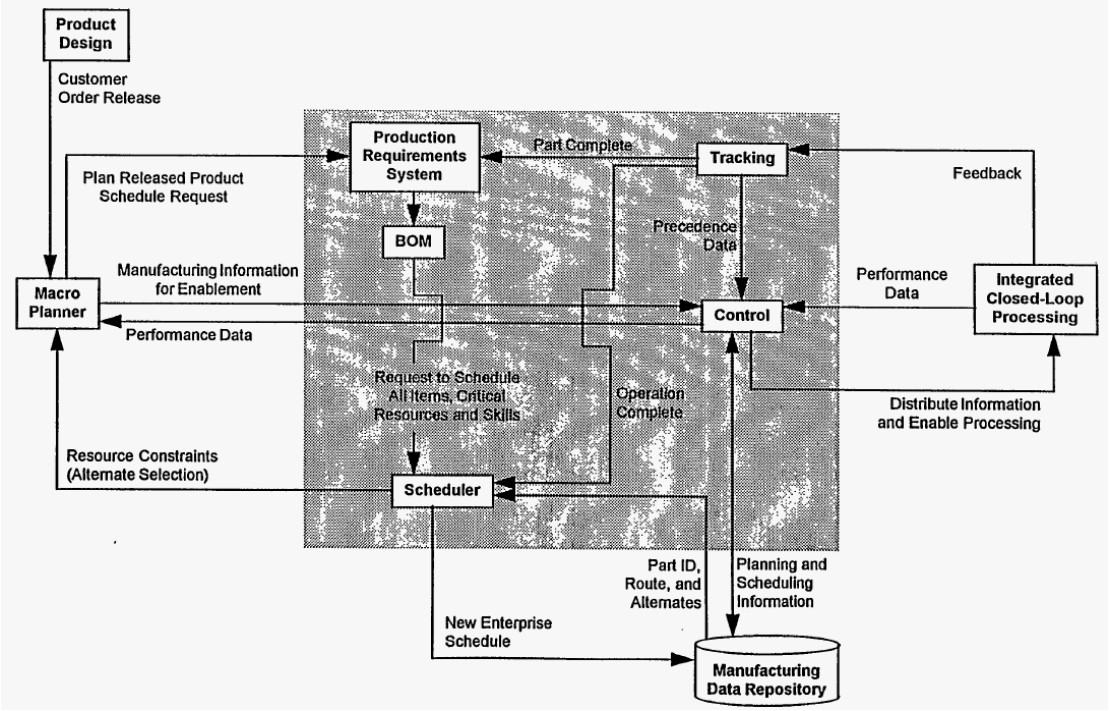


Figure 2-22. Shop floor control functional diagram. (TEAM, 1995:4).

From the illustrated diagram in figure 2-22, the Bill of Material (BOM) explodes requirement data to the manufactured articles, raw material and supplies required for production as stated in Scheduling section. This manufacturing diagram can be applied to ABC restaurant"s production unit for more effective shop floor management and control. Some detail may have to be adapted for better results as adapting to restaurant type. Specifications of appropriate software to deal with shop floor control are also stated in the article.

1. System Mechanics.
2. Job Entry, Schedule Maintenance and Control.
3. Work control & Execution.

4. Quality Management.
5. Queue Management.
6. Time Collection.
7. Collection Attendance of Employees.
8. Tracking of Resources.
9. Tracking of Items.
10. Notification and Reporting.

Some other techniques from TQM (Total Quality Management) concept can be applied to the restaurant as well, KAIZEN philosophy, for example. It is a tool used for continuous improvement. (Lee et al., 2000). Kaizen also relates to Lean thinking. Seven steps of Kaizen procedures are illustrated in figure 2-23.

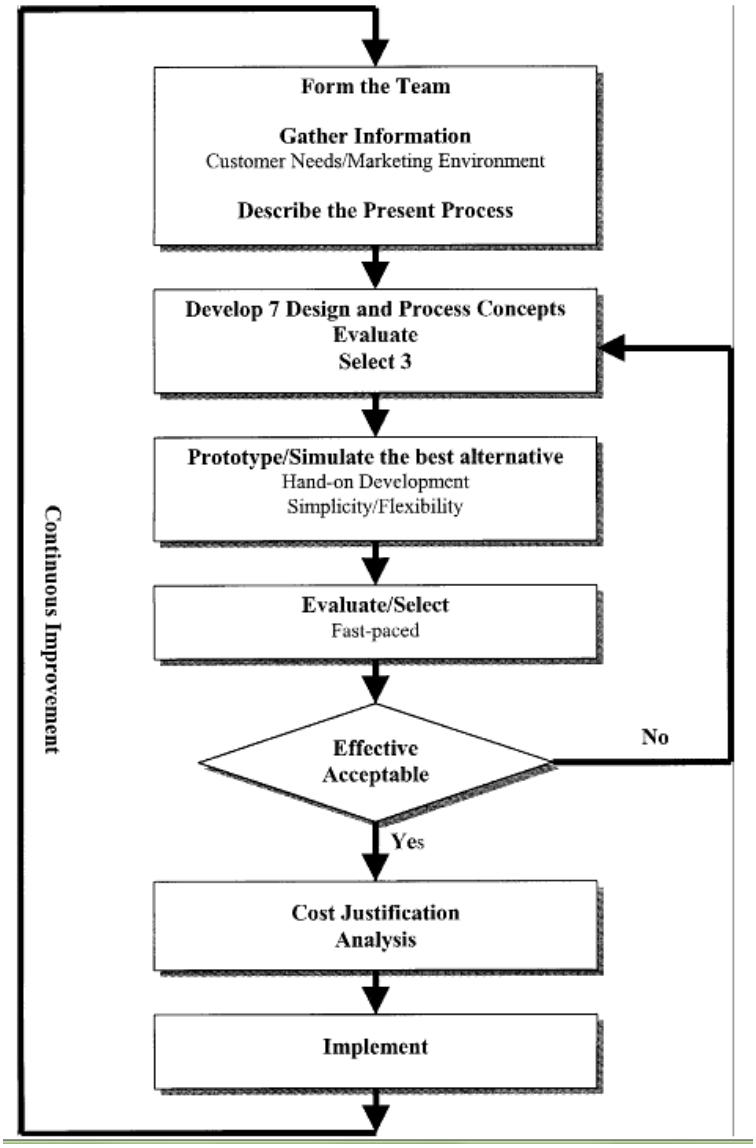


Figure 2-23. Kaizen procedures. (Lee et al., 2000: 4).

Kaizen philosophy will be most effective when everyone in the organization/function/unit is involved.

2.3 Risk Management

ABC restaurant needs to concert about uncertainty in production planning. The restaurant should have appropriate plan to manage the impact from uncertainty, or at least, is prepared for it. Risk has been a subject of interest and study in the recent past. The definition of risk involves some aspects of uncertainty. There are several

definitions of risk, but four distinct terms relevant to risk assessment are stated (Koller, 2008).

1) Risk
2) Uncertainty
3) Probability (Likelihood)
4) Consequence (Impact)

Anything that can threaten the project, or operations, is considered as risk. General risk definitions can also be defined as (Rowe, 1977):

"Risk is the potential for realization of unwanted, negative consequences of an event."

In general, risk management contains two main phases (Raz and Michael, 1999);

2.3.1 Risk assessment, including identification, analysis and prioritization.

2.3.2 Risk Control, including risk management planning, risk resolution and risk monitoring planning, tracking and corrective action.

Risk management is not an one-off activity, instead it should be applied continuously throughout the life of the project, or in this case, for the rest of business life.

Even though some studies suggest guide of risk management for restaurant, including important checklist for self-assessment, basic principles of risk management is still to be concern, so that some parts of the checklist can be corrected to support production and shop-floor control of ABC restaurant. Risk assessment can be broken down into sub-stages (Millers, 2001). However, the risk management steps are mostly simplified into four main descriptions (Leopoulos et al. 2006), as shown in figure 2-24. The development of risk management plan functions as a guide towards the implementation of risk management process.

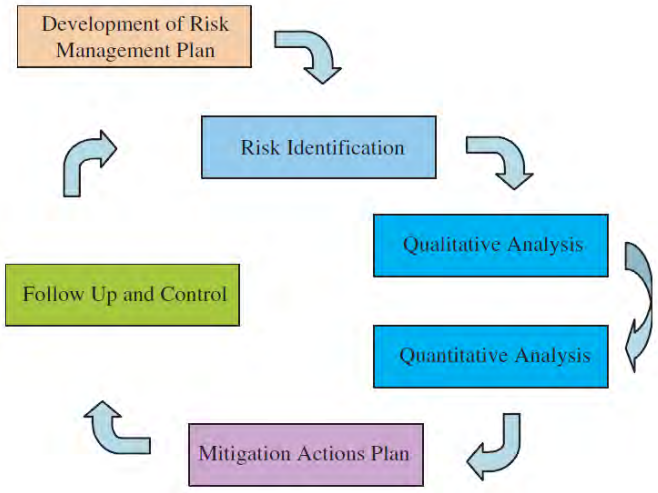


Figure 2-24. The risk management process. (Leopoulos et al. 2006: 323)

A famous tool using for risk assessment is Failure Modes and Effects Analysis (FMEA). The tool doesn't provide problem solving for any cases, but the goal of FMEA is to accomplish the following (Kieckhafer, 2005): identify failure modes, evaluate the effects on the system, define and prioritize actions to correct problems, track corrective actions and their effects, and document the entire decision process.

Potential Failure Modes and Effects Analysis

System _____ FMEA Revision _____
Subsystem _____ FMEA Prepared By _____
Part Number _____ FMEA Date _____
Designer _____ FMEA Revision Date _____

Item/ Function	Potential Failure Modes	Failure Mode Effects	S E V	Potential Failure Causes	P F	Current Controls	D E T	R P N	Actions Req'd	Owner/ Target Date	Actions Taken	S E V 2	P F 2	D E T 2	R P N 2

Figure 2-25. Example of simplified FMEA table. (SiliconFarEast, 2005)

The example of FMEA table is presented above (figure 2-25). Simple FMEA can be conducted to determine risk from production process of ABC restaurant.

2.3.1.1 Risk identification

Williams (Williams, 1995) found that identification of each risk is an essential first step in risk management and is possibly the most difficult. It is the part to find the sources of each risk. All relevant positions in the restaurant should be involved to point out all possible risks in their working area. Identifying failure modes in a process can be done by many techniques and methods, as stated in Problem solving section. Brainstorming is the most popular to help identifying possible failures. To identify processing steps, the process flow is to be broken down into sub-stages (mostly, with an aid from process flow chart), therefore they can be clearly evaluated (Kieckhafer, 2005). The identification of risk can be based on several techniques such as brainstorming, structured interviews, experts‟ opinions, etc. (Chapman, 2001).

2.3.1.2 Risk analysis

Risk analysis aims to prioritize the identified risks. (Baccanini and Archer, 2001).Subsequently, failure modes were identified for each step. Each failure mode is then raked by its estimated frequency of occurrence (O), its probability that the failure would remain undetected (D) and its severity (S), each on a scale of 1-10, the higher the number, the higher the risk. (Van Leeuwen et al., 2009). The most recent approach indicates that risk analysis is divided in two primary methods (Mazareanu, 2007):

1) Qualitative risk analysis: a process of assessment of the impact of the identified risk factors, also determine the priorities of the process to solve potential risk factors.
2) Quantitative risk analysis: numerical results of probability of each risk and its consequences are obtained. Monte Carlo method is used as a technique for determining probability of reaching objectives, identifying proprietary risk factors, and identifying some realistic changes of cost and activity plan. The most common formula to calculate risk exposure are

RE (risk exposure) = P (probability) x L (loss)

A risk matrix can be developed to better understand the risk exposure (as shown in figure 2-26).

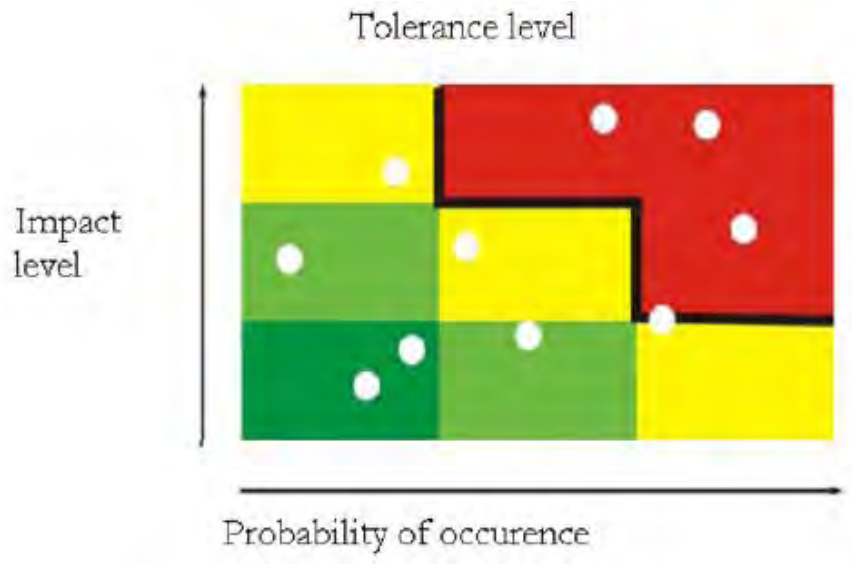


Figure 2-26. Quantitative risk matrix. (Mazareanu, 2007: 44)

After allocating scores to S, O and D, risk priority number (RPN) is calculated by equation below:

$$RPN = S \times O \times D$$

Typically, the failure would be action if the RPN is over 125, or falls between a set-limited range. (Burapachayanont, 2007). RPN is the key approach which leads to next step, *risk mitigation*.

2.3.1.3 Risk mitigation

The response of identified risks is designed in “risk mitigation process”. The way to cope with the risk is defined and the implementation of the decided actions is assigned to the most appropriate member of the project team. Risk with higher exposure (red zone from Figure.) should be focused before others. The risks with potential to happen first is to be treated, even if the latter ones have higher exposure. Common means of risk response include (Hillson, 2003) avoidance (if possible), mitigation (if manageable), transfer (if applicable) and retention (if acceptable).

2.3.1.4 Risk follow up

It is the step to make sure that the plan is really executed. Each action should be tracked, and effectiveness should be measured. (Leopoulos et al., 2006).

It is stated that the quality perceived by customer in service industries is based on what is called “the Moment of Truth”, that are the moments the customers get contact with any aspect of service company. Although most products from service companies are intangible, but for restaurant, half of the products can be sighted, smelled, and even tasted. The advance planning to avoid, or at least reduce, risk from production sector is to be identified.

FMEA is applied in the service business as well, since they must be able to face the challenge of an error-free service to their customers (Rotondaro and Lopez, 2001). Example of applying FMEA to service department is given as a prevention tool to:

1) Identify how a process can fail in meeting customer criteria needs.
2) Estimate the risk of specific causes that lead to these failures.
3) Evaluate the current control plan for the prevention of these failures.
4) Implement the procedures required to obtain the error-free process.

The most important factor leading to restaurant success and more revenue is to satisfy the customers. Apart from production aspect, risk management in a restaurant cannot avoid to fulfill the customers.

2.3 Conclusion

Production planning of a restaurant covers several sub-functions in supply chain management. The integration of these functions, starting from upstream along to downstream of supply chain, is one method to achieve smooth-flow operation. The functions covered in production planning are: demand forecasting, purchasing, scheduling, inventory control, and monitoring & control.

Present restaurant management theories and practices may not be adequate to successful restaurant operation. For higher efficiency, engineering theories and

philosophies, such as problem identification tool, Lean concept, Master production planning (MPP), etc., can be implemented and applied to current operational system of ABC restaurant to gain more benefits within limited resources.

Risk management is another issue that is vital since there is no “perfection” in operation of any business. Potential failures in production process are to be mitigated through risk management process, by an aid of FMEA. The background of ABC restaurant and relevant information are to be given for further analysis in the next chapter.

CHAPTER III
PRODUCTION PLANNING & SHOP FLOOR CONTROL METHODOLOGY OF THE CASE STUDY RESTAURANT

Information about ABC restaurant relevant to production planning & shop floor control is provided in this chapter, which is divided into sub-subjects stated below.

Each topic is to be analyzed in order to improve production process of ABC restaurant.

3.1 Information of ABC restaurant

As stated in Chapter 2 that production planning is a part of supply chain management, the functions covering production planning area of the restaurant, which to be described in detail, are; forecasting, purchasing, inventory, scheduling, and production system. The synchronization and utility of these functions, integrated with administration, are to be analyzed in depth for improvement.

3.1.1 Characteristics of restaurant production system

The standardization of any systems in the restaurant must be based on its characteristics as being a kind of service industry. The characteristics of restaurant production are slightly different from other product-based industry. New standard systems should consider these characteristics as the guidelines for success. The example of simple characteristics which make restaurant industry differs from other product-based industries are stated:

1. Unpredictable demand.

   The resources planning for other industrial production is possible. The forecast can be done by advance booking from customers, which makes raw material and components preparation possible to achieve. The restaurant business is different. All resources must be ready when the customers walk in. This is why raw material requirement planning is vital to the production system, in order to keep selling opportunity and customer‟s satisfaction. Numbers of customers also vary from time to time. The demand can be approximated, but it is impossible to be near the word „accurate‟.

2. Flexibility in innovation.

   Repeat consumption behavior is desirable for restaurant. However, new products are needed to be invented frequently to keep old customers happy while attracting new sectors of customers. Any advance planning should provide flexibility to production unit to generate new products without disturbing daily operation, while being approved by management level.

3. Quality control for products.

   The big difference between quality control between factory and restaurant production is that there is no standard tools used for quality measurement of restaurant product. In other industrial field, production quality control can be done by using numerical measurement to assure that the product has met its standard. The taste and presentation of each dish require personal experience in making judgment.

The restaurant characteristics bulleted above should be considered in order to generate successful improvement of ABC restaurant.

3.1.2 SWOT Analysis

SWOT analysis provides useful information to strategic planning process. It is vital to know the next move and to make sure of the right direction. The restaurant may be able to use one of strategies stated in Chapter 2 to overcome present problems.

Strengths (S)

1. *High variety of menu items*. Plenty of choices for customers is the key of restaurant‟s service. Three categories of menu, Thai, Chinese and Western, contributed from over 200 dishes, lead to three main cooking units.
2. *Located in high populated area*. Situated by the main road with high density of population creates stable customers in a period of time. High potential of customers compared to other area is one of the company‟s strengths.
3. *Qualified by Thai Famous Institute*. Quality of food and drink of ABC has been qualified by one restaurant famous institute of Thailand, which gives ABC the guarantee of high food quality to customers.
4. *Reasonable price*. Price per dish is reasonable compared to other restaurant in the same area at the same quality.
5. *Funding from the director*. The investment of restaurant is funded from other sources but not loan from the bank. Therefore there is no monthly interest payment, which gives us high advantage operation compared to other bank-loan restaurant.

Weaknesses (W)

1. *No experience in food industries.* For the director and GM, ABC restaurant is the first branch and first restaurant operated by the company. Everything is new for the management level. Service industries are slightly different from manufacturing business.
2. *Organization style of management level.* Decision making and operation running rely on GM. The position is the linkage between internal function and suppliers. He is also the information center of the restaurant. The absence of GM causes struggles in daily operation to the restaurant.
3. *Requirement of staffs with expertise.* Most of restaurants fail due to no cooking skills of the owner. The product‟s quality, or even normal production, totally relies on Cuisine chefs. Taste or decoration of each dish is not standardized and sometimes changes from staff turnover.
4. *High staff turnover rate.* Due to the economics and uncertainty of Thai employment culture. Thai people tend to change jobs frequently. Newly trained kitchen staffs, sous chefs, or even the cuisine chefs themselves sometimes have reason to quit the jobs without notification.
5. *Unpredictable demand.* Although the numbers of customers entering the restaurant is likely to be stable, but the food ordered fluctuates. Changing demand causes fluctuation of ingredients required for cooking, which causes difficulties in purchasing and inventory management.

Opportunities (O)

1. *Expansion of business area nearby.* There is new business complex construction which will be finished by March 2012, next year. ABC can see the future high rise of demand from the area nearby and may have opportunity in expand the second branch.
2. *Catering service contract with Educational Institute.* Long-term contract of holding events and meeting, also providing catering service, is another next move of the company. It is also another major advantage of ABC over other competitors.

3. *Advertising in Media.* ABC is becoming famous since 2009. The high standard of food and restaurant‟s internal decoration pulls attention from media; newspaper, magazine, internet, or even television. Getting published in media confirms the growth of customer‟s demand in short term, but effective handling method should be set up.
4. *New route of subway passing the restaurant.* Due to the high populated area, a lot of traffic in ABC restaurant area causes negative effect to restaurant‟s image. New route of Subway, passed in 2010 by Thai Government, is to be constructed. Long term strategies should be set up to cover potential higher numbers of customers in the future.

Threats (T)

1. *Potential of new competitors.* Sudden improvement in the area brings new competitors in food industries. The higher the opportunity of ABC, the more attractive this market will be for new competitors. Due to drastic change in the area, the new comers have more details in market research than ABC at the first start. They will be able to access customer‟s need better.
2. *Declining of Thailand economics status.*
3. *Change in food consuming trend.* Despite of high menu variety, style of food consumption changes every year, leading to changing demand, higher or lower. The consumption trend, mostly in teenagers group, does not rely on menu items only, but also internal decoration, style, and fashion.

SWOT is the analysis of current situation of internal and external of restaurant. Each factor can be useful for future improvement in TOWS analysis. It is suitable for improvement that does not require more investment and can be implemented immediately.

3.1.3 Organization chart and responsibilities

Due to its size, ABC restaurant‟s organization chart is not complicated as other companies. The chart is shown below (figure 3-1) to represent hierarchy of organization.

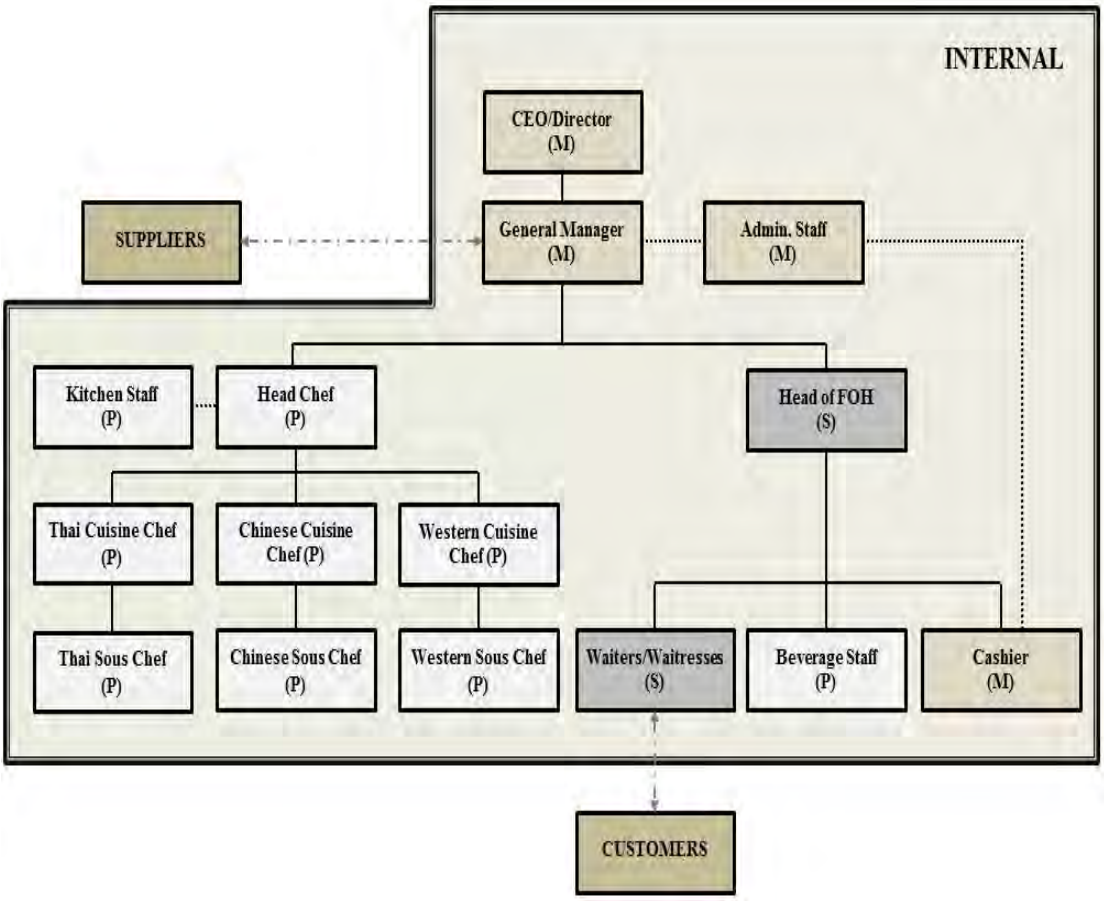


Figure 3-1. ABC restaurant organization chart.

One of strengths is that the restaurant is owned by a director who also owns other fields of businesses. Any major changes, long-term strategies, or significant issues must be passed by the director. While daily operations are mostly the general manager‟s duty. Job descriptions of each position are stated in the table 3-1 below.

Table 3-1. Job descriptions of each position.

Position	Job description
Director	1. Strategic decision & Growth direction of the restaurant. 2. Financial support/Funding. 3. Overall monitoring & control.
General Manager (GM)	1. Daily operation control, including receiving daily money from the cashier. 2. Day-to-day decision making. 3. Daily raw material purchase planning, cooperate with Thai/Chinese/Western cuisine chefs. 4. Purchase raw material & equipment. 5. Cooperate with suppliers for under standard food"s quality (reject and refund). 6. Human resource control. 7. Monthly summary reports to the director.
Admin. Staff	1. Responsible for all document and daily report. 2. Co-operate directly with GM in documentation system.
Head Chef	1. Responsible for overall monitoring & control in the kitchen (production area). 2. Quality control of raw material and product.
Thai/Chinese/Western Cuisine Chef	1. Operate the cooking of Thai/Chinese/Western menu respectively. 2. Responsible for practical inventory management and ordering point. 3. Generate purchase order and report to GM.
Thai/Chinese/Western Sous Chef	1. Assists to Thai/Chinese/Western cuisine chef in operation respectively.
Kitchen Staff	1. Responsible for mundane tasks such as raw material preparation, dishwashing, kitchen cleaning etc.,

	report directly to Head Chef.
Head of FOH	1. Overall control in front of house (FOH-servicing area). 2. Responsible for service employee training. 3. Responsible for drinks/beverages inventory. 4. Generate beverages purchase order and report to GM.
Beverage Staff	1. Prepare all kinds of beverages.
Cashier	1. Receive orders from Waiters, and input them into KIOSK software. 2. In charge of receiving money from customers. 3. Responsible for daily income and hand to Admin. Staff.
Waiters/Waitresses	1. Take orders from customer to the cashier. 2. In charge of serving, the only section that is in direct contact with the customers.

Small letters in brackets in organization chart represent different functions in the restaurant: M – Management units, P – Production unit, and S – Servicing unit. The chart shows those functions with letter P, representing position responsible for quality of product served to customers. Those positions, with letter S in bracket, directly contact to customers, servicing unit. The rest with M letter represent management positions of ABC restaurant. Company‟s long-term goal and target are launched from the director to general manager, who is the key of ABC restaurant. From the job description, GM needs to be the most effective person since he/she is the linkage of bottom and top level of the organization hierarchy. Most of daily decision makings in purchasing, new product launching, and human resources are GM‟s main jobs. Administration staff takes care of a lot of paper work in those functions GM responsible for.

In production unit, each chef is responsible for making food in their own categories, and inventory control for those categories‟ raw material. Each cuisine chef

has their separate refrigerators and cooking tools. Cuisine chefs report directly to GM to purchase required ingredients. GM contacts external suppliers for specific ingredients, which sent to the restaurant on specific date. Head chef organizes overall daily tasks, including assigning jobs to kitchen staffs in material preparation, dish washing, daily stock counting etc. These kitchen staffs have various tasks each day. Head chef also has to be informed about new menu from each chef depending on food categories, before offering to the management level (GM and director) for evaluation.

In Front of House (FOH), Head of FOH is assigned to take overall control. He/she needs to monitor and train waiters/waitresses to provide best service to customers. The beverages, including coffee and fruit juice, are not made in the kitchen, but in the open bar. One beverage staff is stationed at the bar in one shift, making beverages as ordered. Waiters/waitresses are the only position in direct contact to customers, receiving orders and serving food.

The organization type of the management level of the restaurant is more likely to be the "Power culture", which all the control and authority in decision making lie in GM"s power. GM is the center of daily operation, including main functions of the restaurant such as purchasing, staff scheduling, communication between each functions etc. Meanwhile, the type of organization in the production unit, the kitchen, is more likely to be "Task culture". All cuisine chefs are responsible for their own menus of their expertise, and barely produce other"s menu. They also manage their own ingredient stocking system, and reports only directly to the Head Chef and GM. Although Head chef is the boss in the kitchen, he has little role in daily decision making. The amount of food to be purchased, the quality of food, and new product to be launched are mainly the authority of Cuisine chef in each category to make decision.

3.1.4 Production process

There is no complication in production process of ABC. The main idea is to get customer‟s order done as fast as possible, while maintaining quality. The production process follows the process flowchart from figure 3-2.

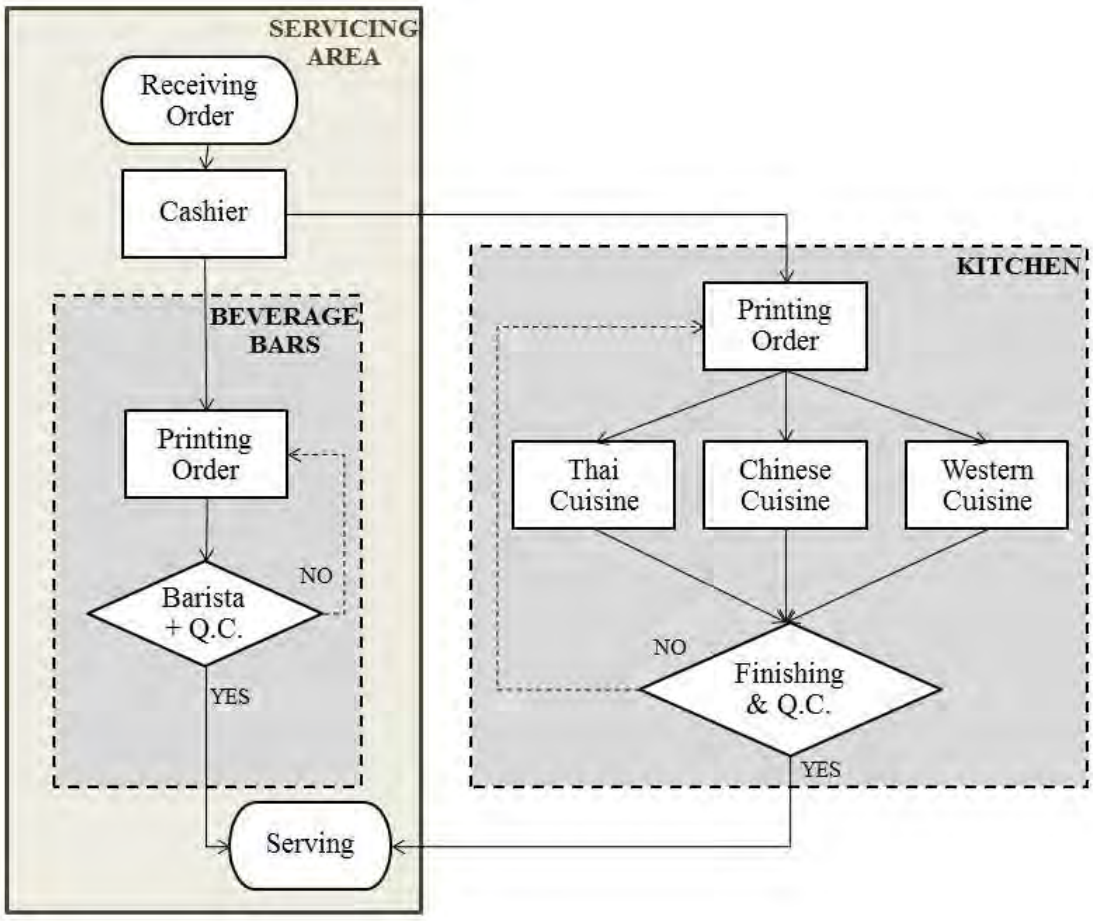


Figure 3-2. Production process flowchart.

The total process of ABC from receiving orders to serving them to customers can be divided into three main sections. In real operation, customers walk in, pick their seats, enjoy their time, and leave. If focuses on service point, the process starts from the moment that customers appear, but in production aspect, the actual process starts from receiving orders from customers. Detail in each process is explained based on working area.

Servicing Area

The area is the contact point between company and customers. The highest performance of employees is required here. Table 3-2 describes detail in each process and relevant staffs.

Table 3-2. Description of process and staffs involved in servicing area in production.

Process	Description	Staff
Receiving order	Customer orders their choices from provided menu list to waiters/waitresses. The orders are written down by hands in an ordering form, stated table"s number and items ordered.	Waiters/Waitresses
Cashier	The orders passed to Cashier will be input to KIOSK software, taking all the information into the system. KIOSK collects amount and selling price of daily orders, and passes the orders to printing machine, separated into two types; Beverages, and Food. The beverages orders are sent to beverage bars, while food orders are sent to printing machine in the kitchen.	Waiters/Waitresses Cashier
Serving	All cooked dishes are delivered from their production areas to the servicing area again. Waiters will serve these dishes to customers.	Waiters/Waitresses

The important factor in servicing unit is the waiter, who is in direct contact with the customers. KIOSK is another success factor in information transferring process from servicing area to other two production areas. The software supports 3 important activities of restaurant;

1. *Information Linkage*: Instead of sending orders recorded in paper from the servicing unit, causing potential in mixing up orders and confusion. KIOSK has ability to pass the orders to production area via the

software. Order slips are printed out in the kitchen by printing machine.

2. *Data collector*: KIOSK records all the sales from each day in its database, which is to be updated every year. Information can be recalled for analysis by GM.
3. *Monthly summary*: Summary reports, showing best sellers, total sales etc., can be produced by KIOSK. It reduces time for GM and staff in summarizing these kinds of data themselves.

Even though the program is very functional, the limitations still exist. The program has its own panels and presentation, which cannot be linked to other data processing program, for instance, generating line graph for moving trend of items sold. The limitation of KIOSK leads to small boundaries of data analysis for management level.

Beverages Bar

It is one of two production areas of ABC where all the drinks and beverages are produced, as details shown in table 3-3. Beverages bar is actually located in servicing area, but not in contact with customers.

Table 3-3. Description of process and staffs involved in beverages bar in production.

Process	Description	Staff
Printing orders	The order slips are printed out of printing machine, stating what kind of drink and numbers of each drink to be served to which table.	Barista
Baristas + Q.C.	Barista take orders from the printing machine and produce as ordered. The quality control is checked by sight before handing to waiters to serve to customers. If the product is not above standards, it will be thrown away, and new one will be made for customers.	Barista

Kitchen

The kitchen is behind the restaurant, KIOSK reduces confusion and time in delivering orders from servicing area to the kitchen. Description of process is stated in table 3-4.

Table 3-4. Description of process and staffs involved in kitchen in production.

Process	Description	Staff
Printing orders	The order slips are printed out of printing machine, stating order items and numbers of each item to be served to which table. One kitchen staff is assigned to take out the slip and distribute the orders to each Cuisine chef. The still-not-made orders are stick up on magnetic board, waiting for available chefs to produce.	Kitchen staff
Thai cuisine Chinese cuisine Western cuisine	This is the process where food is actually produced. Each chef operates their own menus, in their area, with their own tools and equipment. Details of how the menu is distributed to each chef, based on their expertise, are described in the next paragraph. Sous chefs and kitchen staffs are helpers in cooking process. They prepare plates, containers, ingredients and essential tools for Cuisine chefs.	Thai/Chinese/ Western Cuisine chef. Thai/Chinese/ Western Sous chef Kitchen staff.
Finishing + Q.C.	After putting in suitable container, all items go through finishing process, where all the decorative accessories are organized. Trained kitchen staff is responsible for making sure of the correct specification of each menu, matching with order slips, if not same menu will be reproduced. Then completed menus are	Kitchen staff

	delivered to the servicing area by kitchen staff where they are served to customers.	

Responsibility and authority boundary are assigned to each chef in production floor based on various cuisines. Due to high variety of menu items (233 items in total), all the items in this thesis will be presented using menu code (Appendix A), as shown as example in table 3-5.

Table 3-5. Example of coding system representing each menu item.

Menu Item	Code
Deep fried red Tilapia fish with Thai herbs	10001
Deep fried seabass with fish sauce	10002
Fried seabass with garlic and chili	10003
Braised pork spareribs with Kale	10004
Steamed coconut cream rice, grilled chicken & papaya salad (set)	10005
Deep fried mashed potatoes stuffed with bacon	10006
Lasagna pork	10007
Nacho pork	10008
Nacho beef	10009
Nacho chicken	10010
Fried prawn cake (set)	10011

The table below shows how all menus are distributed to each cuisine chef, categorized by cooking method and ingredients used. Five main types are categorized.

1. *Thai* – Thai cuisine mostly emphasizes on lightly prepared dishes with strong aromatic components. High variety of chilli pastes, Thai herbs, and seasonings are used as ingredients, most of them can be found in Thailand. Thai cuisine chefs must be able to produce Thai-ingredient-based dishes. (108 items)
2. *Chinese* – Most of Chinese cuisine dishes are cooked by frying, and steaming. Chinese herbs are used as main ingredients. Some adaptation is needed to meet Thai customer"s satisfaction. (33 items)
3. *Western* – Western cuisine in ABC is quite unique from other categories. Western cuisine chef needs to be highly skilled in creating well-decorated dish, using ingredients based on European cooking style. Dairy products, such as milk and cheese, are also other different ingredients from the other two

types. High quality of raw material is required to generate each dish. The ingredients are expensive since they cannot be found in local, which leads to high selling price to these menu items. (38 items)

4. *Thai-Chinese* – To achieve the maximum utilization of staffs in the kitchen, some menus are designed so that they can be produced by both of Thai and Chinese cuisine chefs. These menus require low cooking skill to be completed, and are chosen from similar cooking procedures. (45 items)
5. *General* – Those dishes with basic cooking procedures such as fried peanuts, and some other appetizers can be accomplished by any chefs, or even kitchen staffs, available in production line. These dishes are categorized as "General Type". (7 items)

Table 3-6. Type of menus, categorized by chef's expertise.

CODE	TYPE
10001	T
10002	T
10003	TC
10004	C
10005	T
10006	W
10007	W
10008	W
10009	W
10010	W
10011	TC
10301	G
10302	G
10303	G
10304	T
10305	C
10306	TC
10307	T
10308	G
10309	G
10310	TC
10311	TC
10312	G
10313	G
10314	T

CODE	TYPE
10509	T
10510	T
10511	T
10512	T
10513	T
10514	T
10515	T
10601	T
10602	TC
10603	TC
10604	TC
10605	TC
10606	TC
10607	TC
10608	TC
10609	TC
10610	TC
10611	TC
10612	TC
10613	TC
10614	TC
10615	TC
10616	TC
10617	TC
10618	TC

CODE	TYPE
10710	T
10711	T
10712	T
10713	T
10714	C
10715	T
10716	T
10717	C
10718	T
10801	T
10802	T
10803	T
10901	TC
10902	TC
10903	TC
10904	TC
10905	T
10906	T
10907	T
10908	TC
10909	TC
10910	T
10911	T
10912	T
10913	T

CODE	TYPE
11008	T
11009	T
11010	T
11011	T
11101	TC
11102	T
11103	T
11104	C
11105	T
11106	T
11107	C
11108	TC
11109	T
11110	C
11111	T
11112	T
11113	C
11114	TC
11115	T
11116	T
11117	T
11118	TC
11201	T
11202	T
11203	T

CODE	TYPE
11224	T
11225	T
11226	T
11227	C
11228	T
11229	T
11230	C
11231	C
11232	T
11233	T
11234	T
11235	C
11236	TC
11237	T
11501	W
11502	W
11503	W
11504	W
11505	W
11506	W
11507	W
11508	W
11509	W
11510	W
11511	W

CODE	TYPE
11532	W
11533	T
11534	W
11536	W
11537	W
11538	W

10315	W	10619	T	10914	T	11204	T	11512	T
10316	W	10620	T	10915	T	11205	T	11513	T
10401	C	10621	T	10916	TC	11206	TC	11514	T
10402	C	10622	T	10917	TC	11207	TC	11515	T
10403	T	10623	T	10918	TC	11208	C	11516	T
10404	T	10624	T	10919	TC	11209	C	11517	T
10405	T	10625	T	10920	TC	11210	C	11518	W
10406	T	10626	C	10921	TC	11211	C	11519	W
10407	T	10627	T	10922	TC	11212	C	11520	W
10408	T	10628	T	10923	TC	11213	C	11521	W
10409	C	10629	W	10924	TC	11214	T	11522	W
10410	T	10701	T	10925	T	11215	T	11523	W
10501	T	10702	C	10926	T	11216	T	11524	W
10502	T	10703	C	11001	T	11217	T	11525	W
10503	T	10704	C	11002	T	11218	C	11526	W
10504	T	10705	C	11003	T	11219	TC	11527	W
10505	T	10706	C	11004	T	11220	T	11528	W
10506	T	10707	C	11005	T	11221	C	11529	W
10507	T	10708	C	11006	T	11222	C	11530	W
10508	T	10709	T	11007	T	11223	C	11531	W

T = Thai, C = Chinese, W = Western, TC = Thai-Chinese, and G = General

The numbers of menu from each type are counted (from table 3-6); 108 Thai, 33 Chinese, 38 Western, 45 Thai-Chinese, and 7 General. Now, ABC can classify itself as “Thai cuisine restaurant”, due to its majority of menu items. Future strategy can be planned out using this information to be supported by current production unit. In order to calculate ratio of each menu type, Thai-Chinese menus are included in both Chinese and Thai type to see percentage of overall menu that each Cuisine chef can produce. General type is to be added to all Thai, Chinese and Western type. Therefore, pie chart below (figure 3-3) represents ratio of menus within each chef's ability.

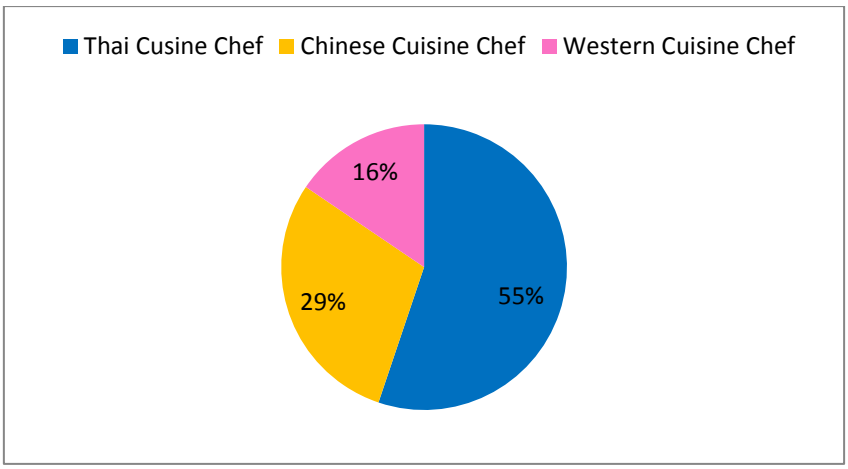


Figure 3-3. Pie chart showing percentage of menu types, categorized based on Chef‟s expertise.

The majority of ABC cooking ability relies on Thai cuisine chef with 55% of overall menus, followed by Chinese cuisine at 29% and Western cuisine at 16%. It doesn‟t mean that workload is distributed to Thai chefs only, because various types of orders are placed at one time. However, this information might be useful in further analysis.

3.1.5 Purchasing and inventory system

Current purchasing and inventory system can be divided into two parts (shown in figure 3-4); one is at the administration function, and another is in operation function (in the kitchen). Getting right material at the right time in the right place for production is the key to successfully operate Purchasing and Inventory system. ABC‟s current systems are described and analyzed for further improvement.

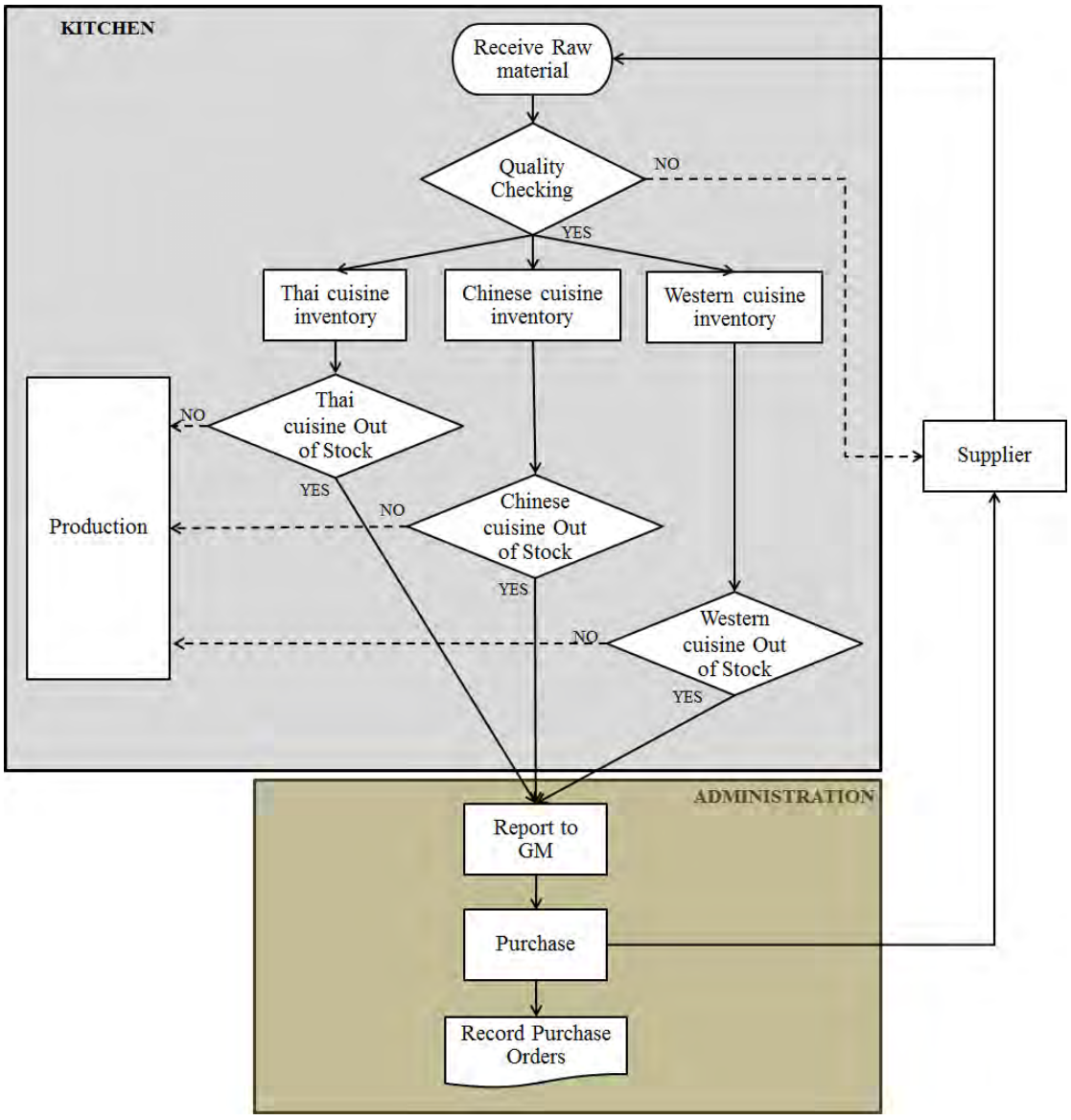


Figure 3-4. Workflow diagram of inventory and purchasing system.

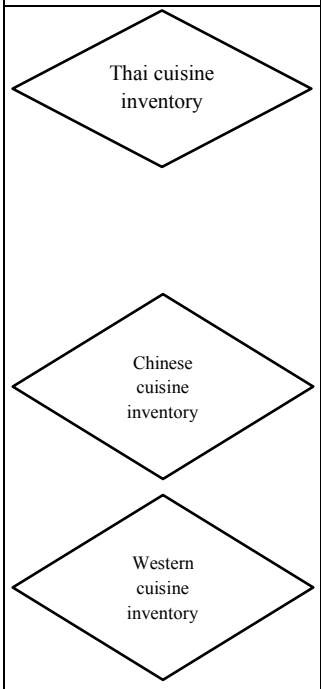
Detail in each process is described in the sub-sections below.

3.1.5.1 Purchasing and inventory in kitchen.

Inventory activities are operated mostly in the kitchen area, where the product is produced. Most ingredients are stored in the place that can maintain longest shelf-life of each kind. Table 3-7 shows the description of each process, and staffs responsible for the activities.

Table 3-7. Description of process and staffs involved in kitchen in purchasing and inventory system.

Process	Description	Staff
Receiving raw material	The first activity is to receive purchased ingredients from suppliers. The suppliers deliver raw material direct to the kitchen, depending on lead time of each supplier. Head chef is responsible for confirming the right amount of ingredients from each batch. He is also responsible for signing receiving forms, which later handed to GM.	Head Chef. Kitchen Staff.
Quality Checking	Before signing the receiving form, Head chef, with aids from kitchen staff, must check for all quality of ingredients. Skills and experience in detecting lower-than-standard quality of each ingredient are required. The under specification ingredients are rejected, and the suppliers need to deliver new batches in the next morning.	Head Chef. Kitchen staff.
Thai cuisine inventory Chinese cuisine inventory Western cuisine inventory	Qualified ingredients are distributed to each cuisine chef, as individually ordered. Each cuisine chef has their own storing units, clearly separated, in order to reduce confusion and complication in their separated operation. Each of them operates their refrigerators differently,	Thai/Chinese/ Western cuisine chef.

	depending on their storing habit.	
	Cuisine chefs are assigned to check their inventory daily, in the evening, before closing the kitchen. Nearly out-of-stock items are recorded and will be informed to GM to purchase from suppliers in the next lot. Reorder points of each raw material are estimated based on cuisine chef's experiences. This sometimes causes problem to production, since some of the estimations are incorrect, leading to overstock and raw material shortage problems.	Thai/Chinese/ Western cuisine chef.

The descriptions clearly state the responsibilities of each position in the kitchen in inventory terms. These staffs are not involved in purchasing, and do not have direct authority to contact the suppliers. The only contact between suppliers and kitchen staffs is through Head chef, who is responsible for quality of ingredients delivered. Most of quality approvals depend on Head chef's decision, skills, and experience. Most of purchasing activities are done in the administration function for better control in financial aspect.

3.1.5.2 Purchasing and inventory in administration.

Table 3-8. Description of process and staffs involved in administration in purchasing and inventory system.

Process	Description	Staff
Report to GM	When reorder point for each raw material is reached, each cuisine chef individually reports GM to contact suppliers, by filling in the purchase orders. Current documentation in	General Manager. Thai/Chinese/

	purchasing system is not set up, a scrap of paper is sometimes used as „purchase orders".	Western cuisine chef.
Purchase	The purchasing method is simple. GM fills in the suppliers" forms ordering particular ingredients stated in purchase orders. The forms are faxed to individual suppliers, and the orders will be delivered on specific date, depending on various lead time of each supplier. The payment will be settled when the ingredients are delivered, and qualified by Head chef in Q.C. stage.	General Manager.
Record Purchase orders	After raw material is delivered, administration staff needs to record all the purchasing activities in the particular time, for monthly report to the director	Admin. Staff.

From table 3-8, important role in purchasing is GM, who responsible for ordering and paying for the ingredients need, and get them delivered before shortage of raw material. The obvious problem occurring is the lacking of stand forms of „Purchase orders", which causes confusion and mistake in ordering stage. The suppliers" forms are standardized by different suppliers, and need to be fill in properly before being faxed. ABC has several suppliers stated in table 3-9.

Table 3-9. ABC"s current suppliers.

No.	Supplier"s Name	Product	Purchasing frequency
1.	Noppawan Food & Fresh Market Delivery	Vegetables, Meat, Dried ingredients	3 times a week
2.	Nida Beef	Beef, Thai-French beef	Once a week
3.	All Green Trading	Hydroponic vegetables	Once a week
4.	P.K. Seafood	Seafood	3 times a week

5.	Khao Song Chai	Rice	Once in two weeks
6.	Mongkol Gas	Gas	Once in two weeks

The suppliers stated are those delivering products to restaurant. Some of ingredients can be acquired in other sources, stated in table 3-10.

Table 3-10. ABC‟s sources for ingredients.

No.	Source	Product	Purchasing frequency
1.	Macro mall	Dried ingredients, Seasoning, Cooking oil	Once a week
2.	Bangkapi local market	Vegetables, Fruits, Meat	3 times a week

The sources stated in table 3-10 are located near to ABC restaurant. The dried ingredients are purchased in a large batch, since they can be kept for weeks. Bangkapi local market is another choice for acquiring fresh ingredients the suppliers are not able to deliver, or out of stock.

3.1.5.3 Current inventory system.

Inventory is one of the vital parts of production planning. Therefore, it has to be focused and improved for more accurate planning. The operation of production depends a lot on inventory management, operation and control. Production shop floor control also involves stock control in real practice. From the observation, and consulting with several kitchen staffs, ABC‟s raw material is categorized into 6 groups.

1. *Meat*: Pork, chicken, beef, Thai-French beef are used as main ingredients in ABC production. The ingredients are low cost, can be acquired in short time, and have average shelf-life around 3-4 days. The quality doesn‟t drop dramatically as days passed. Most of them maintain same quality till the exposing date. All meat is delivered in different forms, but mostly in big pieces. Kitchen staffs need to transform it into small piece and store it in refrigerators at particular temperature.

2. *Seafood*: Freshness is the key of seafood. The examples of this kind are all kind of fish, prawns, squids, and crabs. Seafood needs to be as fresh as possible since the quality drops overnight. Seafood is also a high value stock, due to high unit cost comparing to other types of inventory. They are kept in low-temperature refrigerator as well.
3. *Vegetables and fruits*: These kinds of ingredients have short shelf life, similar to Seafood items. The difference is that vegetables and fruits are cheaper, and when the quality drops, they do not need to be thrown away. The ingredients are still able to be transformed into ingredients for menu that needs lower standard ingredients.
4. *Dairy product*: All the dairy products such as milk and cheese require low temperature to be stored. Being left in Thailand's normal room temperature can damage the product.
5. *Dried ingredient*: Thai recipes use wide range of spices and herbs. These ingredients are categorized as dried ingredients. They need to be kept in dry place, but not require low temperature. Refrigerators are not needed to keep the ingredients.
6. *Beverages*: Beverages in all forms, for example can and bottle are purchased and kept in the beverage bar area.

There is no system in storing raw material from figure 3-5. Most of the meat are cut into small pieces and put in aluminum containers. Vegetables and fruits, in plastic bags, are piled up, non-systematically, in front-door refrigerators. It is very obvious that there is no effective stocking system in ABC restaurant production area.

Figure 3-5. Current stocking system in the kitchen.

Most of all ingredients are placed in plastic bags and put in the fridges. Western cuisine‟s fridge is where the dairy products are kept, in the same fridge as fruits and vegetables.

Beverages are responsibility of baristas who control usage of all kinds of beverages. Baristas also take care of some kinds of fruits used in making fruit juice, and also dried ingredients such as coffee beans. When out of stock, baristas fill in purchase order and hand it to GM to purchase. The inventory area in servicing unit is small and is more likely to have systems compared to inventory in the kitchen.

Necessary information relevant to production, inventory, and purchasing is provided in previous topics. As stated that effective production system requires production scheduling and forecasting to predict fluctuate demand. Historical data of sales has been collected from November 2008, to October 2009, for production planning analysis. It is to be discussed in the next topic. However, production forecasting and scheduling require information from historical sales to formulate static forms of approximate demand in a period of time.

3.1.6 Historical sales

ABC restaurant has just started its operation since 2008, two years ago. From its first year, the historical sales were collected using KIOSK program, but it was not used for any benefits. The author suggested that the second year‟s historical sales, starting from November 2009, should be collected and analyzed using Microsoft Excel. Collecting sales data and transfer it from KIOSK to Microsoft Excel can be time-consuming, but cannot be neglected. Even though customer‟s demand cannot be predicted precisely by historical sales, the previous year‟s data can provide reasonable estimation of sales in each period in the following year.

However, for suitability in presentation, the items are to be divided into 12 categories, based on menu types as classified in the real menu. Numbers of items in each category are shown in table 3-11.

Table 3-11. Numbers of menu in each category.

No.	Category name	Numbers of Item
1.	Recommended Dish	12
2.	Appetizer	16
3.	Vegetarian Dish	10
4.	Thai Northeastern Style Dish	15
5.	Rice Dish	19
6.	Noodle Dish	28
7.	Chilli Paste/Coconut Milk Dip Dish	3
8.	Tomyum/Curry/Coconut Cream Soup/Soup/Fried Dish	26
9.	Spicy Thai Salad	11
10.	Pork/Beef/Chicken Dish	18
11.	Fish/Shrimp/Crab/Squid Dish	37
12.	Western Dish	38
	TOTAL	**233**

The collected demand of each items, from November 2009 to October 2010, are presented separately based on category in bar graphs below (figure 3-6 and figure 3-7).

Figure 3-6. Items sales summary from November 2009 to October 2010 (category 1-9).

Figure 3-7. Items sales summary from November 2009 to October 2010 (category 10-12).

From the historical data, the wide range of demand between each item is obviously shown. Some items are ordered only 1-2 times during the year. The amount of items sold each day was collected and organized. However, at the end of the year, two menus are cancelled from the list due to its low sales (baked spinach with cheese and lasagna beef), which leaves ABC total of 231 menu items. Each item‟s selling price is to be shown in Appendix A. The data is rearranged and cumulative percentage of numbers of items launched and total sales from each item from November 2009 to October 2010 are shown in table 3-12.

Table 3-12. Ranking of cumulative numbers of item sold from November 2009 to October 2010.

Rank	Code	Cum.%	Rank	Code	Cum.%	Rank	Code	Cum.%	Rank	Code	Cum.%
1	10002	4.04	59	10918	69.49	117	10924	90.15	175	11110	98.22
2	10909	7.36	60	11007	70.00	118	11235	90.37	176	11113	98.28
3	10004	10.53	61	11211	70.51	119	10912	90.59	177	11216	98.35
4	10005	13.43	62	10709	71.01	120	10628	90.80	178	10010	98.40
5	10001	16.20	63	11530	71.50	121	11511	91.01	179	10407	98.46
6	11003	18.81	64	10803	71.98	122	10515	91.21	180	11111	98.52
7	11001	21.16	65	11510	72.46	123	10903	91.42	181	11229	98.58
8	10501	23.31	66	10911	72.93	124	11524	91.63	182	10511	98.63
9	10304	25.19	67	11525	73.38	125	11531	91.83	183	11502	98.69
10	10003	26.78	68	10408	73.84	126	10009	92.04	184	11537	98.74
11	10315	28.23	69	10626	74.29	127	10920	92.24	185	11538	98.80
12	10006	29.66	70	10908	74.74	128	10007	92.44	186	10410	98.85
13	11004	31.07	71	10919	75.18	129	10311	92.64	187	11203	98.90
14	10011	32.47	72	11521	75.62	130	10402	92.84	188	11218	98.95
15	10624	33.79	73	10401	76.05	131	11533	93.04	189	11222	99.00
16	10508	35.05	74	10310	76.48	132	10705	93.22	190	10301	99.05
17	10302	36.27	75	11107	76.91	133	11201	93.41	191	10603	99.09
18	10307	37.43	76	10922	77.34	134	11209	93.60	192	11206	99.14
19	10915	38.54	77	11527	77.76	135	11515	93.78	193	11207	99.19
20	10708	39.65	78	10507	78.16	136	11011	93.95	194	10607	99.23
21	10629	40.70	79	10509	78.57	137	11104	94.11	195	11205	99.27
22	11002	41.76	80	11010	78.96	138	11228	94.28	196	11219	99.32
23	10714	42.79	81	10406	79.35	139	11534	94.44	197	11520	99.36
24	10506	43.81	82	10502	79.73	140	11101	94.60	198	10710	99.40
25	10925	44.80	83	11221	80.10	141	11112	94.76	199	11215	99.44
26	11508	45.76	84	10306	80.47	142	10905	94.91	200	10706	99.48
27	10801	46.71	85	11009	80.84	143	10312	95.06	201	11514	99.51
28	10923	47.57	86	10715	81.20	144	10409	95.20	202	10712	99.55
29	11536	48.42	87	11225	81.56	145	11106	95.34	203	11103	99.58
30	11236	49.28	88	10702	81.92	146	10917	95.48	204	11117	99.61
31	11517	50.11	89	10510	82.27	147	11006	95.61	205	10703	99.64
32	10314	50.92	90	11234	82.62	148	10614	95.75	206	11108	99.67
33	10802	51.72	91	11213	82.97	149	10403	95.88	207	11212	99.70
34	10910	52.53	92	11509	83.31	150	11518	96.01	208	11210	99.72
35	10625	53.32	93	11507	83.64	151	10513	96.13	209	11516	99.75
36	10316	54.09	94	10620	83.97	152	10901	96.25	210	10608	99.77
37	10701	54.86	95	10621	84.29	153	10913	96.37	211	10711	99.79
38	10605	55.62	96	10008	84.60	154	11005	96.48	212	11109	99.81
39	11506	56.39	97	10921	84.91	155	11202	96.59	213	11116	99.83
40	11505	57.14	98	11118	85.22	156	10303	96.69	214	11214	99.85
41	10305	57.88	99	10627	85.52	157	11519	96.80	215	11231	99.87
42	10914	58.62	100	11532	85.81	158	11528	96.90	216	11237	99.89
43	10505	59.35	101	10906	86.10	159	10308	97.00	217	11217	99.90
44	10619	60.06	102	11501	86.39	160	10604	97.09	218	11227	99.92
45	10405	60.78	103	10504	86.67	161	10704	97.19	219	10615	99.93
46	10707	61.48	104	10602	86.95	162	11513	97.28	220	11226	99.94
47	10503	62.16	105	11008	87.22	163	10622	97.37	221	11230	99.95

48	10601	62.85	106	11233	87.48	164	10926	97.45	222	10618	99.96
49	10716	63.53	107	10718	87.74	165	11224	97.53	223	10713	99.96
50	11523	64.21	108	11529	88.00	166	10617	97.61	224	11114	99.97
51	10606	64.88	109	10612	88.25	167	11105	97.69	225	11115	99.98
52	10313	65.53	110	11204	88.50	168	10514	97.76	226	11220	99.99
53	10512	66.16	111	11504	88.75	169	10623	97.83	227	11232	99.99
54	10916	66.75	112	11522	89.00	170	11102	97.90	228	10609	100.00
55	10717	67.34	113	11526	89.24	171	11512	97.97	229	10610	100.00
56	10904	67.90	114	10404	89.48	172	10902	98.03	230	10613	100.00
57	10309	68.45	115	10616	89.71	173	11208	98.10	231	11223	100.00
58	10907	68.97	116	11503	89.93	174	10611	98.16			

The color in each code box represents one category out of 12 of all menu items, as defined in figure 3-8.

Category	Category
Recommended Dish	Chilli Paste/Coconut Milk Dip Dish
Appetizer	Tomyum/Curry/Coconut Cream Soup/Soup/Fried Dish
Vegetarian Dish	Spicy Thai Salad
Thai Northeastern Style Dish	Pork/Beef/Chicken Dish
Rice Dish	Fish/Shrimp/Crab/Squid Dish
Noodle Dish	Western Dish

Figure 3-8. Twelve categories represented by various colors in Code column.

However, numbers of items sold do not represent total sales restaurant receive from them. The summary of cumulative selling price of these menus is shown in ranking table below (table 3-13). It is summarized from the same set data, but this time, pay attention to the money ABC has gained from its sales.

Table 3-13. Ranking of cumulative sales from November 2009 to October 2010.

Rank	Code	Cum.%	Rank	Code	Cum.%	Rank	Code	Cum.%	Rank	Code	Cum.%
1	10002	9.01	59	10314	71.15	117	10621	90.61	175	11538	98.19
2	10001	14.07	60	10803	71.63	118	11515	90.82	176	11218	98.26
3	10004	17.39	61	10716	72.11	119	10627	91.01	177	10704	98.33
4	10909	20.14	62	10316	72.58	120	10502	91.21	178	11229	98.40
5	10005	22.42	63	11531	73.03	121	10718	91.40	179	10604	98.46
6	11003	24.58	64	10904	73.47	122	10620	91.59	180	10514	98.53
7	11236	26.67	65	10606	73.92	123	11228	91.77	181	11219	98.59
8	11001	28.62	66	10505	74.35	124	10924	91.96	182	10622	98.64
9	10003	30.28	67	10612	74.79	125	10404	92.14	183	11203	98.70
10	10304	31.76	68	10701	75.23	126	11504	92.31	184	11520	98.75
11	10011	33.10	69	10309	75.65	127	11511	92.49	185	11212	98.80
12	11004	34.27	70	11007	76.08	128	11104	92.66	186	10617	98.86
13	10915	35.44	71	11209	76.49	129	10504	92.83	187	10902	98.91
14	10708	36.60	72	11010	76.90	130	10009	93.00	188	10010	98.96
15	11211	37.73	73	10717	77.31	131	10920	93.17	189	11110	99.01
16	10006	38.86	74	10619	77.72	132	11528	93.33	190	11210	99.05
17	11536	39.98	75	11534	78.12	133	10912	93.50	191	11113	99.10
18	10501	41.09	76	11510	78.51	134	11101	93.67	192	10407	99.14
19	11508	42.18	77	10601	78.90	135	10903	93.83	193	11111	99.19
20	11530	43.24	78	11009	79.29	136	10402	93.99	194	10623	99.24
21	10315	44.25	79	10908	79.66	137	10602	94.15	195	11502	99.28
22	10307	45.21	80	10911	80.03	138	11201	94.30	196	10410	99.32
23	11523	46.16	81	10916	80.39	139	10312	94.46	197	10511	99.37
24	11517	47.10	82	10918	80.75	140	10616	94.61	198	11514	99.41
25	10313	48.01	83	10408	81.11	141	11518	94.75	199	11237	99.45
26	10508	48.89	84	10922	81.46	142	10705	94.89	200	10608	99.48
27	10629	49.76	85	10503	81.82	143	10628	95.03	201	11103	99.52
28	11002	50.64	86	11204	82.16	144	11222	95.17	202	11214	99.55
29	10801	51.51	87	10310	82.50	145	11112	95.30	203	11516	99.58
30	10624	52.38	88	11107	82.84	146	10913	95.42	204	10607	99.61
31	11234	53.24	89	11526	83.18	147	10409	95.55	205	10706	99.63
32	10302	54.09	90	10008	83.51	148	10905	95.67	206	10603	99.66
33	10925	54.91	91	11507	83.83	149	10007	95.79	207	11117	99.69
34	10506	55.70	92	10306	84.13	150	11519	95.91	208	10301	99.71
35	10914	56.47	93	10919	84.44	151	11208	96.03	209	10710	99.74
36	11213	57.24	94	10709	84.75	152	10926	96.15	210	11227	99.76
37	10802	57.98	95	10406	85.05	153	11006	96.26	211	10712	99.78
38	11532	58.71	96	10626	85.35	154	11202	96.37	212	11108	99.81
39	10714	59.43	97	11524	85.63	155	11106	96.48	213	11231	99.83
40	10923	60.14	98	11118	85.92	156	10611	96.59	214	11217	99.85
41	11527	60.83	99	10401	86.21	157	11207	96.70	215	10703	99.87
42	10910	61.50	100	11522	86.49	158	10513	96.80	216	11226	99.88
43	11233	62.15	101	10509	86.77	159	10403	96.90	217	11109	99.90
44	11525	62.79	102	11509	87.05	160	11513	97.00	218	10711	99.92
45	11506	63.42	103	10510	87.33	161	11005	97.09	219	11116	99.93
46	11505	64.05	104	10515	87.60	162	11215	97.18	220	11230	99.94
47	11221	64.67	105	10921	87.86	163	11216	97.27	221	11220	99.95
48	10305	65.28	106	10715	88.11	164	11206	97.35	222	11232	99.96
49	11225	65.88	107	11501	88.36	165	10917	97.44	223	10610	99.97
50	10405	66.44	108	10507	88.61	166	10901	97.52	224	10615	99.97
51	10512	67.00	109	11503	88.84	167	11105	97.60	225	10609	99.98
52	10907	67.55	110	10702	89.08	168	11205	97.68	226	11114	99.98
53	11235	68.09	111	10906	89.31	169	10308	97.76	227	11115	99.99
54	11529	68.61	112	11011	89.53	170	10614	97.83	228	10713	100.00
55	10707	69.13	113	11008	89.75	171	10303	97.91	229	10618	100.00
56	10625	69.65	114	11533	89.98	172	11102	97.98	230	10613	100.00
57	10605	70.15	115	11224	90.19	173	11512	98.05	231	11223	100.00
58	11521	70.65	116	10311	90.40	174	11537	98.12			

The information above can be used in the next step, improvement of production planning. The next topic is about current risk management of ABC.

3.2 Production planning and implementation process

Implementation methodology to improve efficiency of ABC production process chain is stated in sub-sections below.

3.2.1 Team selection

The improvement procedures cannot be achieved without internal staffs from the organization. Positions relevant to the change need to be identified for brainstorming and pointing out existing problems, involving suggestion and support in improvement procedure. The stakeholders involved in changing in any functions are required to attend the meeting for improvement of production planning. Members in each meeting are composed by 2 groups:

1. Fixed members: at least 2 people must attend every meeting from the start, the general manager, and the author. They are two important positions involving in all changes which to be stated in implementation process.
2. Variable members: various positions selected from each operation unit will attend some of the meeting, depending on topics of each meeting. Requirement of at least 1 position from functions relevant to the change in each week is set.

After implementation in practice, meetings are to be held for suggestion and presentation of outcome in each week. The meeting is held on Monday, after the restaurant is not in service, in order to report, summarize, and suggest ideas to operate in the following weeks. Restaurant operation is daily basis, therefore results and improvement from changing plan can be monitored in a short time. The results lead to next implementation step. Implementation schedules are shown at the end of this chapter to estimate timeline of implementation process.

3.2.2 Implementation process

Steps of improvement and contribute new system in each function are stated below, which will cover all aspects in production planning and shop floor control. Required meeting will be held in each step for reports and brainstorming from relevant positions as stated.

3.2.2.1 Menu list analysis and recipe standardization

All the menus ABC provides to customers will be analyzed. Appropriate numbers of menus should be kept, since high variety of menu items lead to difficulty in raw material planning, and operations to production unit. Before setting up any procedures, the products should be set in shape for further planning. A few tools, such as fishbone diagram, decision matrix and Pareto diagram, are to be used to cut off some menus from the list.

3.2.2.2 Material requirement planning and Scheduling

Approximation of ingredients required daily is needed for accurate raw material planning. Historical sales data is still useful to approach effective planning. Amount of raw material used is one of important factors to decide material acquirement method; buying from suppliers, buying from local market, or in-housing if possible.

3.2.2.3 Documentation system

Standard forms and documentation system are required to control activities in the process. Current documentation used in ABC‟s system is under standard due to lack of management experience of management level. New document forms will be generated and implemented in functions relevant to raw material flow process.

3.2.2.4 Inventory in practice

One important reason of restaurant‟s waste is inappropriate inventory system. Non-systematic inventory system in operation area is caused by under-educated employees, with lack of training. Ingredient storing knowledge shall be applied to inventory in real operation to reduce wastes in production process.

3.2.2.5 Shop floor improvement

Service is another vital part which is the only contact point between restaurant and customers. Apart from kitchen shop floor control, service area is also to be monitored, set standards, and controlled. Some checklist and training may be required to increase efficiency and effectiveness in servicing unit.

3.2.3 Meetings

A few meetings, joined by meeting members as stated in table 3-14, are required to carry out these steps in menu list analysis:

Table 3-14. Activities and members attending in the meetings.

Meeting	Activities	Members
1	1. Identification of problems and struggles in individual working unit. Members from management unit, production unit, and servicing unit are required to attend the meeting so that all problems in daily operation are covered. 2. Fishbone diagram will be used to point out root cause of each problem, with an aid of brainstorming from team members. 3. Historical data is collected from GM, and will be transformed from KIOSK to Microsoft Excel for analysis process.	1. Director 2. General manager 3. Head chef 4. Cuisine chefs 5. Head of FOH 6. Author
2	1. Report the summary of historical sales analysis to team. 2. Brainstorm to cut off some menus, to reduce variety of items provided to customers. 3. Thai/Chinese/Western cuisine chefs are	1. Director 2. General manager 3. Cuisine chefs 4. Author

	required to record all recipes in their own expertise.	
3	1. Gather recipes from the chefs. 2. Discuss to classify raw material type individually (seasonal/base). 3. New menu list discussion. 4. All cuisine chefs are required to be able to perform all the remaining standardized menus. The result of training will be reported in the next meeting.	1. General manager 2. Cuisine chefs 3. Author
4	1. Report of ability to perform all menus from all cuisine chefs. Quality of food will be rechecked during the week. 2. Implementation of MRP (MPS, BOM and aggregate purchasing plan) in Microsoft Excel is introduced to GM. 3. Discussion of purchasing procedures, and suppliers.	1. General manager 2. Cuisine chefs 3. Author
5	1. Discussion for more effective inventory system in the kitchen. Suggestion of appropriate storing method is provided to kitchen staffs. 2. Report results from new purchasing system to the team. 3. Report results of training of cuisine chefs.	1. General manager 2. Cuisine chefs 3. Kitchen staff 4. Author
6	1. Report the results in new inventory system. 2. Customer‟s feedback is gathered for servicing unit analysis of ABC. 3. Discussion of shop floor analysis and	1. General manager 2. Cuisine chefs 3. Head of FOH 4. Author

	brainstorm for improvement.	
7	1. Conclusion of shop floor improvement. 2. Suggestion of further improvement by team.	1. General manager 2. Cuisine chefs 3. Head of FOH 4. Author

The results in each meeting are monitored to evaluate the improvement of implementation process. Since the meetings are not to be held every single week due to various implementation time in real practice, therefore timeline of implementation schedule is provided in figure 3-9.

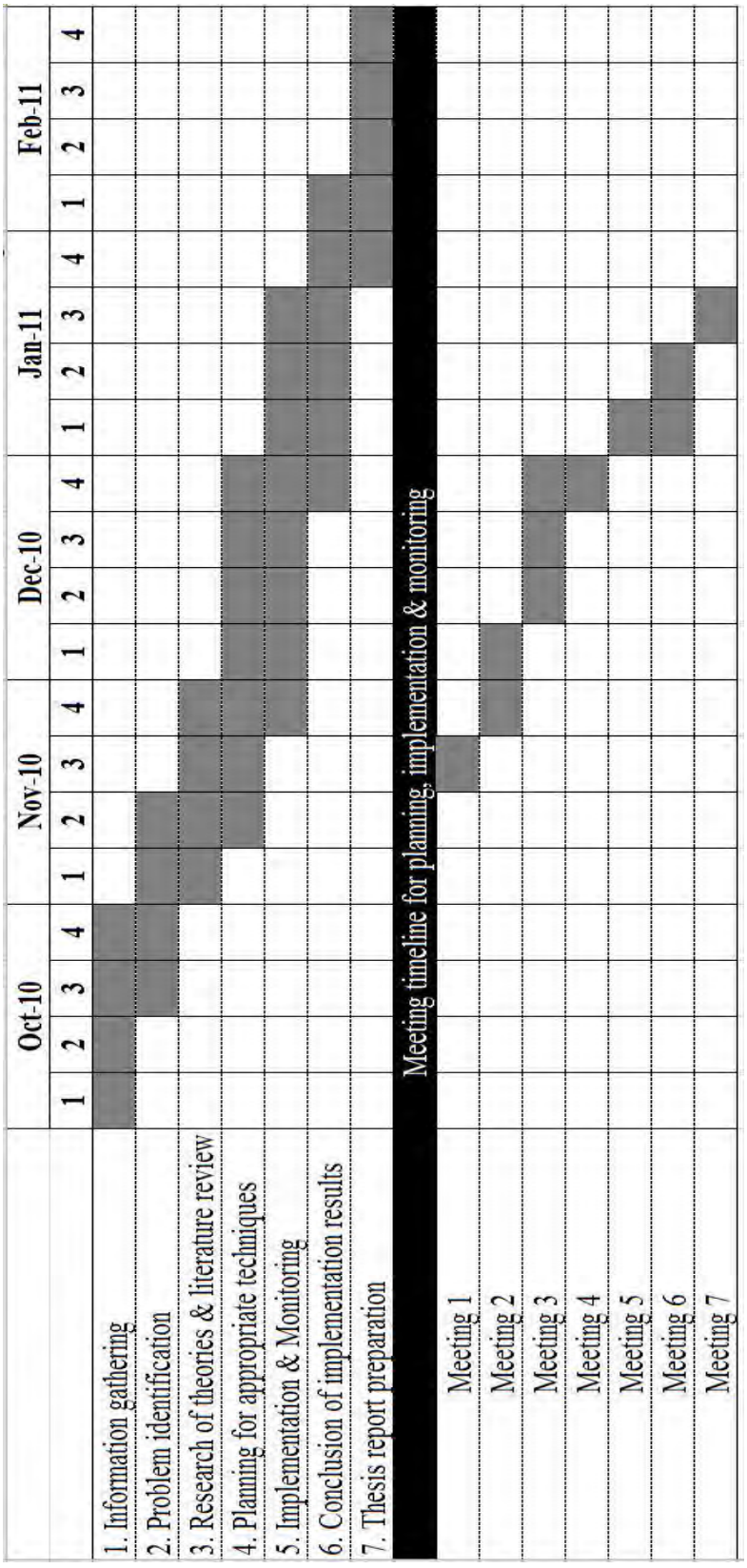


Figure 3-9. Schedule for all activities

3.3 Conclusion

Information of ABC‟s current operations is given in this chapter. Effective production planning in the restaurant includes these functions: purchasing, inventory, scheduling, and shop floor control. The improvement method and procedures will be done based on historical sales data of ABC from November 2009 to October 2010, since KIOSK program was used to integrate information system among internal functions.

Implementation process starts from problem identification from management unit, production unit, and servicing unit. These problems are to be solved individually, but for those problems sharing same root cause, one solving method can be applied to solve lapped problems. Getting it right at the start is the main idea of improvement process. Therefore, menu list is the first thing to be focused on. Several meetings will be held throughout improvement period in order to communicate and report the results to the management level. The brief framework of total process is also presented, providing approximate timeline to complete the improvement procedures.

The next chapter will be discussing about how each step is accomplished in detail. Several tools are applied to gain desired results for more efficiency and more effective production operation of ABC restaurant.

CHAPTER IV
IMPLEMENTATION OF PRODUCTION PLANNING & SHOP FLOOR CONTROL OF THE CASE STUDY RESTAURANT

Real implementation and analysis taken by improvement team are shown in this chapter. Theories and previous studies in chapter 2 is used as the guideline for real action to be taken, based on summary of each meeting‟s results. The previous chapter has summarized activities in each meeting which to be followed up by, at least, a person from a function that is involved in that activity. The information presented in this chapter is bulleted below.

4.1 Problem identification and root cause analysis
4.2 Menu list analysis
4.3 Recipe standardization, Menu categorization & New organization chart
4.4 Material requirement planning
4.5 Purchasing system
4.6 Inventory in practice
4.7 New job description & Shop floor improvement
4.8 Results from implementation
4.9 Conclusion

This chapter shows the „actions‟ taken by improvement team in order to achieve the objective of this thesis, development of effective and systematic production planning and shop floor control.

4.1 Problem identification and root cause analysis

Team started the first meeting by identifying problems of each working unit: kitchen area, administration, and service unit. Team listed these problems, and brainstormed to figure out root causes leading to the problems to occur. The problems

are summarized in fishbone diagram in order to show the possible root causes, categorized by area of problem occurrence.

Kitchen area

Problems from kitchen operation are summarized below. High amount of raw material waste and purchasing cost is the first problem stated, represented by figure 4-1.

1. High raw material waste and purchasing cost

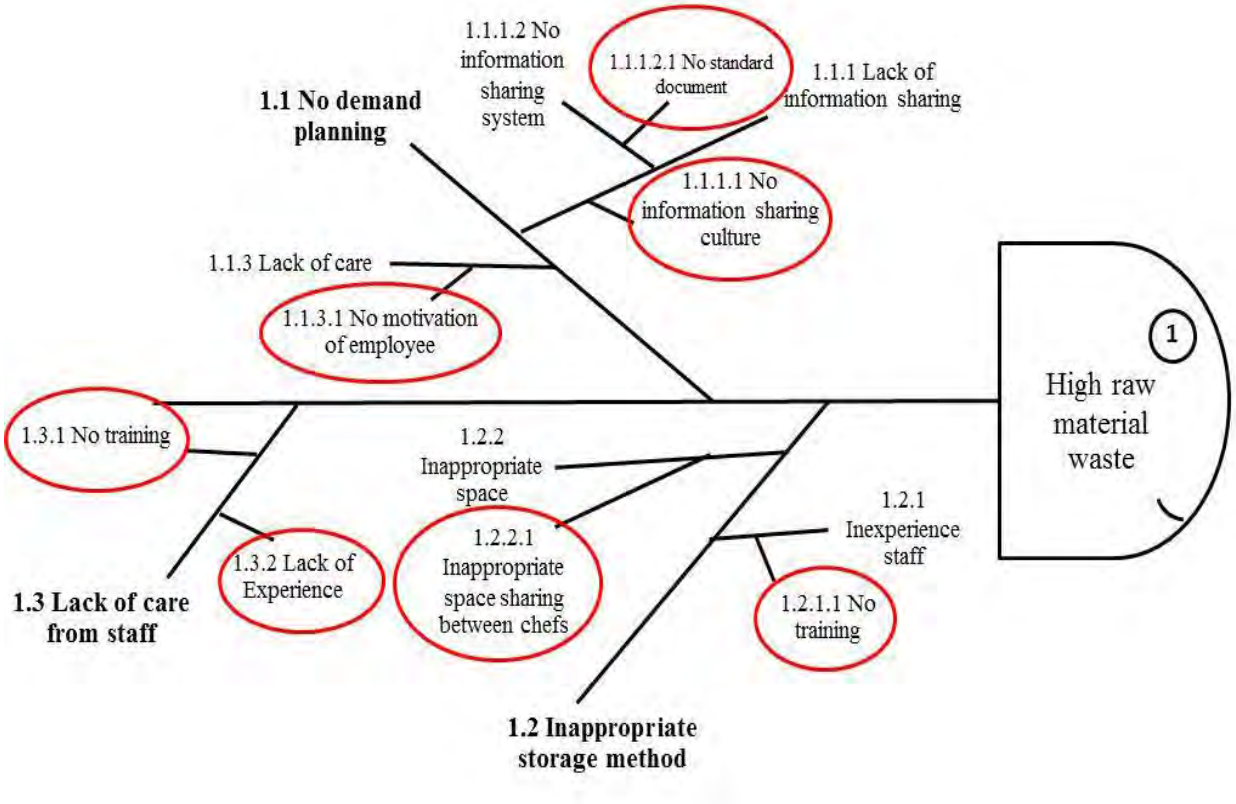


Figure 4-1. Fishbone diagram of "high raw material waste".

1.1 No demand planning

There is no records about how much raw material was „actually" left as waste, but high raw material purchasing cost records, comparing to sales rate doesn"t show high performance in raw material management. One cause of this problem is the restaurant never predicts, or estimates customer"s demand. The reasons behind is that

there is no information sharing system or information sharing culture. The historical sales data is kept by GM in KIOSK software, which cannot be applied to other computers.

1.2 Inappropriate storage method

The inventory in the kitchen is divided into 3 main zones relating to 3 types of cuisine. The unbalance sharing of refrigerators and shelves causes vegetables, meat, and other ingredients to expire before real usage. There is no training for new staff of how the raw material should be managed.

1.3 Lack of care from staff

This could be the most problem faced in every business. Staffs are careless in daily operation and only take action in activities within their job descriptions. Lack of experience of working experience in restaurant operation makes them don‟t know what to do or how the best should be.

2. Unavailability of RM

Next problem in kitchen area is shortage of some ingredients for cooking. The fishbone diagram in figure 4-2 represents results of brainstormed root causes from team.

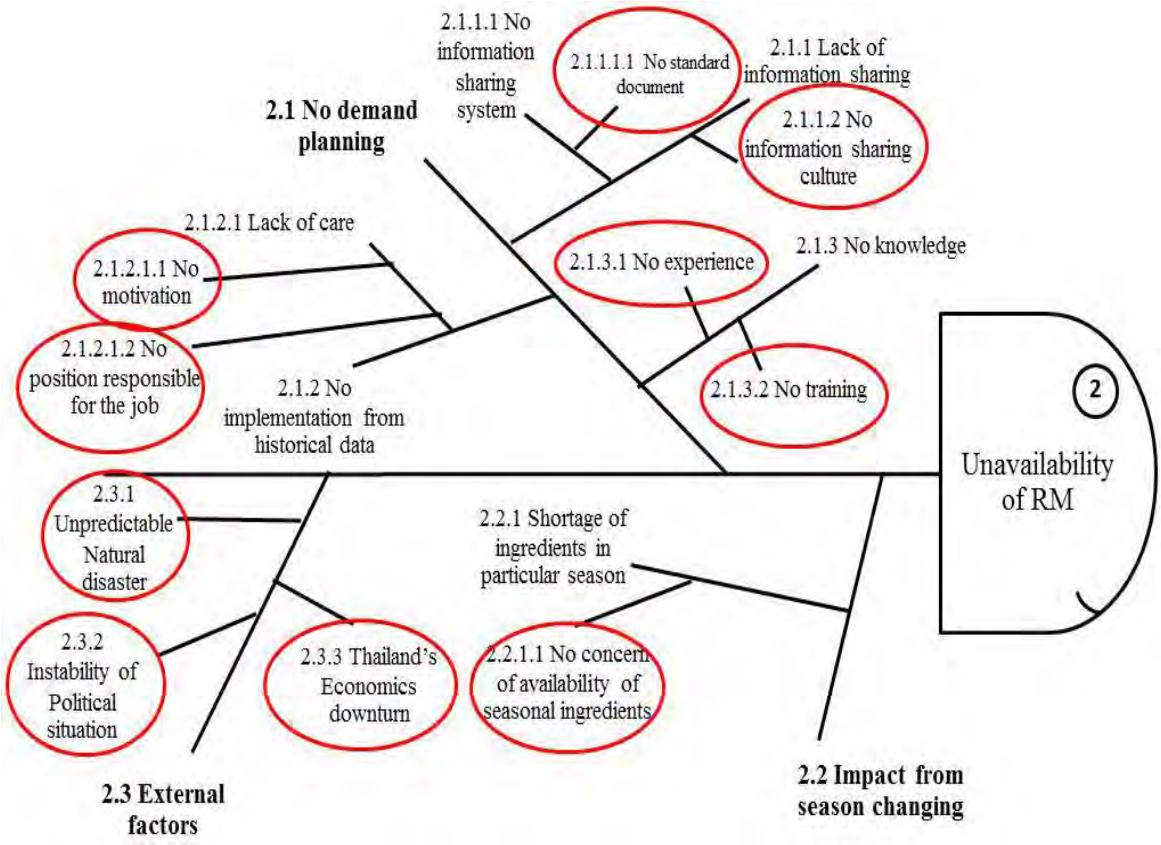


Figure 4-2. Fishbone diagram of "unavailability of RM".

2.1 No demand planning

Same cause as raw material waste problem, the restaurant doesn"t have demand planning system, which causes sudden shortage of some raw material. Information sharing system is not provided in practical. The restaurant doesn"t have any standard documentation system in daily operation. The forms are only used to report monthly summary to director. Lack of knowledge and experience in demand planning is one of root causes. The historical data is left in GM"s computer, without implementation for better system. There is no position responsible for demand planning or data management from historical sales.

2.2 Impact from season changing

The first menu creation was made without experience in food business. Raw material that is seasonal based can hardly be acquired whenever its seasons are passed. ABC has been suffering in purchasing very expensive seasonal ingredients.

2.3 External factors

Other external factors such as natural disasters, political situation, and economic downturn can also causes unavailability of some raw material.

3. Conflict among chefs

Teamwork is most important in any organization. The internal conflict causes problems in working culture of ABC. Fishbone diagram in figure 4-3 shows the root causes of this problem.

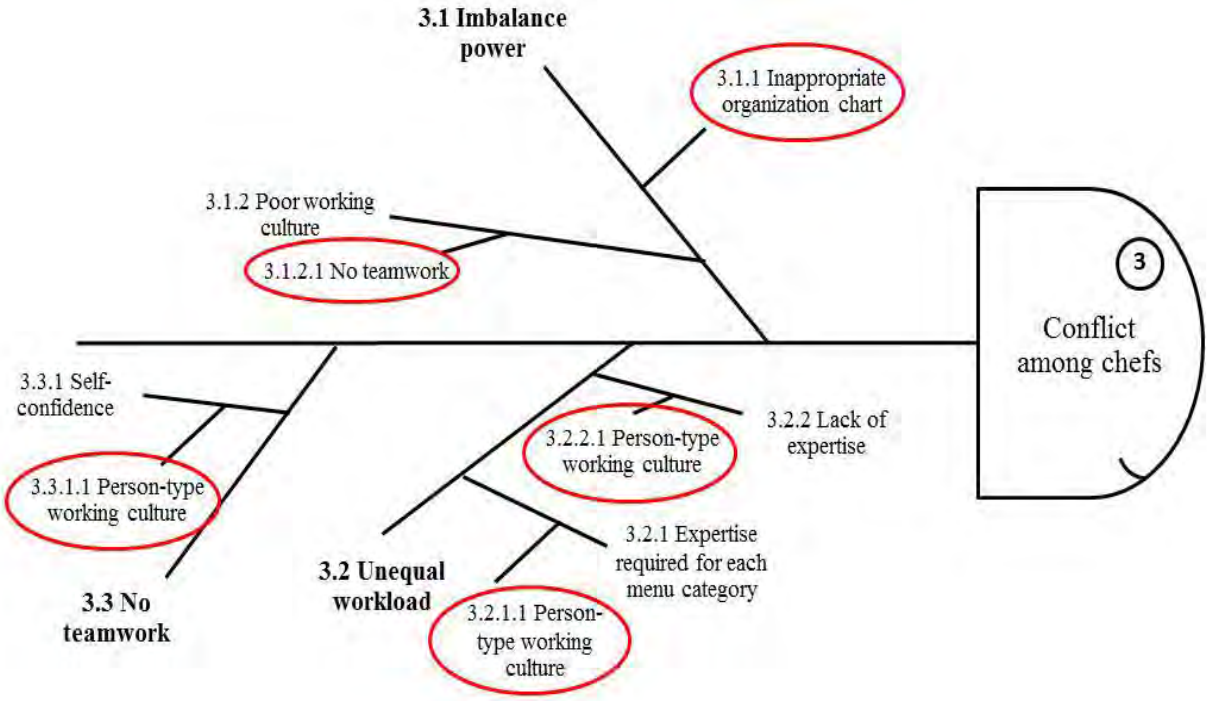


Figure 4-3. Fishbone diagram of “conflict among chefs”.

3.1 Imbalance power

Specific expertise in each cuisine type causes no team work and imbalance power among cuisine chefs. The dividing of chefs into personal expertise doesn‟t urge chefs to work together as team, but to work individually in their specific areas.

3.2 Unequal workload

Orders from customers are not equally spread to all 3 cuisine types. The workload is usually tense for Thai and Chinese cuisine since they share most of the abilities to cook menu (from menu"s categories stated in chapter 3). Western cuisine chef seems to have least workload in daily operation, but the required skill is highest due to complexity in cooking method.

3.3 No teamwork

It is obvious that staffs in the kitchen are divided into 3 groups, relevant to whom they work for. The working zone is separated too clearly and they are barely interested on other cuisine"s activities.

Administration

Operations in administration also have problems those can be summarized into 2 topics below.

4. High workload of General Manager

ABC restaurant obviously relies on General Manager (GM) in daily operation. The absence of GM can cause confusion in simple daily tasks. The root causes are shown in figure 4-4 below.

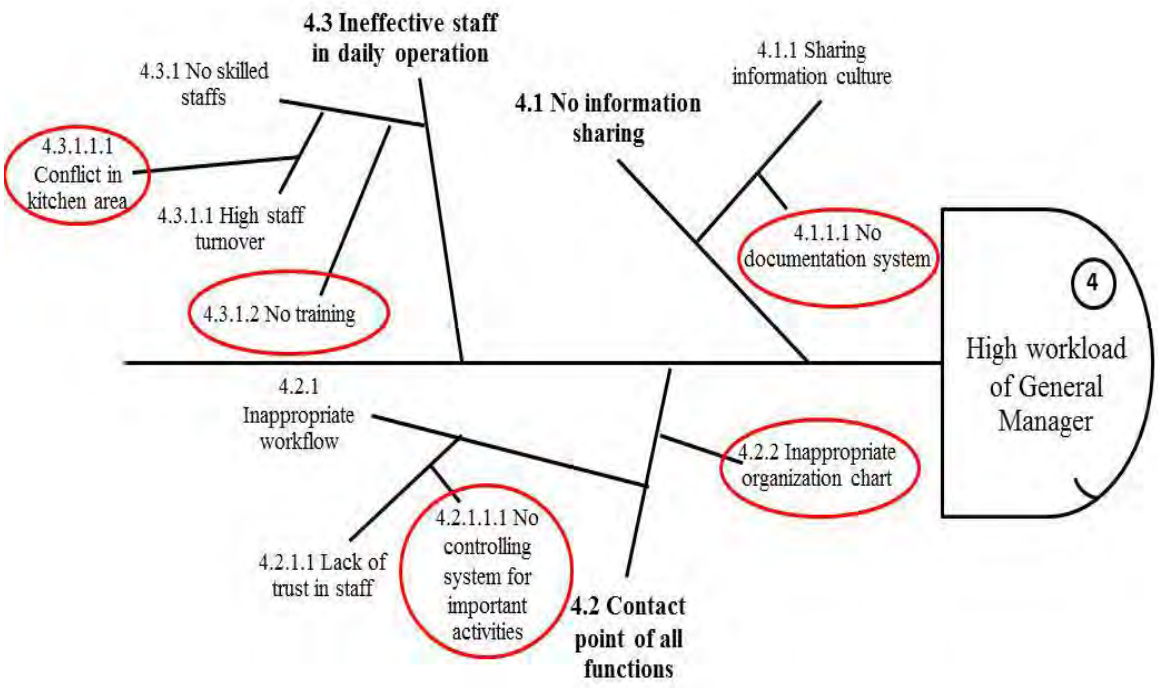


Figure 4-4. Fishbone diagram of "high workload of General Manager".

4.1 No information sharing

This problem appears as a cause of most problems in ABC restaurant. GM is the center of information flow. The position must be able to make decision and monitor all the activities in daily tasks.

4.2 Contact point of all functions

The organization chart makes GM the linkage between upper level, director, and lower level, staff and employees. GM needs to control daily operation along with reporting restaurant‟s movement to the director. All decision makings must be done by GM in daily operation because he/she is the only person given authority. The director doesn‟t trust to leave many activities to other employees due to lack of controlling system in daily activities. GM is also the linkage between internal (kitchen area) and external department (Suppliers) of the restaurant.

4.3 Ineffective staff in daily operation

As stated that employees cannot take care of most daily activities due to lack of trust from management level. These staffs mostly require higher management skill and care to take responsibility in these activities. High staff turnover rate due to conflict in the kitchen causes high numbers of no-experience working staffs in the kitchen area and FOH.

5. High raw material purchasing cost

It seems to be relevant to problem 1, but there are some areas of these two aspects which are not intersected. Fishbone 5 in figure 4-5 shows the causes of high material purchasing cost summarized by team.

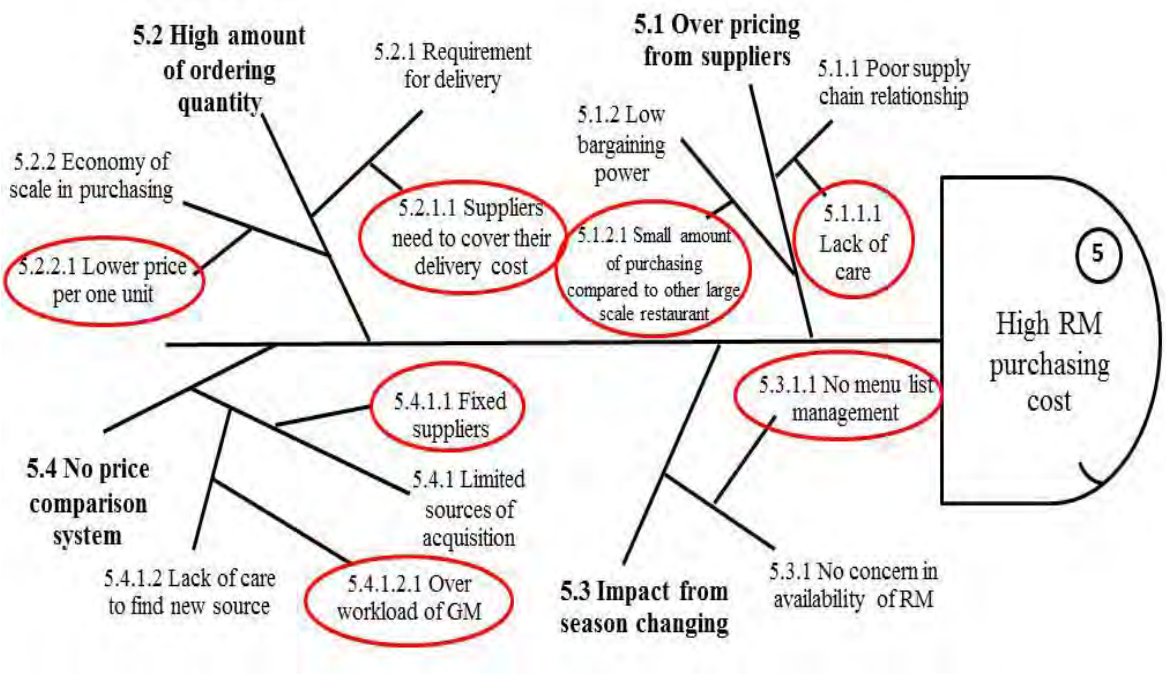


Figure 4-5. Fishbone diagram of “high RM purchasing cost”

5.1 Over pricing from suppliers

All of suppliers of ABC restaurant have high numbers of contact between other restaurants in the area nearby. They have high bargaining power since those restaurants are large scale and have no other sources of raw material. Theses suppliers do not see the important of small to medium sized restaurant, and no favors are provided. The relationship between suppliers and ABC restaurant are not developed.

5.2 High amount of ordering quantity

The delivery service from suppliers is provided only if the restaurant order up to stated batch size, which varies between suppliers. Raw material from each batch sometimes can be used for several weeks. Lack of demand planning makes the chefs decide numbers of batch from their experiences, which is not reliable. GM also tries to purchase high amount due to lower unit cost, but it sometimes results in raw material waste.

5.3 Impact from season changing

Some ingredients are very costly at a specific time of the year. The restaurant doesn‟t want to disappoint customer, therefore all kinds of ingredients are to be ready in shelf at all time. These ingredients are purchased at very high price, mostly over 140% of its normal price. The main reason is from the first menu set up which did not consider seasonal ingredients related problem. The selling price was set based on the ingredient‟s estimated normal price and the company is not making profit from selling these out-of-season-ingredient-based items.

5.4 No price comparison system

ABC restaurant trusts its suppliers in providing above standard quality of raw material, meanwhile the price is not rechecked from other sources such as wholesalers or local market. Over workload of GM also makes price recheck more likely to be impossible. It is faster to just make a call and all the required ingredients arrive at the kitchen waiting for quality checking.

Service unit

The only contact point of the restaurant and its customers only have one main problem, as shown in figure 4-6.

6. Customer‟s complaints

Feedback from customers is gathered when the comment forms are filled. These comments are very useful to improve the restaurant‟s service and production

since the goal of success is to make customers satisfied. The complaints from customers are divided into 4 main groups as shown in figure 4-6. Each group is analyzed to find the real root causes.

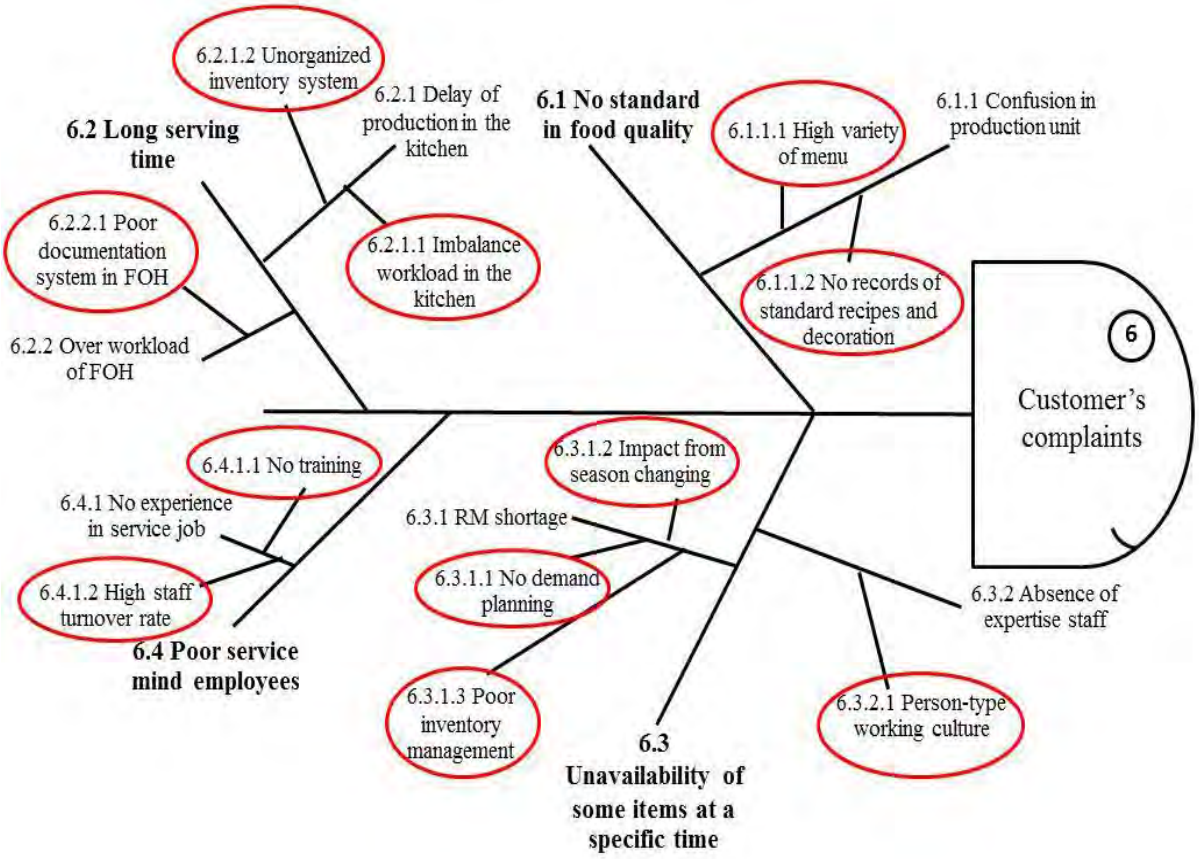


Figure 4-6. Fishbone diagram of "customer's complaints".

6.1 No standard in food quality

Changes of taste and decoration disappoint the restaurant's customers. Due to high variety of menu and no standard set for each recipe, food from the kitchen sometimes differs in details. Therefore the customers are sometimes upset if their favorite dishes are not the same from their prior visit.

6.2 Long servicing time

Long waiting time after the orders are taken from the customers is not a good thing. Customer's compliant in long waiting time is due to 2 main reasons; delay in

the kitchen area and not enough waiters in the service area. Unorganized inventory system and imbalance power among chefs are the root causes of long production time.

6.3 Unavailability of some items at a specific time

The unavailability of some items is caused by raw material shortage and absence of cuisine chefs. Shortage of raw material is caused by three main reasons: lack of demand planning, poor inventory management and impact from season changing. Chef"s prediction of customer"s demand from their experience cannot be totally reliable. Since the restaurant"s production requires high expertise from cuisine chefs, the absence of any chefs can cause the unavailability of menu items within their expertise.

6.4 Poor service mind employees

Some of waiters are part time. The high staff turnover in FOH of ABC makes the employees do not have time to improve their servicing mind and skill. The skills cannot be developed in short time. There is no training session for these people in service relevant activities.

After using Why-why analysis in brainstorming to figure out the real root cause of each problem, these sub-root causes at the end of each bone (no other sub-bones attached to, and are circled in red) are focused for improvement planning stated separately in each topic. Team held up meeting to find solution to eliminate these selected root causes within the scope of this thesis. These solutions will be implemented step by step as also shown in figure 4-7.

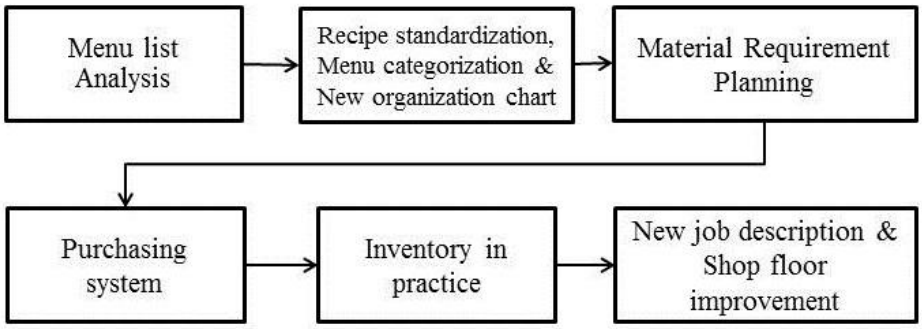


Figure 4-7. Problem solving steps.

The summary of what actions to be taken in each solution topic are shown in diagrams below. The diagrams also link those actions to root causes they eliminate (from figure 4-9 to figure 4-13).

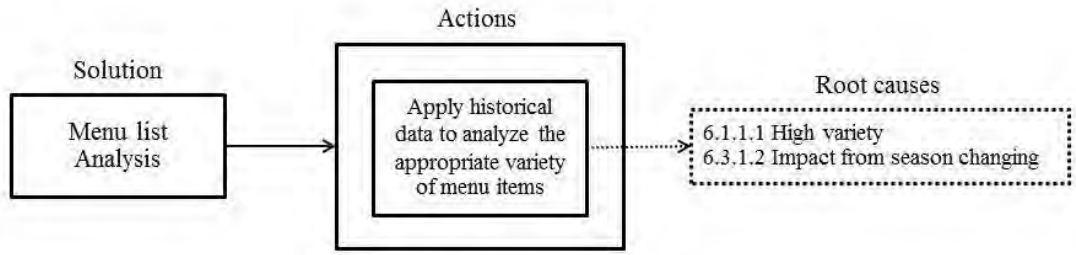


Figure 4-8. Actions and eliminated root causes by „Menu list analysis"

Menu list analysis must be taken in actions first to reduce numbers of menu to analyze in next steps. Team will manage to maintain adequate amount of menu items which will not cause complexity in operation.

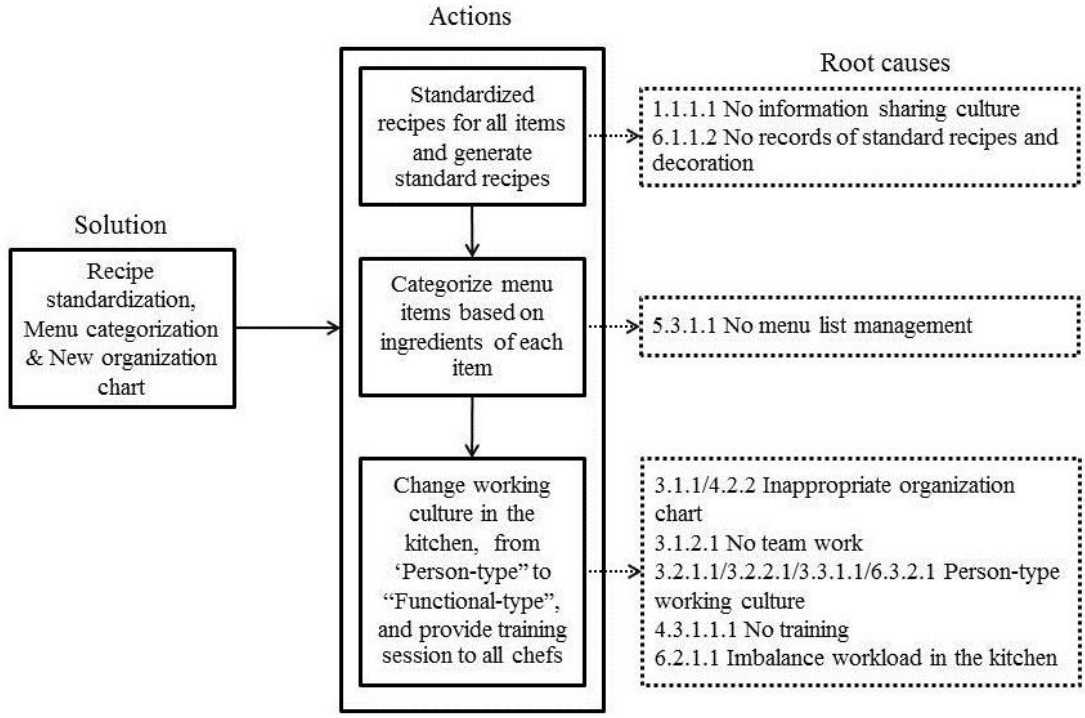


Figure 4-9. Actions and eliminated root causes by „Recipe standardization, Menu categorization & New organization chart".

Recipes of all items will be collected from chefs and recorded. The menu items will be categorized using new indicators. The organization culture and responsibility area of the chefs are changed to eliminate root causes by adjustment of organization chart.

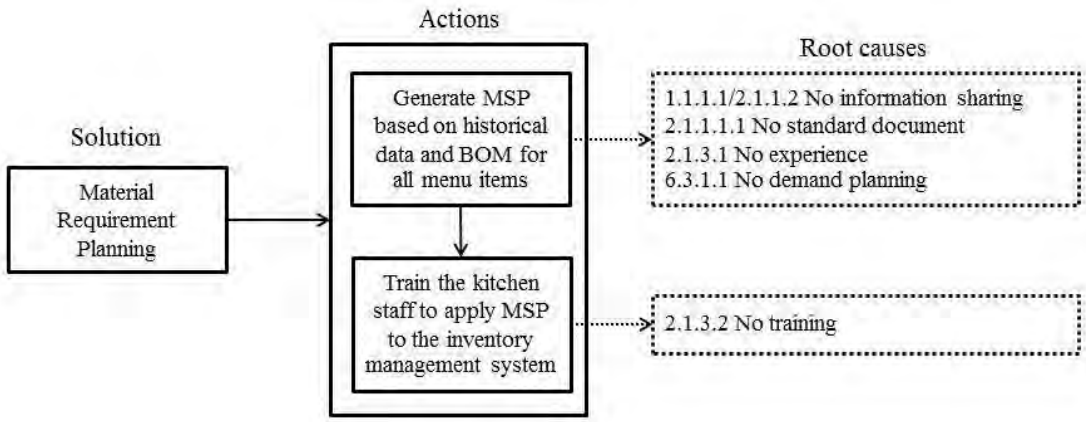


Figure 4-10. Actions and eliminated root causes by „Material requirement planning".

After stating raw material and cooking method for all recipes, the management level can generate Master Production Schedule (MPS) of the restaurant based on historical menu. This MPS can be used by staff in daily operation to estimate raw material needed for a period of time. Training is required to improve skills in implementation.

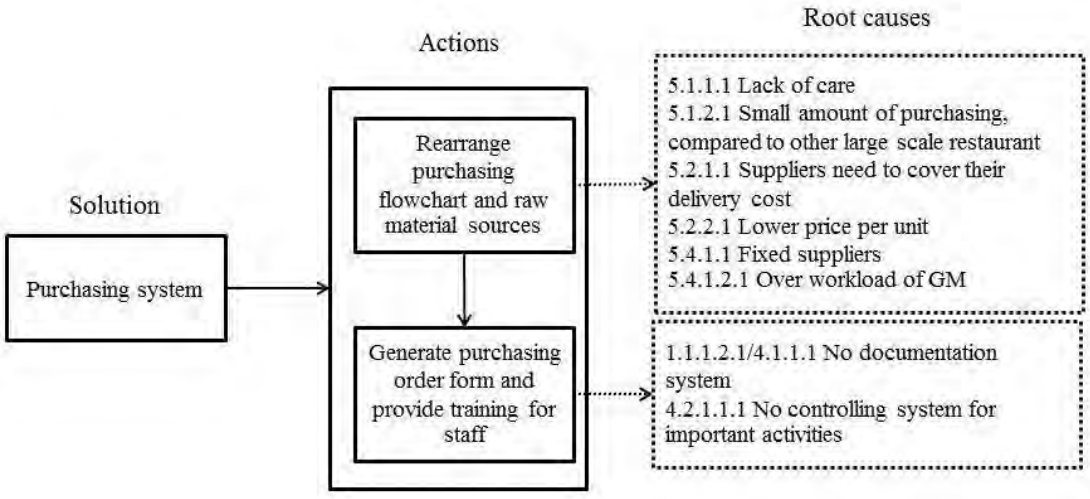


Figure 4-11. Actions and eliminated root causes by „Purchasing system".

Reconstruction of purchasing flowchart is required to help reducing workload of GM. Standard forms are generated by team to control and keep records of purchasing activities.

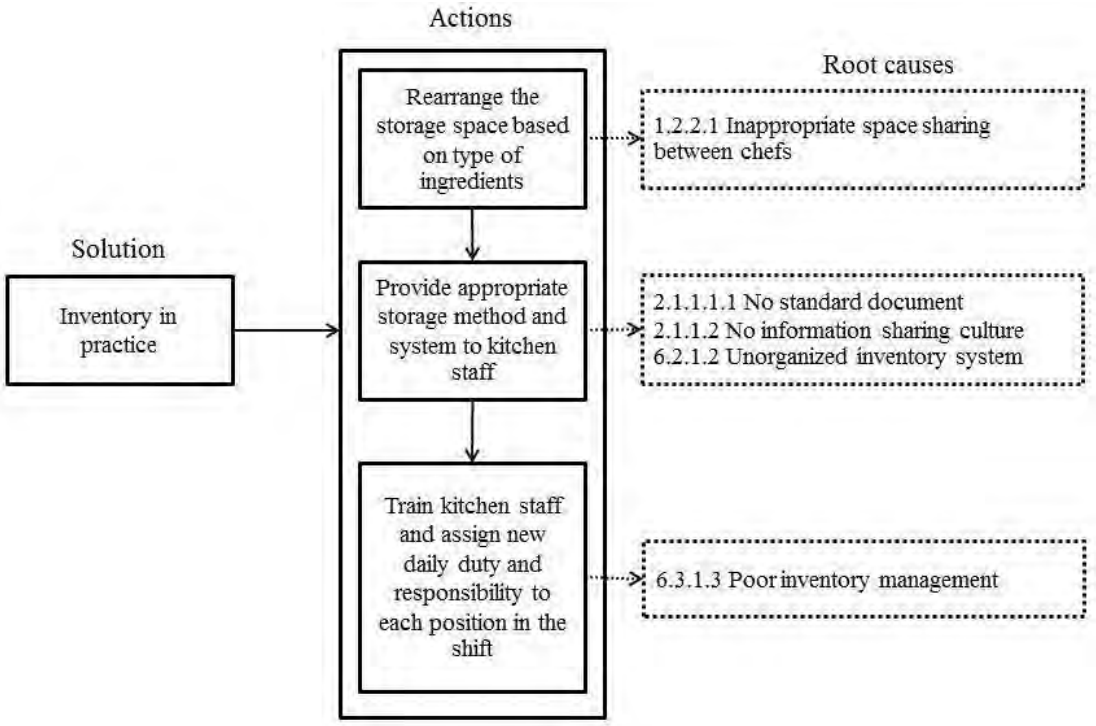


Figure 4-12. Actions and eliminated root causes by „Inventory in practice".

New storage methods are introduced to the kitchen. New organization chart allows more flexibility to allocate each type of ingredients to have their own space in refrigerators and storage shelves.

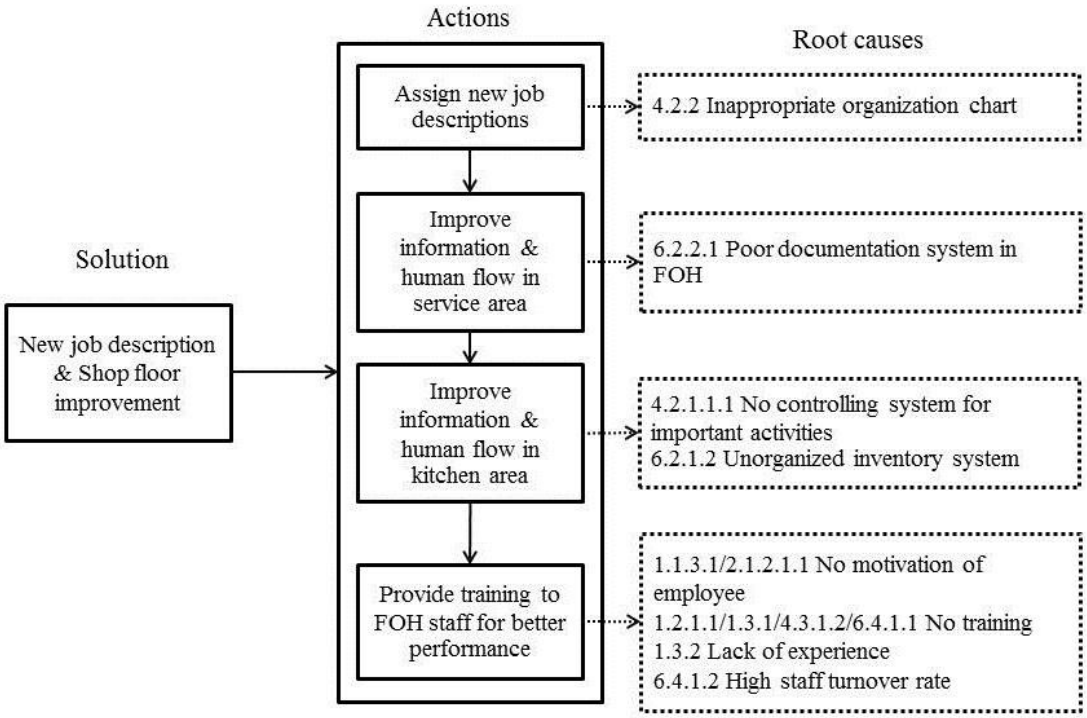


Figure 4-13. Actions and eliminated root causes by „New job description & Shop floor improvement".

The last section of improvement step is to analyze information flow and human flow of current shop floor activities after the new job descriptions for each position are set. This step focuses in training staffs in servicing area, which is in direct contact with customers.

Details of actions taken in each solution topic are stated in the following topics.

4.2 Menu list analysis

Customer"s behavior varies from one place to another, therefore historical sales are important to forecast and predict average consumption behavior in specific area. The evaluation of historical data has shown numerical statistics of each menu item sold in a period of time. The analysis is based on information collected from historical sales from November 2009 to October 2010, which is the most update information from ABC in hand. ABC needs to adjust appropriate variety of menu to

reduce complexity in resource preparation. Pareto analysis is used as a tool to scope down variety of existing menu. Historical data is collected in 2 perspectives:

1. Numbers of item sold: The numbers of each item ordered by the customer indicates customer‟s need, or demand of consumers. By cutting down the top-hit menu may disappoint customer‟s expectation.
2. Profit from sales: It tells which items are actually making money to the restaurant, which reflects total revenues. Some items are seldom launched but with the big gap between selling price and approximate cost, they generate high income to the restaurant.

Menu removal must consider these 2 perspectives so that the restaurant can also make profit while satisfying its customers. Pareto analysis (the rule of 80:20) is to be applied to the data in both perspectives, to support decision-making in menu selection. The procedures in applying Pareto and its results are explained below.

Numbers of item sold

First of all, all items are ranked from most items sold to least items sold, using Microsoft Excel. These ranks are shown in the previous chapter (table 3-12). There were 27,567 items sold during that period, with overall 231 menus from menu list. The 20% of 231 equals 46.2 ≈ 46, or the 46^{th} items from the rank. The cumulative amount from the first to 46^{th} items is counted as 16,948 (≈ 62% of overall items sold). However, the team had decided to choose the first 75% of total items sold, which will make the first 70^{th} menu from the rank (≈ 30.3% of total menu ranking from most sold to least sold) as shown in figure 4-14, so that it will be closest to 80:20 of Pareto analysis.

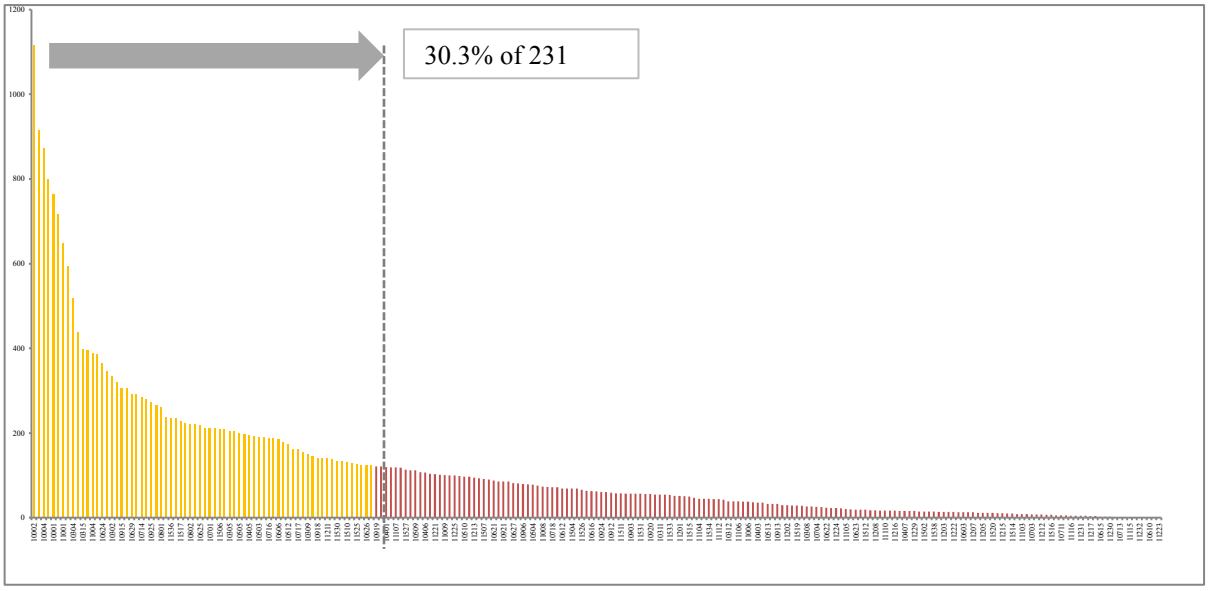


Figure 4-14. Pareto analysis of most items sold.

The first to 70th items left in the list are shown in table 4-1.

Table 4-1. Remaining items after Pareto analysis, based on number of items sold.

Rank	Code	Cum.%	Rank	Code	Cum.%
1	10002	4.04	36	10316	54.09
2	10909	7.36	37	10701	54.86
3	10004	10.53	38	10605	55.62
4	10005	13.43	39	11506	56.39
5	10001	16.20	40	11505	57.14
6	11003	18.81	41	10305	57.88
7	11001	21.16	42	10914	58.62
8	10501	23.31	43	10505	59.35
9	10304	25.19	44	10619	60.06
10	10003	26.78	45	10405	60.78
11	10315	28.23	46	10707	61.48
12	10006	29.66	47	10503	62.16
13	11004	31.07	48	10601	62.85
14	10011	32.47	49	10716	63.53
15	10624	33.79	50	11523	64.21
16	10508	35.05	51	10606	64.88
17	10302	36.27	52	10313	65.53
18	10307	37.43	53	10512	66.16
19	10915	38.54	54	10916	66.75
20	10708	39.65	55	10717	67.34
21	10629	40.70	56	10904	67.90
22	11002	41.76	57	10309	68.45
23	10714	42.79	58	10907	68.97
24	10506	43.81	59	10918	69.49
25	10925	44.80	60	11007	70.00
26	11508	45.76	61	11211	70.51

27	10801	46.71	62	10709	71.01
28	10923	47.57	63	11530	71.50
29	11536	48.42	64	10803	71.98
30	11236	49.28	65	11510	72.46
31	11517	50.11	66	10911	72.93
32	10314	50.92	67	11525	73.38
33	10802	51.72	68	10408	73.84
34	10910	52.53	69	10626	74.29
35	10625	53.32	70	10908	74.74

Same procedures are taken for „Revenue from sales" perspective, to create better view point for analysis.

Profit from sales

Management level approximated average raw material cost for each item. These costs are used to calculate the profit it can generate to the restaurant, with their fixed selling price. Same procedures are also taken for this perspective. Data is now ranked from highest to lowest based on the profit each item generates to the restaurant. The first 70 menus from the rank (≈ 30.3% of 231 menus) make approximately 76% of total revenues, as shown in figure 4-15.

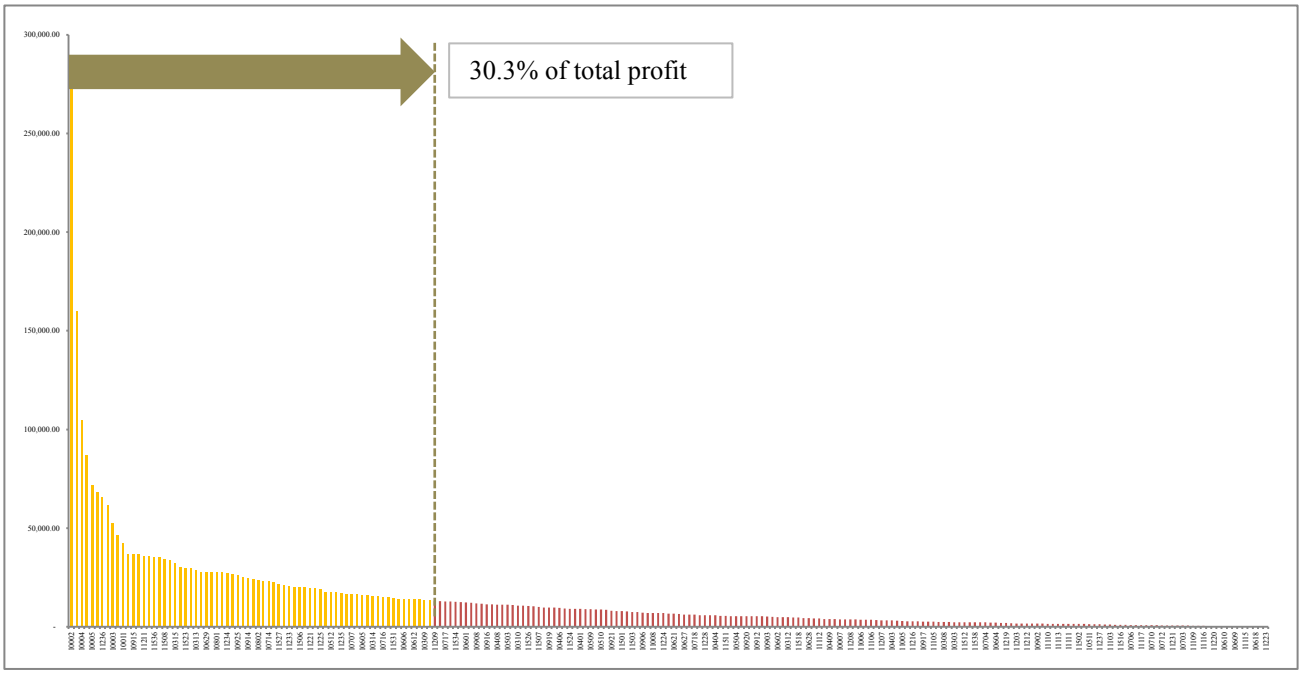


Figure 4-15. Pareto analysis of highest profitable items.

The first to 70th items left in the list are shown in table 4-2.

Table 4-2. Remaining items after Pareto analysis, based on profit.

Rank	Code	Cum.%	Rank	Code	Cum.%
1	10002	9.23	36	11213	58.16
2	10001	14.42	37	10914	58.92
3	10004	17.81	38	11234	59.67
4	10909	20.63	39	10910	60.40
5	11001	22.85	40	10305	61.08
6	11003	25.06	41	11523	61.75
7	10005	27.22	42	11233	62.37
8	11236	29.02	43	11221	62.95
9	10003	30.72	44	10803	63.53
10	10304	32.35	45	10405	64.10
11	11004	33.64	46	10512	64.67
12	10708	34.83	47	11506	65.21
13	10011	36.00	48	11505	65.76
14	11211	37.16	49	11527	66.30
15	11536	38.31	50	10904	66.83
16	10915	39.45	51	11225	67.35
17	11508	40.56	52	10907	67.87
18	10302	41.63	53	11532	68.39
19	10006	42.70	54	10707	68.88
20	10307	43.76	55	10625	69.37

21	10501	44.81	56	10716	69.86
22	10801	45.84	57	10316	70.34
23	11002	46.83	58	10612	70.82
24	10508	47.80	59	10605	71.30
25	11517	48.77	60	10309	71.77
26	10313	49.69	61	11235	72.24
27	10925	50.60	62	11529	72.69
28	10629	51.50	63	11525	73.14
29	10315	52.37	64	10701	73.59
30	10802	53.25	65	11007	74.03
31	10714	54.10	66	11521	74.46
32	10624	54.95	67	10314	74.89
33	11530	55.78	68	10916	75.32
34	10506	56.59	69	10918	75.74
35	10923	57.38	70	11209	76.16

The first 3 digits of item codes represent menu category each item belongs to, for example 110XX are all the menus from „Recommended Dish" group (as stated in chapter 3). Categorizing menus is important for analysis because it identifies some resources required for each item. Numbers of „top hit" and „most profitable" items, from each category, are shown in table 4-3.

Table 4-3. Numbers of items from each menu category.

First 3 Digits	Category name	Top Hit	Most profitable items
100	Recommended Dish	7	7
103	Appetizer	9	9
104	Vegetarian Dish	2	1
105	Thai Northeastern Style Dish	6	4
106	Rice Dish	8	5
107	Noodle Dish	7	5
108	Chilli Paste/Coconut Milk Dip Dish	3	3
109	Tomyum/Curry/Coconut Cream Soup/Soup/Fried Dish	12	10
110	Spicy Thai Salad	5	5
111	Pork/Beef/Chicken Dish	0	0
112	Fish/Shrimp/Crab/Squid Dish	**2**	**9**
115	Western Dish	**9**	**12**
	TOTAL	**70**	**70**

The selected 70 items are not identical from each group. Team needs to decide which menus will be kept in order to maintain customer"s satisfaction along with keeping its profit from sales. Items those do not share „top hit" and „most profitable items" articles are summarized in table 4-4 below.

Table 4-4. Items which are not identical in „top hit" and „most profitable items" list.

Top Hit	Top Profit
10408	11010
10503	11209
10505	11213
10601	11221
10619	11225
10626	11233
10709	11234
10717	11235
10908	11521
10911	11527
11510	11532

These non-identical items are focused. Team had to decide which items are to be kept in regular menu providing to customers. „Top hit (only)" menus are those having high demand but not making high profit to the restaurant, while „most profitable item (only)" are those making high profit even though they are barely ordered from the customers. Out of these ranks, items from two categories of menu list generate high profit to restaurant although they are seldom launched. These items are from:

- Fish/Shrimp/Crab/Squid (Seafood) category (112XX): Seafood is profitable items since the selling price is high compared to menu from other categories. The seafood ingredients are analyzed and categorized as „seasonal-based ingredients" in following section. The fluctuation of seafood cost during a year causes difficulty to predict raw material cost of the dish in a period of time.
- Western dishes (115XX): Western food has higher selling price compared to other categories, due to their high raw material cost. Therefore, it is not a surprise that low numbers of items ordered can generate a big number of

money to ABC. After analysis, problems of daily operation are found in process of Western dish production. The detail is discussed below.

After focusing on Western items (115XX), the confidential information from accounting and purchasing history are analyzed. Team found that characteristics of Western items, as bulleted below, cause difficulties in kitchen operation.

1. High raw material cost: Cost from purchasing raw material of Western items is approximately 45%-55% of selling price, which is relatively high compared to other categories because most ingredients of Western dishes cannot be produced locally and must be imported.
2. Requirement of staff's expertise: Staff's salary varies depending on position and personal expertise. Western chef gets higher salary than other cuisine chefs due to expertise in making dishes local chefs are not familiar with.
3. Low sales rate: Western dishes are not frequently launched, even though this category generates high revenues to the restaurant (as discussed above), the unpredictable sales rate causes large amount of wastes from stored ingredients. The idle time of Western cuisine chefs and Sous chefs also cause conflicts among staffs (due to unfair workload in the kitchen).

To eliminate these undesirable characteristics in daily operation, 9 items of Western categories (from „Top Hit") are removed from menu list, which leaves overall remaining 61 serving items. Analysis from this point forward will be based on these remaining items only.

As stated that items from „most profitable item (only)" contain undesirable characteristics (difficulties in daily operation from 115XX items production, and problems from seasonal effects of seafood ingredients from 112XX items production). Team decided to keep all items from „top-hit" group. However, to prevent opportunity loss from cutting off some of high profitable items, team decided to re-categorize menu groups to provide opportunity in launching these menus (explained in „*Menu categorization*" section).

The cancellation the Western category causes changes in responsibility and organization culture in the kitchen area, from cuisine-expertise-based to functional-based type. Each chef is identified as „Cuisine chef" instead of „Thai chef" or „Chinese chef". Now, all chefs in the kitchen are required to have ability to cook every recipe served in the restaurant. The actual implementation is possible because of reasons stated below.

1. *Standardized recipes*, which to be generated by each cuisine chef, allow any chef to cook standard quality for every dish. The recipes used to be kept in secret by each cuisine chef, rather than keeping as records. These recipes used to be passed on when new chefs are hired only, by personal training. However, standardized recipes allow ability to train all chefs to produce same quality of food. The transition of sharing recipes in practice is implemented within 2 weeks, started after the conclusion of meeting 3. The evaluation is done by general manager and the director to assure that the quality of taste and decoration for every dish is within standards.
2. *Less menu items* causes less time to train the chefs. ABC used to have more than 200 items which make training period to cook all dishes very long.
3. *High numbers of overlapped skills of Thai and Chinese chefs* allows training to take only several days. Thai and Chinese food are similar and required similar skills to produce, unlike Western dishes, which local chefs are not familiar with.
4. *New organization chart* states same level responsibility to every chef. Western chef used to have higher salary compared to others due to high requirement of expertise for cooking the Western food, now all chefs are required to be able to generate all items those are left, which creates equality in power among all chefs, and causes less problems in kitchen area.

Next step is to collect all standardized recipes to take action in menu categorization and arrange new responsibilities in the kitchen area.

4.3 Recipe standardization, Menu categorization & New organization chart

Recipe standardization

Difficulties from operation that ABC is now facing are mostly due to lack of standardization and effective management system. Standardization of recipe is vital to generate stable ingredients used for each plate. Kitchen staff can be trained to generate same quality of food from standardized recipes. Team managed to gather all remaining recipe from chefs responsible for each item. However, 2 weeks period are required for each cuisine chef to train each other all of 61 menus. Example of „plate card" is created as the form shown in figure 4-16. The chefs are required to fill in all information needed to identify what to be used, how to be done, and approximate cost for every single ingredient.

Name:			Last revised date:	
Code:			Serving:	
Ingredient	Amount	Unit	Cost/Unit (Baht)	Remarks
Equipment	Amount	Unit		
		Total cost		
Instructions:				
Instructor Chef:				

Figure 4-16. Example of plate card form.

Example of actual plate card used in ABC restaurant is shown in Appendix B. Pictures of finished product are also taken and kept in file to maintain same decoration when the food is served to customers, while avoiding confusion in plate decoration from staff. The recipes collected from chefs can be used as cooking standards in daily operation. Moreover, ingredients and equipment required can be estimated based on standardized recipe.

Ingredients stated in standardized recipe can be implemented to seasonal-based menu categorization. Thailand is very famous for high variety of fruits and vegetables, which are available all year. The efficiency of Thailand‟s agriculture can

provide most of the ingredients, fruits, vegetables & meat, at all time. However, season change is the cause of high cost of some kinds of ingredients at a specific time during a year. The remaining 184 ingredients required to generate 61 items are summarized from standardized recipes to classify types of each menu, and shown in Appendix C. These ingredients are categorized into 2 groups.

1. Seasonal-based ingredients: Ingredients those have fluctuation of cost over than 5% during a year are counted as „seasonal-based ingredients". These ingredients cause swing in raw material cost for production.
2. Non-seasonal-based ingredients: Ingredients with fluctuate price less than 5% are categorized as „non-seasonal ingredients".

Ingredient code is also identified to classify ingredient"s types as shown in Appendix C. Team has studied the highest and lowest cost of each ingredient in the previous year and summarized that there are 43 seasonal-based ingredients and 141 non-seasonal-based ingredients. The seasonal-based ingredients are shown in table 4-5, the period of time in a year when these ingredients can be purchased at its normal cost is highlighted. Information of purchasing history is analyzed to categorize fluctuation of purchasing price for each ingredient and monitor the changing price.

Table 4-5. Period of time when each seasonal-based ingredients are lower or equal average.

	Seasonal ingredients	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Baby corn												
2	Bamboo shoot												
3	Banana blossom												
4	Broccoli												
5	Capsicum												
6	Carrot												
7	Celery												
8	Cherry tomatoes												
9	Chinese cabbage												
10	Chinese leek												
11	Cow-pea												
12	Crab												
13	Crab meat												
14	Cucumber												

15	Dong quai												
16	Frillice Iceberg												
17	Galingale												
18	Green apple												
19	Italian parsley												
20	Ivy gourd												
21	Lemongrass												
22	Lettuce												
23	Lime												
24	Lime juice												
25	Long cucumber												
26	Luffa gourd												
27	Mango												
28	Parsley												
29	Pea												
30	Pea eggplant												
31	Pineapple												
32	Radish												
33	Red apple												
34	Red coral												
35	Red radish												
36	Small eggplant												
37	Spinach												
38	Spring onion												
39	Straw mushroom												
40	Thai parsley												
41	Tomatoes												
42	Water morning glory												
43	Winged Bean												

Most of seasonal-based ingredients are vegetables and fruits. As stated that Thailand has 3 seasons, each of which is suitable for some vegetables to grow. The fluctuation of price is due to shortage of particular ingredients during its low season period. For seafood, crab for example, its price changing does not rely on season. There is no exact changing pattern to be monitored. However, the fluctuation of its price during a year must be under concerned.

Menu categorization

The classification of menu type is vital in raw material acquisition aspect. The remaining menus will be divided into 3 types, using information from Appendix C.

1. Regular menu: These items are to be fixed in normal menu list provided to customers. They are available all year.
2. Seasonal menu: These items are launched in a specific period of time in a year, by adding them to regular menu list.
3. Chef‟s special menu: These are items needing special ingredients that do not rely on seasons. They will be added up to the regular menu as “Chef‟s special” when ingredients are available with a reasonable price. This type also solves “opportunity loss” in cancellation of unpopular menus that generate high profit to the restaurant.

The specific decision tree shown in figure 4-17 is created by team member to help identifying menu‟s category more precisely. Team has designed a decision tree used for menu categorization together, relying on chef‟s experience in ingredients purchasing and historical purchasing cost data. Each item will be run through the decision tree to identify its category.

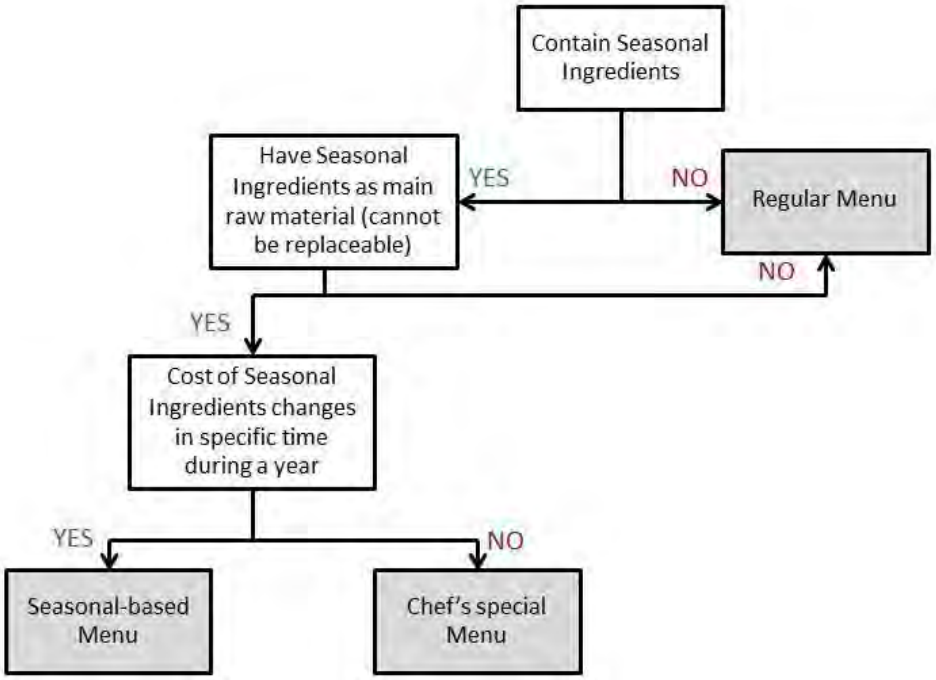


Figure 4-17. Decision tree diagram used to categorize an item from menu list.

The first step is to consider whether the menu contain seasonal ingredients or not, if not, it is put in regular menu list. For those contain seasonal ingredients, they

are to be considered if the seasonal ingredients are the main raw material which cannot be replaced by other similar ingredients. For those replaceable ones, they are put in regular menu list also. The menu contains irreplaceable seasonal ingredients goes to the next step, which tells it is the „seasonal-based menu" or „chef's special menu". Price fluctuation of raw material can be varied as same pattern during a year, or randomly changes due to other external factors rather than seasonal effect. In this step, if the seasonal ingredient's price is not varied in the same pattern during a year, that menu is not to be launched in particular seasons, but is counted as chef's special. For example, menu item 11004 (Crispy Morning glory spicy salad with seafood, minced pork) contains water morning glory as a main ingredient, which cannot be replaced by other vegetables to complete the dish. Water morning glory's price rises up in winter and summer (November to May), therefore it falls in „seasonal menu". Results of categorization are shown in table 4-6.

Table 4-6. ABC restaurant"s menu categorization.

Regular Menu		Seasonal Menu
10003	10629	10001
10004	10701	10002
10005	10707	10315
10006	10708	10405
10011	10709	10408
10302	10716	10503
10304	10717	10606
10305	10904	10714
10307	10907	10801
10309	10908	10802
10313	10909	10803
10314	10910	10911
10316	10914	10925
10501	10915	
10505	10916	
10506	10918	
10508	10923	
10512	11001	
10601	11002	
10605	11003	
10619	11004	
10624	11007	
10625	11211	
10626	11236	

ABC restaurant"s new menu list contains 48 menu items, and 13 seasonal menu items will be launched based on pricing situation of raw material of each item.

This decision tree diagram in figure 4-17 is also useful for creating new menu. It can identify new menu"s type to prevent purchasing expensive raw material cost, which have fluctuation due to external factors.

New menu creation

New menu must be generated to attract customers and also provide prevention of opportunity loss in selling some such as those containing seafood as main

ingredients. ABC is situated in Bangkok which is the capital of Thailand. The seafood sold in nearby market is not always at the acceptable quality. However, the seafood items do not required high skill in generating and can generate high revenue to the restaurant (based on historical data analysis). Cutting these menus off the list may cause opportunity loss to the restaurant, as suggested in *Menu list analysis* that each item from seafood category (112XX) is profitable even though they are barely sold. These items can be suggested as Chef"s special menu whenever the main ingredients can be acquired in local market at reasonable price. These chef"s special items are presented to customers during their selling period. Restaurant production is different from industrial production. „Research & development function (R&D)" doesn"t exist in most restaurants. The production staffs are also staffs in R&D function, that have responsibility in new product invention. Therefore, improvement team had generated „Chef"s special menu category" in order to provide flexibility in new menu creation to kitchen staffs. The new menu suggestion follows these procedures.

1. Study the seasonal based ingredients table.
   Raw material used for the new dish is the first to be considered. Chefs must make sure that the time launching new menu is the period when cost of ingredients used for new menu does not exceed acceptable cost (referring to table 4-5). If any ingredients are not presented in seasonal-based ingredients, information of its normal price must be acquired by survey from local market.
2. Fill in the "Test plate card" form.
   The form is used to record the ingredients, cooking procedures and presentation of each dish by chefs who want to produce new menu items. This form is the same as plate card in Appendix B, except that the menu code is not yet given.
3. Evaluation from management level.
   New menu will be cooked and presented to the director and General Manager to evaluate the taste and presentation, along with cost evaluation. The selling price is set by management level. Raw material cost must not exceed 30%-35% of its selling price.
4. Record standard recipes and train other cuisine chefs.

The new menu will be recorded in admin‟s data base before provide training to all cuisine chefs to be able to generate the new item.

5. Identify numbers of „Chef‟s special‟ in the first week.
   The numbers of items to be launched during its selling period are identified by kitchen staffs, with an approval from General Manager. The adequate numbers of new items to be sold each week are useful in the next step, Material requirement planning, so that staff can perform raw material purchasing smoothly.
6. Monitor and adjust prediction of new items sold each week.
   Amount of new items launched in the first week of launching each Chef‟s special item is recorded, so as the numbers of time customers are turned down for unavailability of new items. Management level can sum up the numbers and use it as next week prediction for approximate numbers of Chef‟s special menu so that adequate amount of ingredients can be prepared to generate more accurate prediction of ingredient preparation.

These Chef‟s special procedures are identified to provide flexibility for new menu creation so that the restaurant can have new products launched for its customers, while following its purchasing system and keeps its material requirement planning accurate.

New organization chart

Organization chart of ABC restaurant is changed due to reduction of position required in the kitchen. The positions that are no longer required after discussion are as follows.

1. Western cuisine chef
2. Western cuisine sous chef

These two positions are no longer required due to new menu list, which cut off Western items. The restaurant is now changed the organization chart in the kitchen to “matrix organization chart‟. Figure 4-18 below shows new organization chart of ABC restaurant.

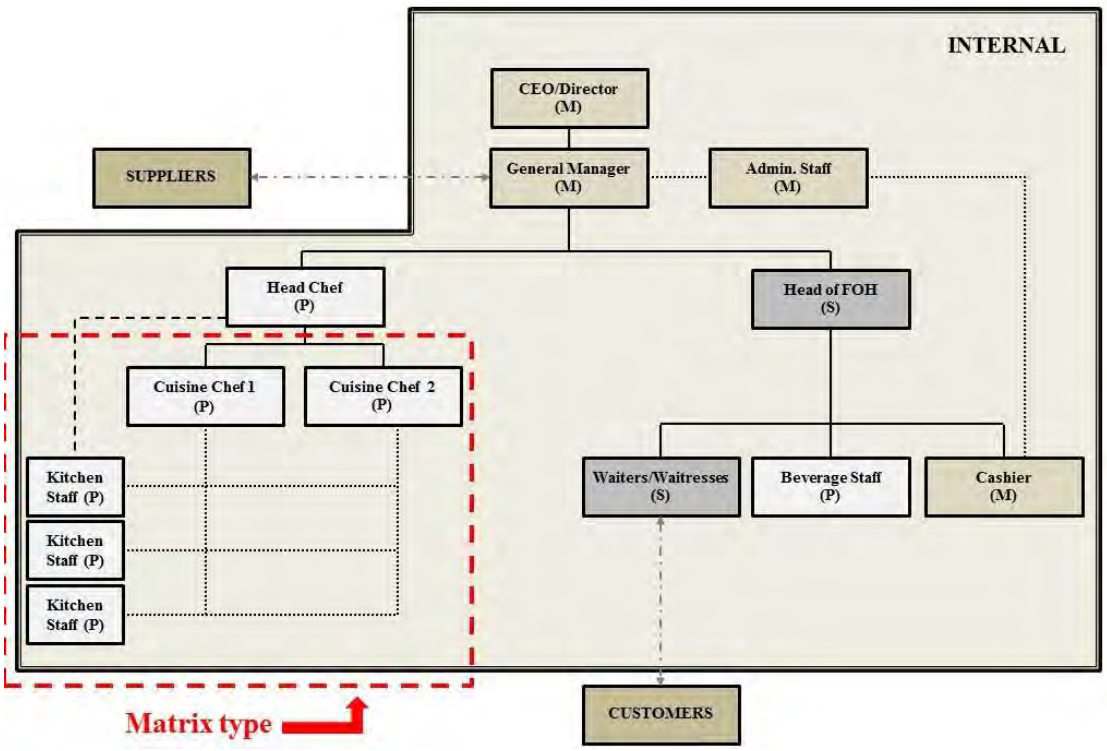


Figure 4-18. New organization chart (Matrix type in kitchen area).

Now that all chefs are assigned to cook each order received from the customers, with an aid from kitchen staff in preparation of raw material and equipment. There are no more sous chefs in operation since all kitchen staffs are assigned to do different tasks depending on their shifts. Staff's shift schedule is shown in figure 4-19.

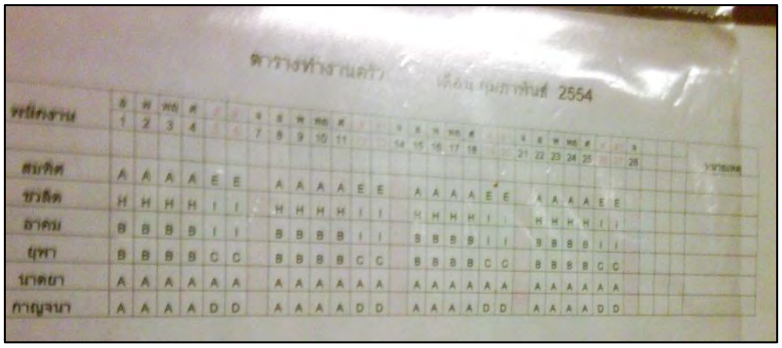


Figure 4-19. Example of staff's shift schedule.

From this new organization chart, ABC uses 2 less positions in daily operation, and also manages balance power between 2 cuisine chefs. Head chef is

now responsible for shift assignment. Duties for each kitchen staff are assigned by Head chef to take care of daily inventory checking, kitchen cleaning and raw material preparation.

The new menu is expected to solve problem from high cost of raw material. The prediction of raw material used at a specific day will be done in the next topic, the „Material requirement planning". Team set up the material requirement planning before actual launch of new menu to train kitchen staff in operation in advance.

4.4 Material requirement planning

Material requirement planning (MRP) is useful to make sure that raw material is available when needed, while maintaining lowest possible level of inventory. Unlike other fields of production, restaurant"s production is "made-to-order" with unpredictable demand and has very short lead time. The only way to make availability of sales is to get all raw materials ready in shelf at all times. Historical sales have been collected from November 2009, which can be used to predict customer"s purchasing behavior of ABC restaurant.

To generate most precise demand planning, data must be grouped together to match customer"s consumption behavior pattern as much as possible. The numbers of items sold is used to represent numbers of customers in each day. Items launched are grouped together, separated by the day in a week. Customer"s behavior has similar consumption pattern in each day of the week. The sales rate slightly increases from Tuesday to Sunday. The bar chart in figure 4-20 shows numbers of item sold each day separated by day in a week.

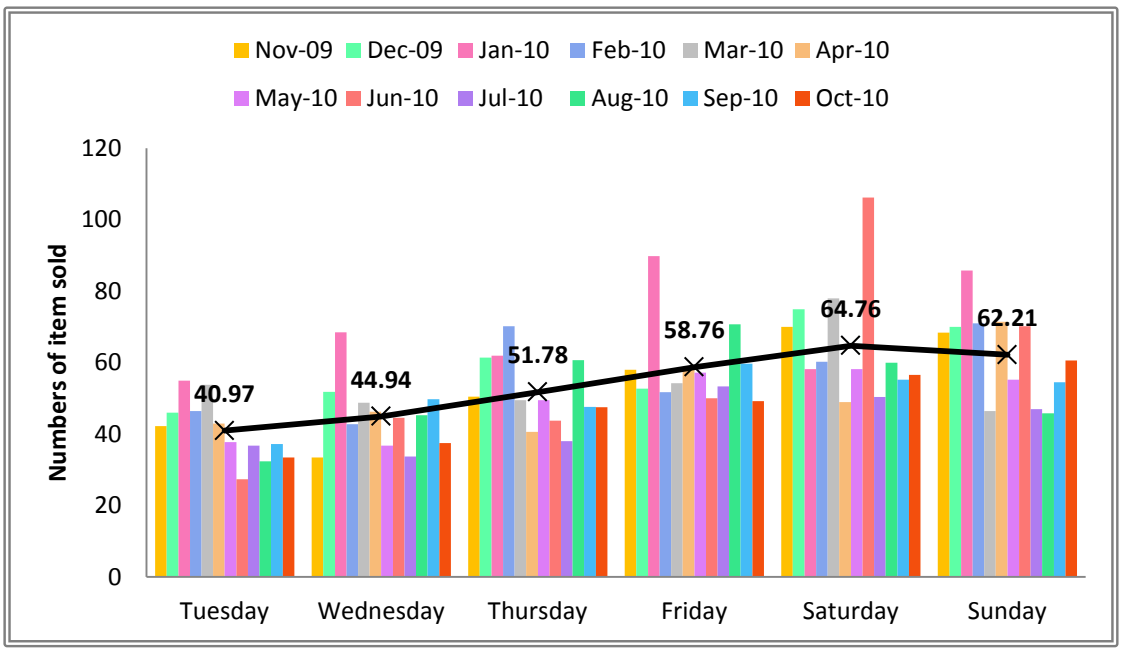


Figure 4-20. Bar chart showing numbers of item sold in each month separated by days in a week (from November 2009 to October 2010).

It is obvious that there is no pattern of the restaurant‟s sales from month to month. Team needs to use the demand planning separately for each month.

The purchasing and inventory checking of ABC are likely to be done every week. Thai people normally have high consumption rate at the end of every month, after the salary is paid. Team expects to gain higher sales at the end of every month. Therefore, the difference of consumption rates among week 1, week 2, and so on of the month also plays important role in demand planning. The summary of numbers of item sold separated by weeks within a month (4-5 weeks in a month) is shown in figure 4-21 below.

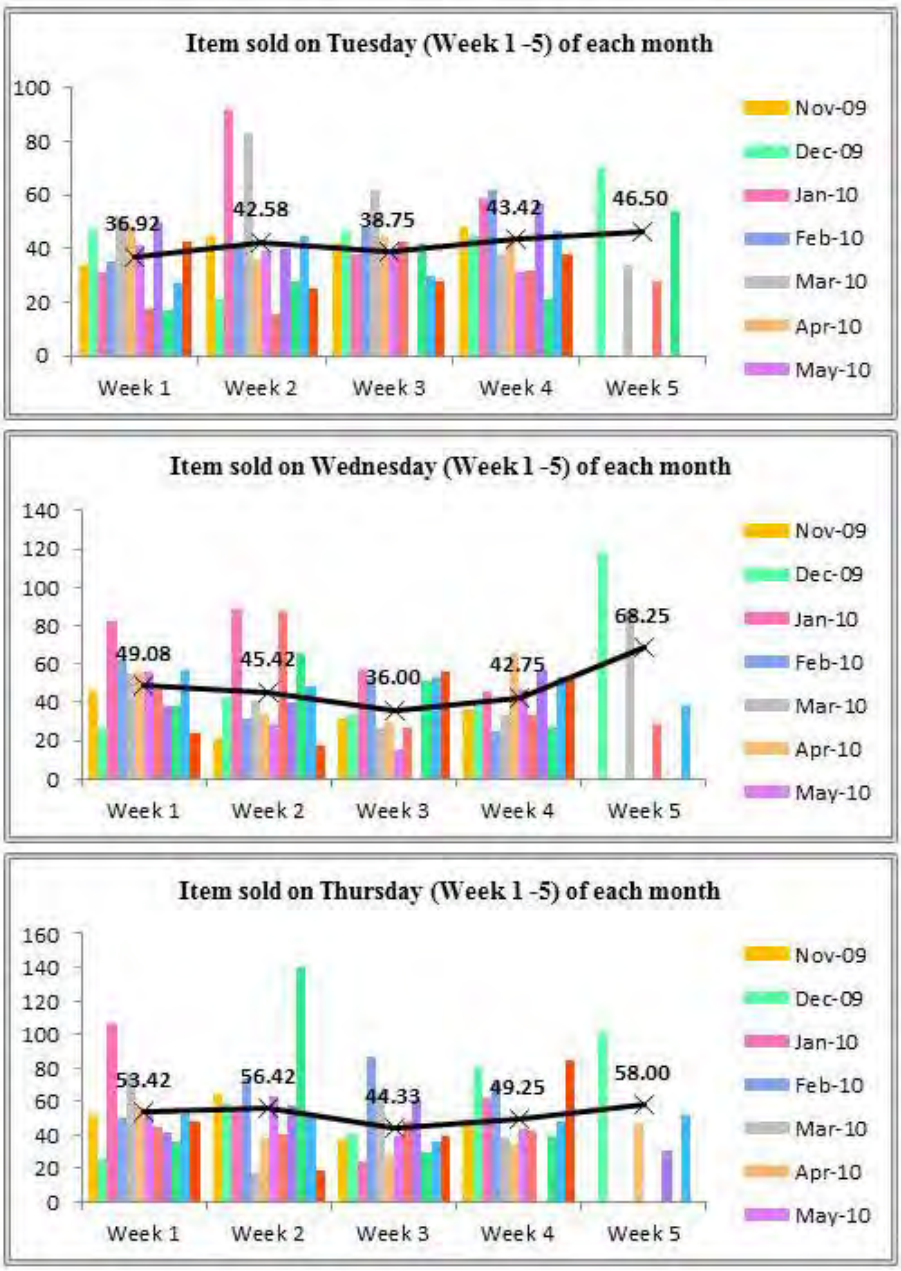


Figure 4-21. Bar chart showing numbers of item sold in each week during a month, with an average line (Tuesday, Wednesday, and Thursday).

In week days, the selling items tend to be slightly higher than other weeks on last week of each month, due to the reason stated about salary paid at the end of the month. Historical data shows that sales rate increased from average sales on each day by 11.69%, 41.3% and 10.93% on Tuesday, Wednesday, and Thursday relatively.

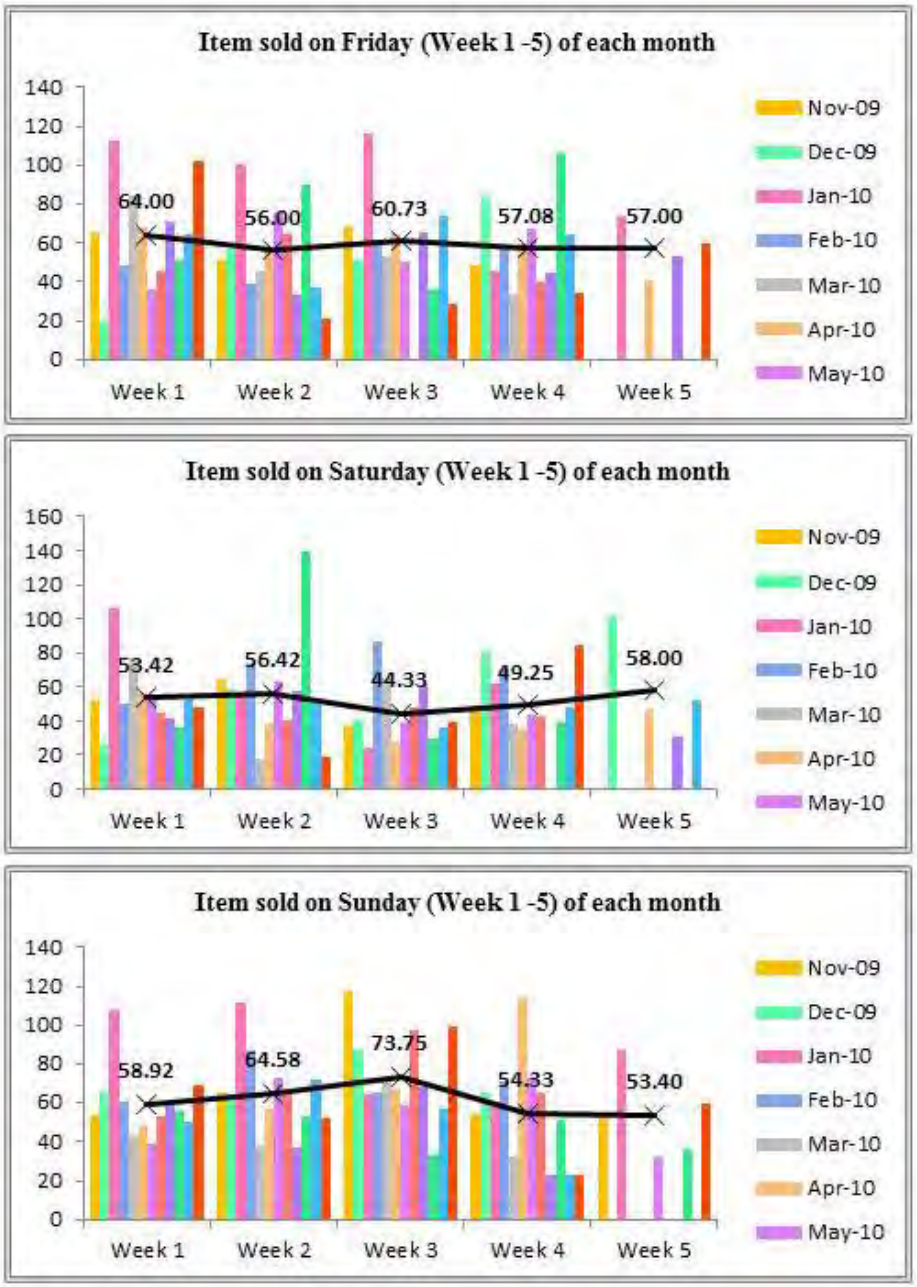


Figure 4-22. Bar chart showing numbers of item sold in each week during a month, with an average line (Friday, Saturday, and Sunday).

On Friday and weekends, amount of sales seem to stay the same on Friday and Saturday, and slightly drops when it reaches the last week of each month. The percentages of dropping sales in last week of each month from average are 12.45%, 3.33%, and 30.56% on Friday, Saturday, and Sunday respectively.

The assumption that higher sales should be achieved at the end of each month is not always correct. Customers in ABC restaurant‟s area tend to celebrate their receiving of salary at ABC restaurant if that day is from Tuesday until Thursday. However, the behavior changes when the end of the month (salary payment date) is on Friday, Saturday and Sunday. Team will set up raw material planning based on the analysis, which can be concluded:

1. Raw material preparation will be planned based on historical data week by week, using historical information from last year.
2. If last week the month is on Tuesday, Wednesday or Thursday, sales increases by ≈ 20% in average.
3. If last week of each month is on Friday, Saturday or Sunday, sales drops by ≈ 15% in average.

The new menu list with less variety is very useful for prediction. Team starts to generate Material requirement planning for ABC production planning which is composed of 2 components: Master Production Schedule (MPS) and BOM (Bill of Material).

Master Production Schedule (MPS)

MPS specifies which finished goods are required at what time. ABC‟s MPS is expressed separately in months, showing expected sales of each item in each day in a week. Estimated numbers of items sold are from historical sales collected in 2009-2010. However, the item reduction of menu list caused 4 times less items provided for customers. The first month implementation of MPS for new menu (January 2011) is a little tricky because of the assumption that overall customers stay the same. Less menu variety will surely cause increased amount of each item ordered from customers. Raw material planning in the first 3 months (January - March 2011) is done based on 4 times numbers of average menu items sold from data from 2010. Example of MPS for January 2011 is shown below in table 4-7. The first 3 weeks of the month use average numbers for prediction, but for week 4, sales of Tuesday to Thursday will be based on 20% increased from average item sold, and 15% decreased from Friday to Sunday.

Table 4-7. MPS for ABC production planning in January 2011.

	JANUARY (WEEK 1-3)						JANUARY (WEEK 4)					
Item	TUE	WED	THU	FRI	SAT	SUN	TUE	WED	THU	FRI	SAT	SUN
10003	12	4	12	8	12	8	15	5	15	7	11	7
10004	8	8	16	20	16	20	10	10	20	17	14	17
10005	8	16	12	16	16	16	10	20	15	14	14	14
10006	8	4	8	16	8	16	10	5	10	14	7	14
10011	8	12	4	8	4	12	10	15	5	7	4	11
10302	4	8	4	8	8	12	5	10	5	7	7	11
10304	4	12	8	12	8	16	5	15	10	11	7	14
10305	4	8	4	8	4	4	5	10	5	7	4	4
10307	4	4	4	8	4	8	5	5	5	7	4	7
10309	4	4	4	4	4	4	5	5	5	4	4	4
10313	4	4	4	12	4	4	5	5	5	11	4	4
10314	0	0	0	0	0	0	0	0	0	0	0	0
10316	0	0	0	0	0	0	0	0	0	0	0	0
10501	12	8	12	8	8	12	15	10	15	7	7	11
10505	0	4	4	4	4	4	0	5	5	4	4	4
10506	4	4	4	4	4	4	5	5	5	4	4	4
10508	4	8	4	8	4	12	5	10	5	7	4	11
10512	4	4	4	4	4	4	5	5	5	4	4	4
10601	4	8	4	4	4	4	5	10	5	4	4	4
10605	4	4	4	8	4	4	5	5	5	7	4	4
10619	4	4	4	0	4	4	5	5	5	0	4	4
10624	4	8	8	8	4	4	5	10	10	7	4	4
10625	4	4	8	4	4	4	5	5	10	4	4	4
10626	4	4	4	4	4	0	5	5	5	4	4	0
10629	4	4	4	8	4	8	5	5	5	7	4	7
10701	8	8	4	8	4	4	10	10	5	7	4	4
10707	8	4	0	8	4	4	10	5	0	7	4	4
10708	4	8	8	4	8	16	5	10	10	4	7	14
10709	4	4	8	4	4	4	5	5	10	4	4	4
10716	4	8	12	4	4	4	5	10	15	4	4	4
10717	4	8	4	0	4	0	5	10	5	0	4	0
10904	12	4	4	4	4	8	15	5	5	4	4	7
10907	0	4	4	4	4	4	0	5	5	4	4	4
10908	4	4	4	4	4	8	5	5	5	4	4	7
10909	8	8	12	16	12	20	10	10	15	14	11	17
10910	4	4	4	4	4	8	5	5	5	4	4	7
10914	4	4	0	8	4	8	5	5	0	7	4	7
10915	8	8	4	8	8	12	10	10	5	7	7	11
10916	0	8	8	4	4	4	0	10	10	4	4	4
10918	8	0	4	8	4	8	10	0	5	7	4	7
10923	4	4	4	4	4	4	5	5	5	4	4	4
11001	12	20	12	20	12	8	15	24	15	17	11	7

11002	8	8	4	12	4	8	10	10	5	11	4	7
11003	12	4	8	16	16	12	15	5	10	14	14	11
11007	4	4	4	4	4	4	5	5	5	4	4	4
11211	8	4	4	4	0	4	10	5	5	4	0	4
11236	4	8	4	8	4	4	5	10	5	7	4	4

The first 3 months implementation of MPS (January - March 2011), material requirement prediction based on 4 times 2010 sales volume will be used. The actual consumption rate of each menu will be recorded for more accuracy. Actual sales collected from January 2011 (when new menu list is launched) will be compared to data from 2010 to see the pattern and team will need to brainstorm the similarity or difference of changing pattern to generate most appropriate pattern of MPS for future production planning. MPS will be linked to bill of material to predict purchasing amount of each ingredient.

Bill of Material (BOM)

The standardized recipe can be used to generate Bill of material (BOM) for material planning. Each item‟s ingredients are listed and used Microsoft Excel as a simple BOM generator. Each menu item is broken down by BOM to estimate the ingredients to be used in specific period of time.

Product structure will be created from standard recipes. Team divided raw material into 5 types based on its shelf-life, as shown in table 4-8.

Table 4-8. Five types of ingredient for product structure.

No.	Ingredient	Approximate shelf-life (days)
1	Meat	3-4
2	Vegetables	3-4
3	Fruits	7
4	Seafood	2
5	Dried ingredients	14

Ingredient code contains characteristics of each material as shown in figure 4-23.

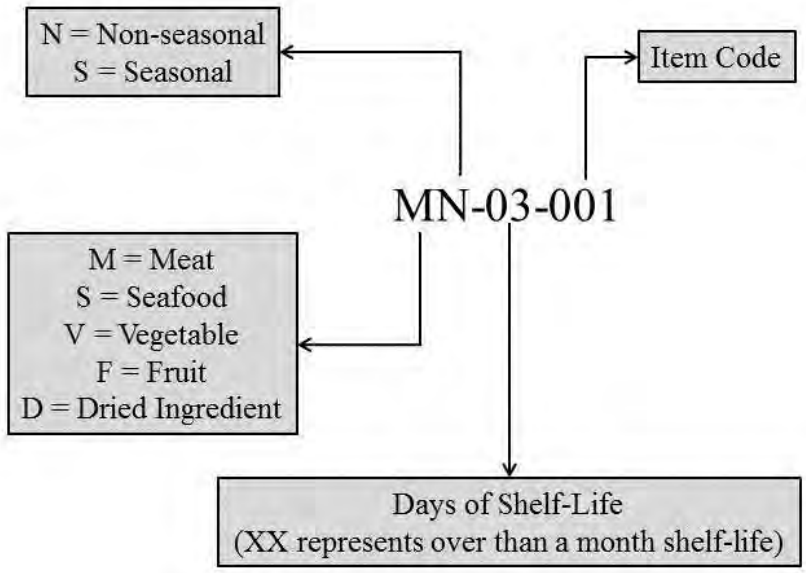


Figure 4-23. Example of ingredient code and what it represents.

The example shows that this ingredient is a kind of non-seasonal meat (pork, chicken or beef). Numbers of days of its shelf-life is shown in the first and second digit, for this one it has 3-day shelf-life. The last three digits represent individual item. This coding system is also useful for inventory management. In MRP, the days of shelf-life is used to create product structure to minimize number of purchasing time during a week. Therefore each type of ingredients will have purchasing day in a week as shown in table 4-9 as example.

Table 4-9. Purchasing day of each type of ingredient in a week.

CODE	Shelf-life (days)	Day of purchasing					
		TUE	WED	THU	FRI	SAT	SUN
xx-02-xxx	2						
xx-07-xxx	7						
xx-14-xxx	14						
xx-XX-xxx	Over a month						

Table 4-9 shows purchasing days of each raw material identified by the second and third digits from ingredient code. Ingredient with code xx-02-xxx means that its shelf life lasts 2 days, it will be needed to purchase every Tuesday, Thursday and Saturday. Unlike other manufacturing businesses, inventory of components of restaurant cannot be stored over than their shelf-lives for next batch. The repeated purchasing is needed on the day identified since the left-over ingredients are expired and cannot be used anyway. While those ingredient having code xx-XX-xxx, which has over a month shelf-life, will be needed to be bought at the start of every month. The approximate consumption of these long shelf-life materials (mostly died ingredients) can be done by checking the inventory left in the kitchen.

The purchasing frequency is useful in purchasing planning which is related to MPS and BOM generated. The material planning system is shown in the diagram below (figure 4-24).

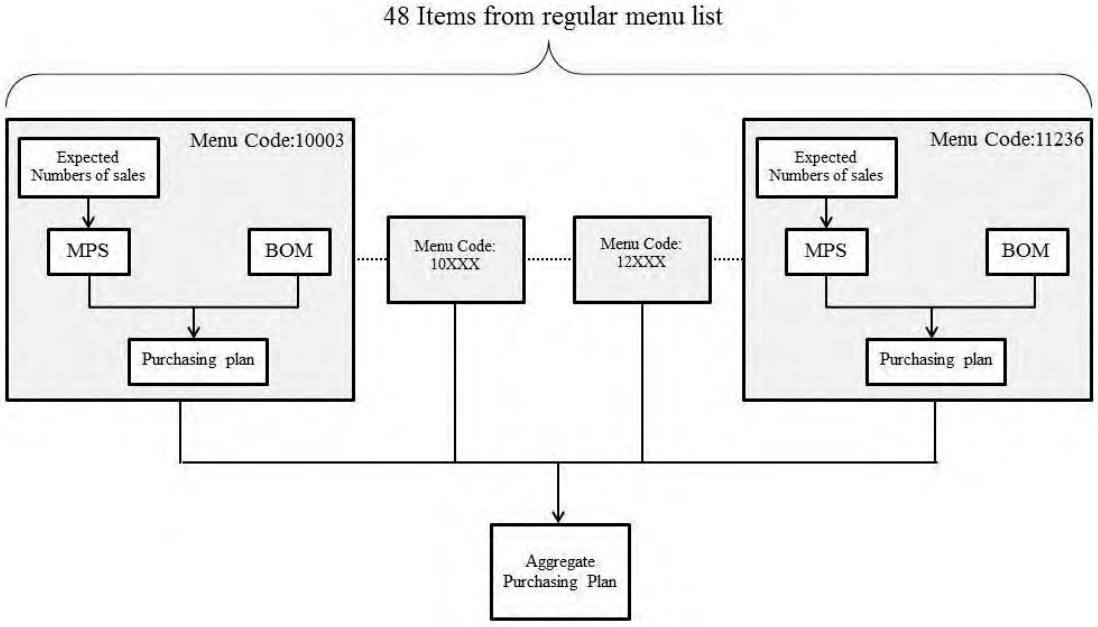


Figure 4-24. Aggregate purchasing plan system.

Actual MPS and BOM from Microsoft Excel are presented in figure 4-25. The numbers of expected sales of each menu can be edited by staff and the software will calculate purchasing amount at specific date in purchasing plan table.

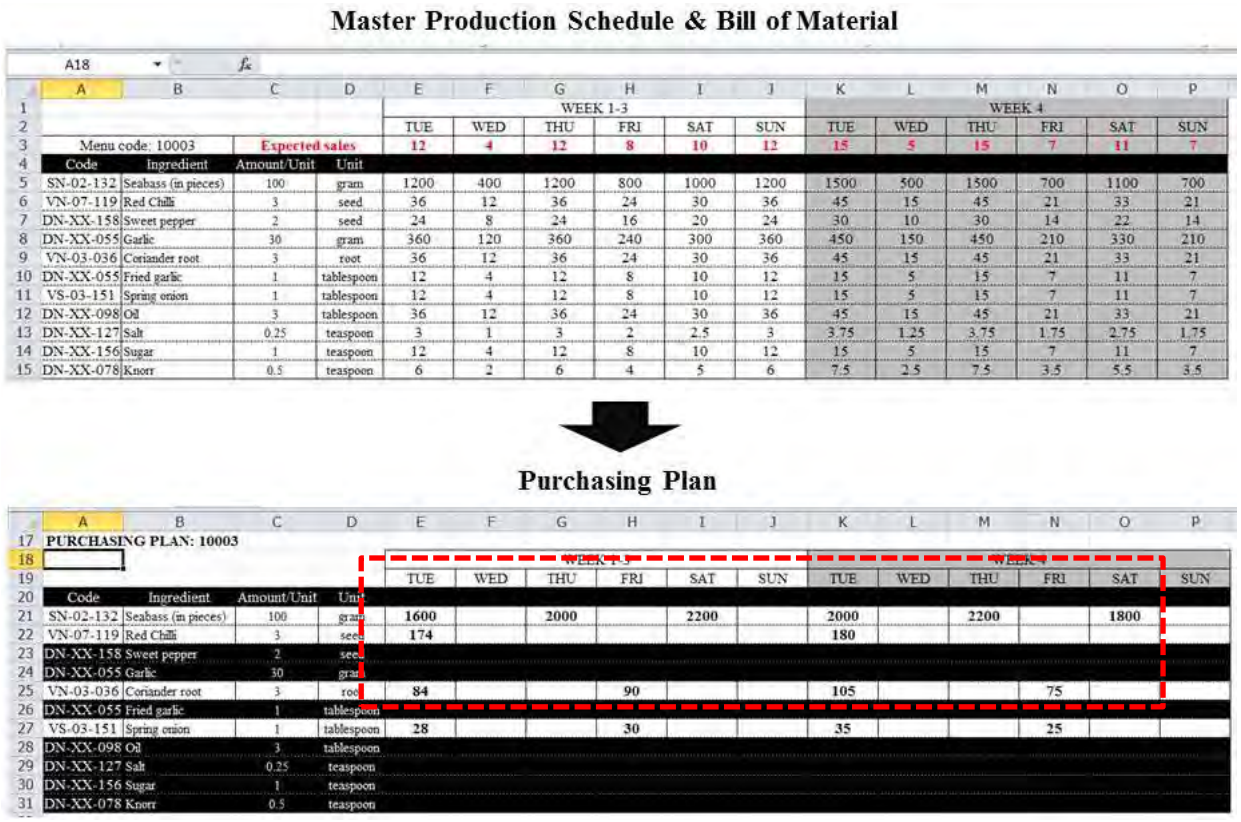


Figure 4-25. Actual MPS and BOM created by Microsoft excel for Menu 10003.

The ingredient"s amount from purchasing plan, in dotted square area, will be summed up in aggregate planning worksheet, as shown in figure 4-26.

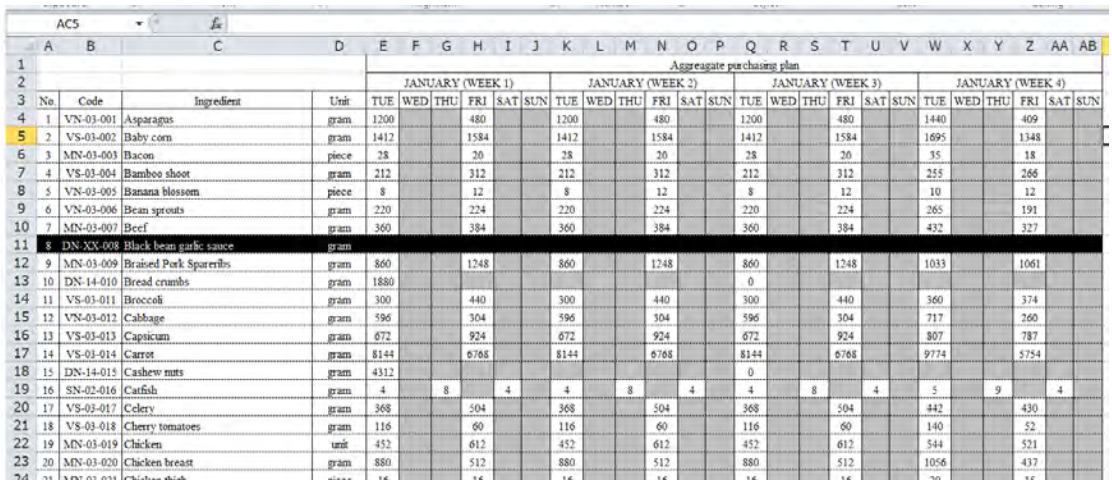


Figure 4-26. Actual aggregate purchasing plan worksheet (Microsoft excel).

The new purchasing tool is provided for more accuracy in amount to purchase, now the purchasing system of ABC needs to be reconstructed to consume less time in operation.

4.5 Purchasing system

Purchasing flow chart of ABC, shown in previous chapter, shows the method of how ABC purchases its raw material. The details of ingredient acquisition are also provided. Each supplier requires minimum amount for delivery. GM is the person who is in contact between cuisine chefs and suppliers, which causes confusion and complication in purchasing ingredients. New purchasing flow chart is needed to reduce all the problems in purchasing activities. The new flowchart can be created due to the reasons stated below.

1. New responsibility and organization"s culture in the kitchen area: Kitchen area used to operate as separation of food cuisine type. Inventory and purchasing activities are operated by each cuisine chef. After the „person culture" has changed to „functional culture", every chef is responsible for inventory and managing all materials in the kitchen. They tend to work together as a team.
2. New adjusted regular menu and seasonal menu list: Purchasing activities used to be GM"s duty because the fluctuation of raw material"s cost needs people with experience, because sometimes seasonal ingredients" cost is too high to generate profit from sales. The categorization of menu makes decision making in purchasing easier to employee. For regular menu, the price doesn"t change much during a year, but for seasonal menu, acceptable price is provided by GM at a specific time for kitchen staff to help in purchasing decision making.
3. Standardized recipe: The recipes allow GM to cross checking the actual amount of purchasing and actual amount of sold products. BOM helps comparing real ingredients used to ingredient purchased in each period of time, to avoid corruption from purchasing activities.
4. Demand planning: Historical data can provide approximate demand of ingredients so that chef"s experience of how much each dish will be sold is not required in purchasing order anymore.

The new purchasing flow is shown in figure 4-27.

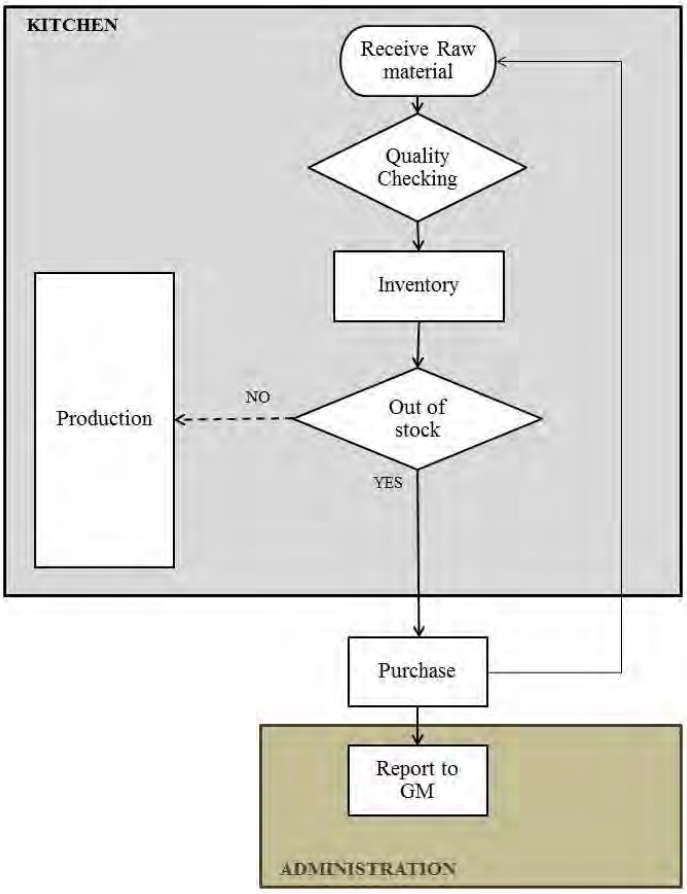


Figure 4-27. New purchasing flow chart.

New purchasing flow chart is less complicated compared to the previous one. Chefs and kitchen staffs are given responsibility to monitor inventory level of each raw material, relating with demand planning provided by admin, and decide purchasing quantity of each ingredient before they are out of stock. The elimination of suppliers is very useful to the restaurant because it also eliminate high purchasing price, big quantity of purchasing, and GM‟s over-workload.

First of all, the restaurant‟s strength can be useful to this improvement. A few local markets and wholesale stores are located within 2 kilometers from restaurant‟s location. Instead of relying on suppliers, ABC decided to purchase its ingredients from those local markets and wholesale stores. Staff assigned to purchasing ingredients is required to fill in the form of daily purchasing. The scale of restaurant

makes purchasing in small quantity more profitable, because the local markets are very close and consumption rate is not very high. The survey from wholesaler and local market shows the cheaper average price of ingredients by 10%-15%, compared with purchasing from suppliers. New sources for each ingredient‟s type are shown in table 4-10 below.

Table 4-10. New sources for ABC‟s raw material.

No.	Source	Product
1	Macro Mall	Dried ingredients, Rice & Beverages
2	Bangkapi local market	Meat, Vegetables, Seafood & Fruits
3	Mongkol Gas	Gas

The new purchasing flowchart consumes no time for under standard raw material rejection and refund from suppliers. The quality of raw material is controlled at work place, in the market, where chefs can choose the ingredients by themselves. The only supplier kept is Mongkol gas since the product cannot be acquired from other sources. This new purchasing method also allows flexibility for the kitchen staff to operate their inventory system.

Moreover, historical analysis of BOM from previous year shows very small amount of some ingredients. Team had evaluated the situation and use advantage of Thailand‟s weather, which can provide vegetables all year, and approximate demand from demand planning. Team decided to in-house some ingredients by arranging plantation of „Non-seasonal vegetables‟ at the back yard of the restaurant.

Kitchen staffs are assigned into shift to look after the plantation. The vegetables to be in-house can be seasonal or non-seasonal because if there‟s any problem with plantation, ABC can acquire the ingredients in the local market nearby. The average of harvesting period from the first plant is around 2-6 weeks. The pictures below, in figure 4-28, show the results of first batch of trial batch.

Figure 4-28. Trial batch of vegetables plantation of ABC restaurant.

The new purchasing flow allows more flexibility and raw material‟s price control for daily operation. Cost reduction raw material purchasing is monitored and recorded.

4.6 Inventory in practice

Inventory system of ABC restaurant was operated based on experience from chefs and kitchen staff. The raw material‟s flow in inventory system is not clarified and there is no record of stock leftover. However, changes in organization chart and responsibility area in the kitchen. Inventory checking used to be one small operation unit in purchasing flow chart. It is now separated from the chart so that specific detail in inventory system activities can be described in this topic.

As stated that facilities in the kitchen before changing working culture are allocated to each cuisine chef, who take responsibility of inventory management of their own separately. The refrigerators in ABC"s kitchen used to be divided as shown in figure 4-29.

Figure 4-29. Facilities sharing in ABC"s kitchen.

Problems from this allocation are stated:

1. *Inappropriate temperature*: The old system makes inappropriate temperature of raw material storage. Meat and Seafood are needed to be kept at lower temperature than vegetables and fruits, but they are kept in the same temperature which causes shorter average shelf life.

2. *Confusion and time-consuming in finding ingredients*: No label system to identify where the ingredients are kept, causing struggles in finding ingredients for new staff, or even the cuisine chefs themselves. Some ingredients are put in other cuisine‟s fridges because there is not enough space in that cuisine type‟s fridge, or some ingredients need very low temperature which other fridges cannot provide, therefore they are stored in the place they shouldn‟t be. Kitchen staffs sometimes find ingredients gathering consume most of their time for daily operation.
3. *Limitation in inventory checking*: Inventory checking cannot be done by other staffs apart from cuisine chefs. Cuisine chefs are the only persons knowing how much ingredients are left and when to purchase more. The responsibility of other staffs is to count the ingredients left, not knowing when to throw what away. The relying-on-one-person inventory causes expiration of high amount of raw material because they are not taken care of.
4. *Lack of appropriate utilization of raw material*: Quality of ingredients drops as day goes by. Highest quality can be delivered to customers only if the raw material is used as fresh as possible. However, for ingredients used in cooking methods such as boiling or plate decoration, do not need freshness to complete high quality items. The old system of putting old and new ingredients of same types in the same place causes mixing up in using less fresh ingredients to cook for customers. Moreover, ABC provides lunch and dinner for its staff and ingredients for staff‟s food are cut off from raw material in the kitchen. The quality of staff‟s food doesn‟t need to be as high as those ingredients used to serve customers.

These problems are solved in this topic by several actions.

Facilities rearrangement & Storage flowchart

ABC restaurant needs to rearrange new facilities allocation in the kitchen to solve problems stated. New working culture with no separation of cuisine types supports new allocation. The fridges are now separated by ingredient‟s type. Figure 4-30 shows new „shelf-based storage system‟ in the kitchen.

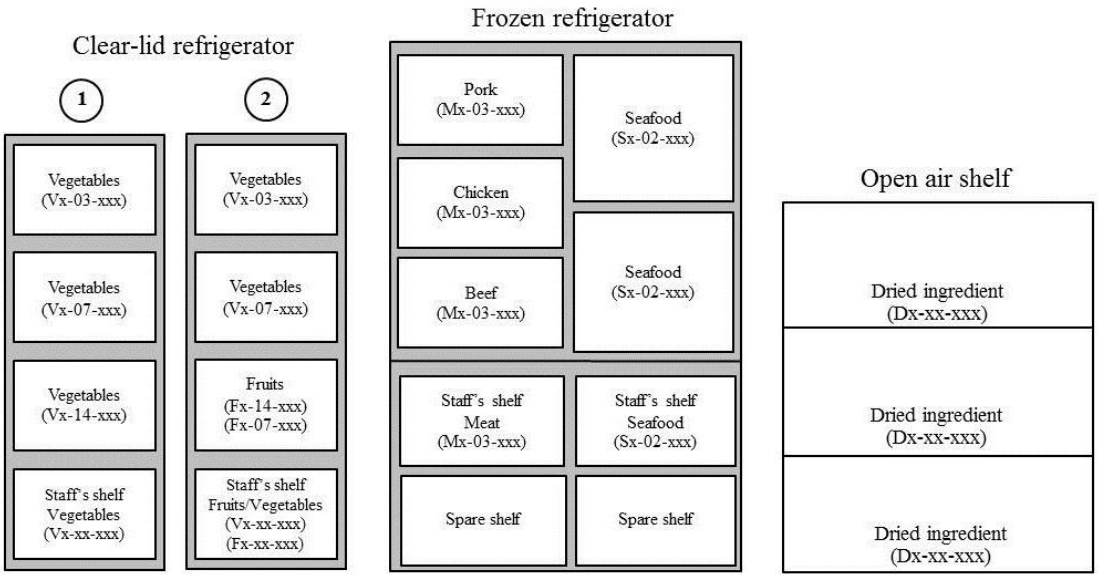


Figure 4-30. New storage system for each refrigerator.

Appropriate temperatures are set for each fridge to maintain longest possible shelf life as possible for each ingredient type. All vegetables and fruits are put in the clear-lid refrigerator because they do not need very low temperature to maintain their freshness. The appropriate temperature for keeping them is set at 15 degree Celsius for both number 1 & 2 clear-lid fridges. Another good point for using clear-lid fridge to store vegetables and fruits is that they are very fragile. Staff can do inventory checking without moving vegetables and fruits in and out of the fridges, which will cause damage to the ingredients and shorten its shelf-life. They are arranged into baskets before putting in the fridge. Storage flowchart is identified starting from receiving raw material to arranging them into the fridges. Different types of ingredients require different process before storage. Ingredient code plays important role in identifying material type and method to process them before putting them into fridges. The diagram in figure 4-31 shows activities of storage flowchart in ABC‟s kitchen.

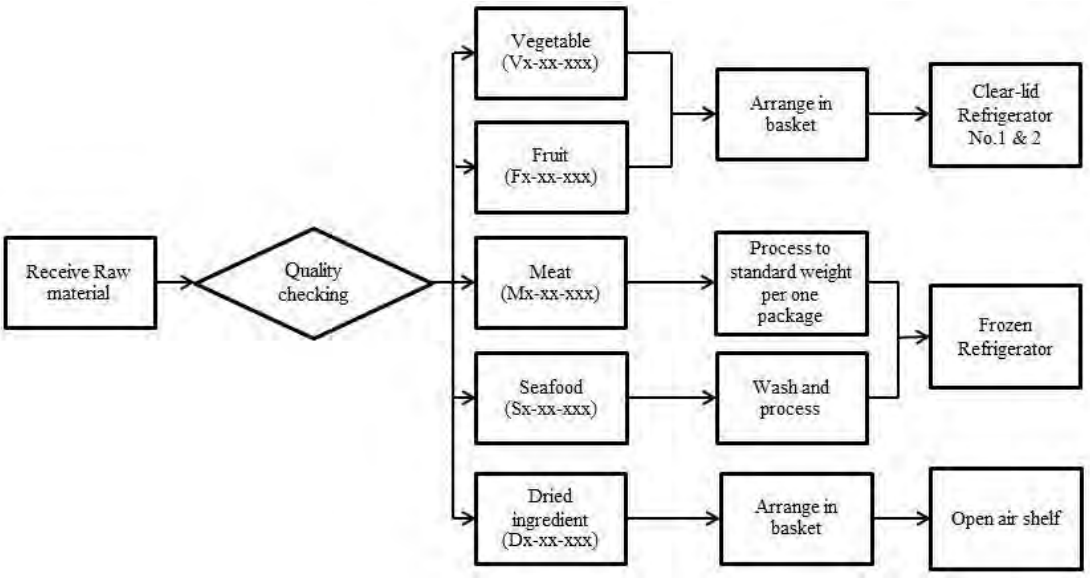


Figure 4-31. Storage process flowchart of each ingredient type.

To reduce time in finding raw material in daily operation, team decided to use marker to write the type of raw material to be put in each shelf in the fridges. This label system makes inventory checking easier.

Clear-lid refrigerator

This type of refrigerator provides convenience for vegetables and fruits inventory checking. The vegetables and fruits are arranged into the baskets before placing on their own places in the fridge. The temperature of the fridges is set at 8-10 degree Celsius. Too low temperature can cause damage to these items.

Figure 4-32. Clear-lid refrigerator No.1.

Figure 4-33. Label system for vegetables and fruits storage.

Label system on the lid identify specific place for each type of vegetables. Figure 4-32 and Figure 4-33 shows new vegetables and fruits storage system in the kitchen.

Frozen refrigerator

Figure 4-34 below shows new storage method of meat (Mx-xx-xxx) and seafood (Sx-xx-xxx) in the kitchen.

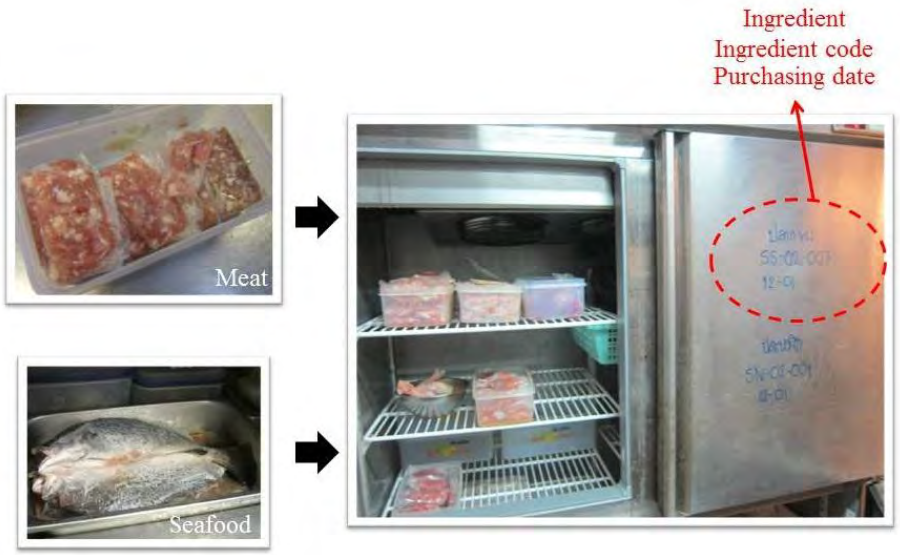


Figure 4-34. Frozen refrigerators.

Pork, chicken, beef and seafood are kept in this low temperature fridge. They are processed into small packages, at standard weight per serve. Fish, shrimp, squid and crab (seafood) are also processed before placing on its shelf. The temperatures are set at 4-8 degree Celsius. The marker is used to write down the raw material stored at each shelf. The purchasing date is also recorded to make sure that each batch is removed by the „removal date" (which depends on raw material type).

Open air shelf

For dried ingredients, open air shelf is used to store them. The long shelf life can make monthly inventory checking possible. These items are counted at the end of each month and will be purchased at the amount that can be used for the whole month. The shortage of dried ingredients does not often occur since they are easy to be purchased in the local shop nearby. The over-stock of dried ingredients doesn"t cause problem because these items can stand in the shelf for over months. Dried ingredient"s storage place is shown in figure 4-35.

Figure 4-35. Open air shelf for storing dried ingredients.

New storage system is more organized and systematic. The comparison of old and new inventory in ABC"s kitchen area is shown in figure 4-36.

Figure 4-36. Comparison of old and new inventory in the kitchen.

More storage space is available when the raw material is put into their places which are well-organized.

Staffs relevant to inventory operation need to be acknowledged and trained for new inventory system and the meaning of ingredient code. The new system was introduced to the restaurant at the beginning of January 2011. The training is provided by Head chef, as shown in figure 4-37.

Figure 4-37. Training of new storage system.

Inventory checking flowchart

ABC‟s inventory system was not focused on as much as other processes. The system was blended in purchasing flowchart and relied on chef‟s experience to estimate amount of each ingredients to be put in purchasing order. There was no record of actual waste of raw material. New inventory checking system is introduced in figure 4-38 below.

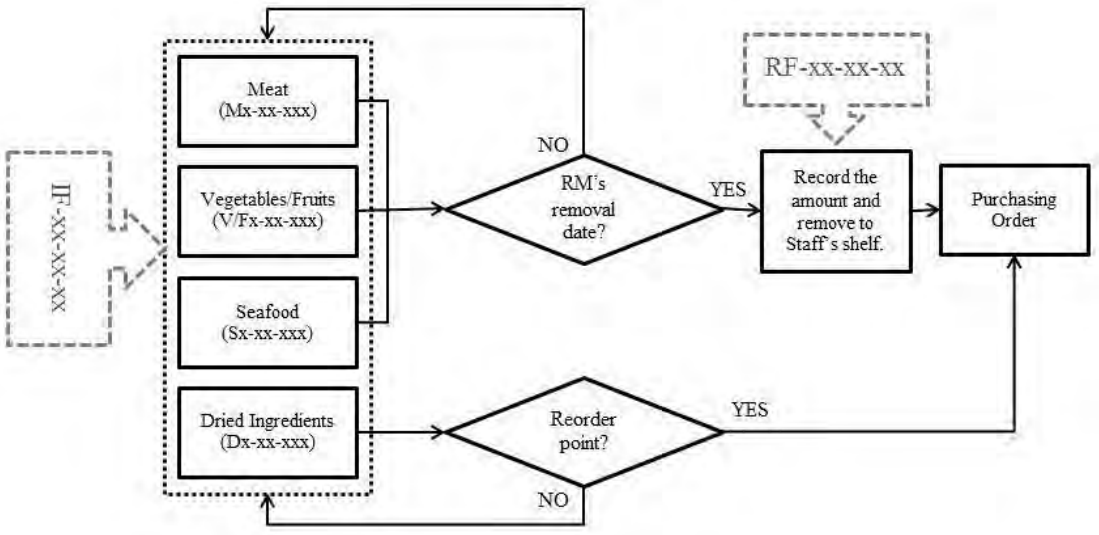


Figure 4-38. Inventory checking flowchart.

The third and fourth digits show appropriate days for keeping the meat, depending on its type and actual expired date. Staff can tell by these 2 digits, for example MS-07-001 tells that this ingredient can be kept to create serving quality product for 7 days. On day 8, counted from the purchasing date labeled on the fridge, this batch will be moved to staff‟s shelf in each fridge to create lower quality items, or to be cooked as staff‟s food later. Two important documents are generated by team for recording inventory system‟s infomation.

1. Inventory record (IF-xx-xx-xx)

This form is used to record raw material left at the end of each day. The actual form is shown in Appendix D. The form code tells the date of the record. One kitchen staff is assigned to make record at the end of the day.

2. Removal ingredient record (RF-xx-xx-xx)

This form is used to record raw material moved to staff"s shelf. The actual form is shown in Appendix D. The form code also tells the date of the record. This form is very useful for monitoring raw material waste from daily operation and inaccurate purchasing planning. Real record of expired raw material or waste from unused raw material cannot be achieved because of fear of punishment. Therefore, amount of raw material moved to staff"s shelf is recorded instead to represent the amount of actual raw material waste from operation.

All kitchen staffs are acknowledged the new inventory process and trained to use 2 forms correctly.

4.7 New job description & Shop floor improvement

Change of internal structure of ABC restaurant causes changes in job description of some positions as well. The new job descriptions are stated in table 4-11 below.

Table 4-11. New Job descriptions of ABC restaurant"s employee.

Position	Job description
Director	4. Strategic decision & Growth direction of the restaurant. 5. Financial support/Funding. 6. Overall monitoring & control.
General Manager (GM)	8. Daily operation control, including receiving daily money from the cashier. 9. Day-to-day decision making. 10. Human resource control. 11. Monthly summary reports to the director.
Admin. Staff	3. Responsible for all document and daily report. 4. Co-operate directly with GM in documentation system.

Head Chef	3. Responsible for overall monitoring & control in the kitchen (production area). 4. Assign different duty to the staff in each shift.
Cuisine Chef	4. Operate daily cooking. 5. Responsible for practical inventory management and ordering point. 6. Generate purchase order to report to GM, and responsible for purchasing activities in the restaurant.
Kitchen Staff	2. Responsible for mundane tasks such as raw material preparation, dishwashing, kitchen cleaning etc., report directly to Head Chef. 3. Assists to cuisine chefs in operation.
Head of FOH	5. Overall control in front of house (FOH-servicing area). 6. Responsible for service employee training. 7. Responsible for drinks/beverages inventory. 8. Generate beverages purchase order and report to GM.
Beverage Staff	2. Prepare all kinds of beverages.
Cashier	4. Receive orders from Waiters, and input them into KIOSK software. 5. In charge of receiving money from customers. 6. Responsible for daily income and hand to Admin. Staff.
Waiters/Waitresses	3. Take orders from customer to the cashier. 4. In charge of serving, the only section that is in direct contact with the customers.

General Manager is now having less job descriptions than it used to be. The position is now involved in purchasing or inventory system in the kitchen (except

receiving reports from the kitchen). Head chef is required to assign duties of people taking care of daily inventory counting, dish washing, raw material preparation, and purchasing. Cuisine chefs are now responsible for purchasing activities in the kitchen. The quality control is done by cuisine chefs when the raw material is acquired.

Shop floor improvement

Real operation in servicing area is now focused on. Information flow from the starting point, orders from customers, is tracked down to where the product is made, where the information flow stops and the product flow starts.

Servicing area

Team studied the flow of production process focusing on servicing area and brainstormed to find linkage that might cause errors in operation. The result is shown in diagram below.

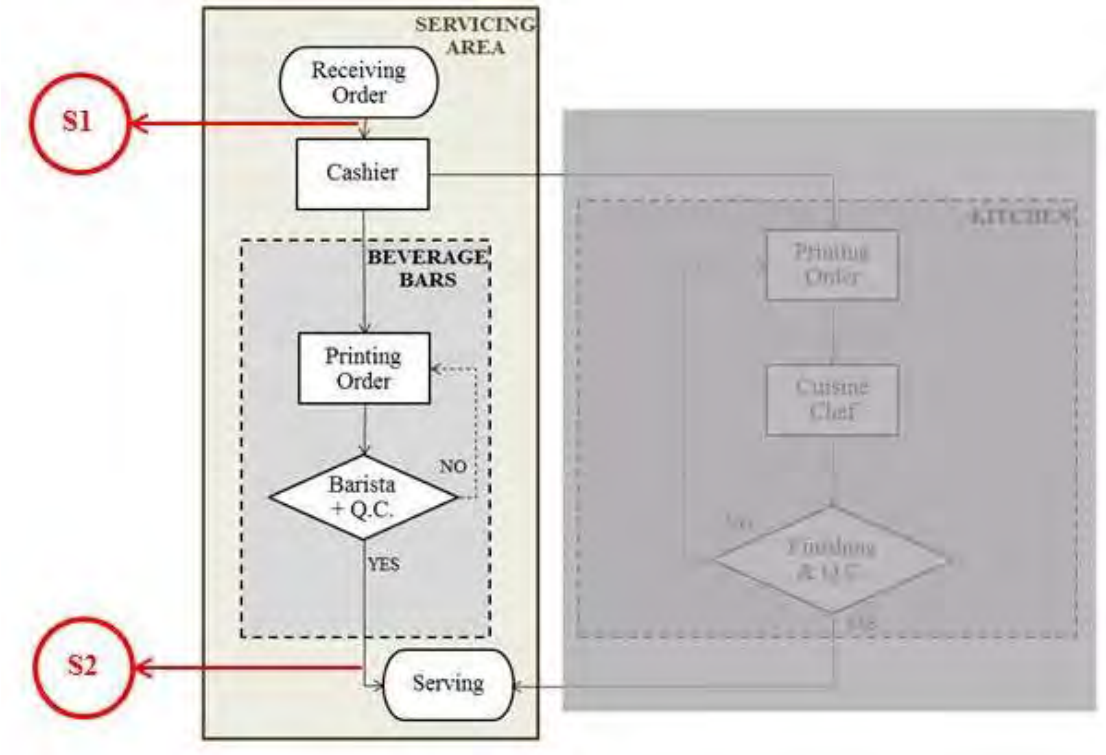


Figure 4-39. Possible error points from production process in servicing area.

Diagram in figure 4-39 shows the points where possibility of errors from production process. Two possible linkages that might cause errors are identified. Possible causes and preventive methods for each point are stated in table 4-12.

Table 4-12. Possible causes and preventive methods for error points in servicing area (S1)

No.	Possible causes of error	Preventive methods
S1	Mistakes from waiters when taking notes from customers.	Provide checklist to record orders from customers.
	Low service mind of employees & lack of experience from servicing tasks.	Set up servicing standard and provide training session to staffs.

Orders used to be written down in blank paper by waiters. This is the first spot mistakes can happen. The hand-written note can be unclear and misunderstood from the cashier who transforms the order list to KIOSK, which sends the orders to kitchen and beverage bar. The first preventive method is to provide checklist of numbers of orders instead. So the waiters can just write down the numbers of each items ordered instead of writing them down with their own hand-writing. The example of order checklist is shown in Appendix E. There are 3 types of checklist used for order taking.

1. Food checklist, containing regular menu, seasonal menu and chef"s special menu. The last two items are varied based on each period in a year.
2. Beverages checklist, containing list of all kinds of beverages.
3. Desserts checklist, containing desserts list.

Another issue from customer"s complaint is low-service-mind employees can cause mistakes in servicing area. No prior experience in serving patterns and manners can cause disappointment from customers. The preventive method is to provide required manners and serving patterns for the employees to be trained. The training will take place once a week, on every Tuesday, half an hour before the restaurant is

open. Checklist of training topics is provided for Head of FOH to train all waiters and waitresses (figure 4-40).

SERVICE TRAINING CHECKLIST

☐ GREETING CUSTOMERS

☐ TABLE ARRANGEMENT

☐ ORDER TAKING
1. PROVIDE MENU BOOKLET
2. OFFER SPECIAL MENU/RECOMMEND MENU
3. CHECKLIST USING

☐ SERVING TECHNIQUES
1. FOOD SERVING MANNERS
2. DRINK SERVING MANNERS

☐ FOLLOW-UP
1. KEEP STANDING POSITION
2. ATTENTIVE TO CUSTOMERS
3. RECHECK ORDERS COMPLETION OF EACH TABLE

☐ HANDLING COMPLAINTS
1. PROVIDE COMMENT FORMS TO CUSTOMERS

DATE_____ HEAD OF FOH _____ (SIGNATURE)

STAFF ATTENDED

Figure 4-40. Checklist for servicing training.

The next possible error point in from analysis is shown in table 4-13 below.

Table 4-13. Possible causes and preventive methods for error points in servicing area (S2).

No.	Possible causes of error	Preventive methods
S2	Low service mind of employees & lack of experience from servicing tasks.	Set up servicing standard and provide training session to staffs.
	Confusion of in delivering beverages to correct table.	Attach printed slip to the items after they are made.

The first possible cause is prevented by the same method from S1, provide training session for waiters/waitresses. The second cause, confusion in serving beverages to correct table, can be prevented by attaching printed slip from the machine on the serving plate so that there is label to tell which table the order belongs to. This slip will be collected by waiters before serving to customers.

Kitchen area

Now the production process in the kitchen is studied. Team brainstormed to find linkage that might cause errors from production operation in the kitchen area. The result is shown in figure 4-41.

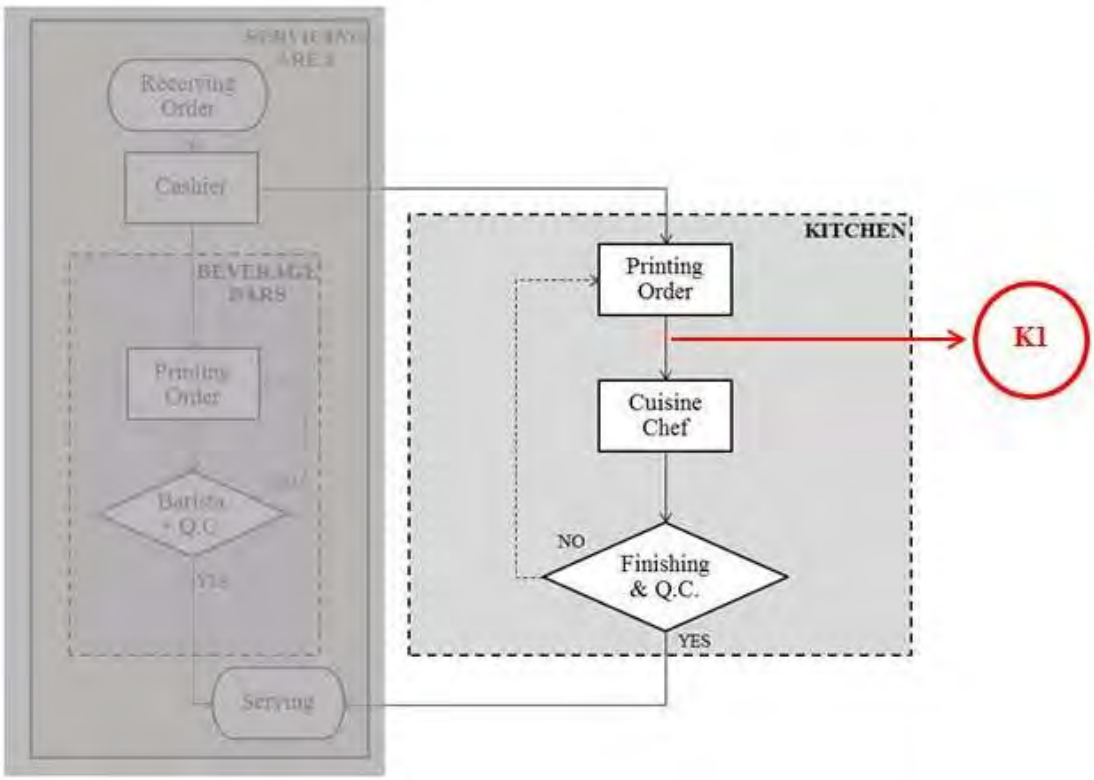


Figure 4-41. Possible error points from production process in kitchen area.

Possible cause of errors is summarized in table 4-14. Team also discussed for preventive method as stated.

Table 4-14. Possible causes and preventive methods for error points in kitchen area (K1).

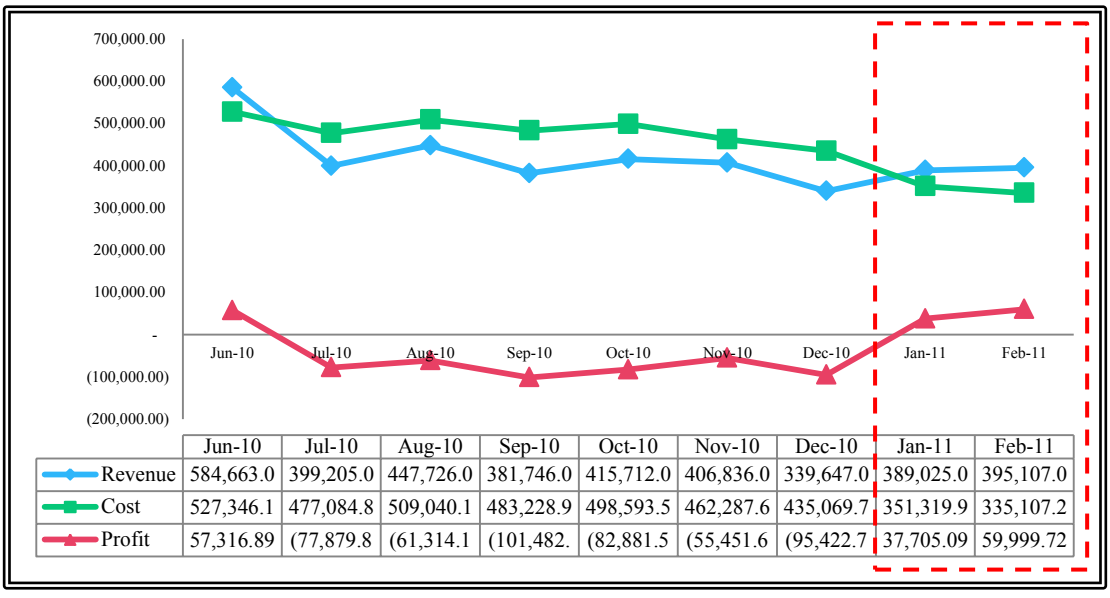
No.	Possible causes of error	Preventive methods
K1	Confusion of order‟s sequence.	Leave the slip at the printing machine until the orders are to be produced by any of the cuisine chefs. The orders are cooked in sequence of each slip.
	Incorrect calling of orders which causes production of not-ordered items.	

The only weak point in the kitchen area is when the slip is printed out of the printing machine. Kitchen staff was positioned at the printing machine to tear off the

order and pin it on the board before calling out the items to be produced. The mix up of order slips causes confusion in order‟s sequence, leading to long waiting time of customers who come first. The menu call out aimed to save time in production but sometimes makes the misunderstanding of item‟s name by cuisine chefs, leading to faulty production of items to be served. The new habit is acknowledged to all kitchen staffs that the printing orders are not to be torn off the machine, but to be left waiting for available cuisine chefs to come take it themselves. The items from each slip order are to be produced in sequences before getting quality checked and sent back to servicing area.

4.8 Results from implementation

The results from implementation are monitored and recorded by several ways. The indicator which determines success in improvement steps is changing from monthly loss to monthly profit of ABC restaurant. Line chart in figure 4-42 shows success after the implementation had started (from January 2011).



	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11
Revenue	584,663.0	399,205.0	447,726.0	381,746.0	415,712.0	406,836.0	339,647.0	389,025.0	395,107.0
Cost	527,346.1	477,084.8	509,040.1	483,228.9	498,593.5	462,287.6	435,069.7	351,319.9	335,107.2
Profit	57,316.89	(77,879.8	(61,314.1	(101,482.	(82,881.5	(55,451.6	(95,422.7	37,705.09	59,999.72

Figure 4-42. Monthly revenues, cost and profit of ABC restaurant, before and after implementation.

The direct and indirect benefits from improvement caused reduction of total cost of ABC restaurant. After the implementation, results from first month (January

2011) reflect success from improvement activities from team. The restaurant can finally generate monthly profit, after suffering from monthly loss for a period of time.

For main problems from operation, team had come up with KPI (Key performance indicators) to measure their success in each problem of the restaurant before actions are taken. The KPIs are indicated for each fishbone as seen in table 4-15.

Table 4-15. KPI for each fishbone diagram

Fishbone	Problem	KPI
1,5	High raw material waste & High RM purchasing cost	Ratio of sales and RM purchasing cost
2	Unavailability of RM	Average numbers of unavailable orders per day
3	Conflict among chefs	Observation and personal interview
4	High workload of GM	Scope of GM‟s job descriptions
6	Customer‟s complaints	Average numbers of customer‟s complaints per week

1. High raw material waste & High RM purchasing cost

These two problems use same indicator because ABC has no historical record of unused raw material due to prior expiration. Kitchen staffs are afraid of punishment in over stocking of raw material so they do not keep any record relevant to actual amount of raw material waste. However, the ratio of sales and raw material purchasing cost is used to measure the improvement from internal change in raw material planning.

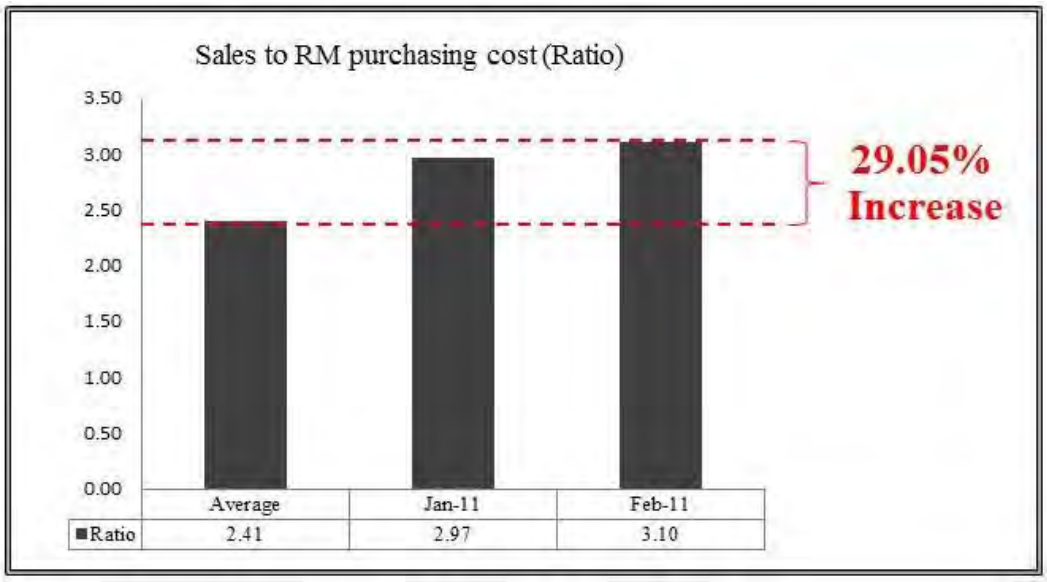


Figure 4-43. Ratio of sales and raw material purchasing comparison.

As shown in figure 4-43, sales are compared to cost of raw material purchasing per month. The higher the ratio, the better revenue generated by lower raw material cost, which proofs that the restaurant has decreased cost of purchasing raw material as well as less amount of waste is produced. The result shows that the ratio has increased 29.05% at the end of February, 2011, compared to the average ratio in year 2010. ABC had succeeded in saving raw material cost after the change of its internal organization system.

2. Unavailability of RM

ABC restaurant started to record numbers of dishes rejected to customers per day 2 months before the implementation. Average numbers of times rejecting customers due to unavailability of items are at 5 times per day. The data is used to compare with results from internal improvement. The comparison is represented by bar chart in figure 4-44 below.

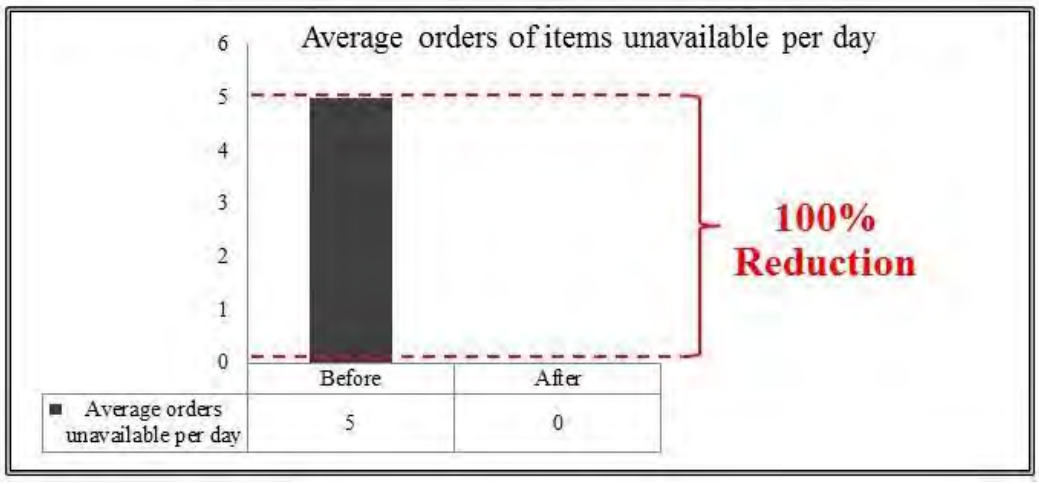


Figure 4-44. Bar chart showing reduction of average unavailable orders per day.

The record is also kept starting from January, 2011. After 2 months of improvement, 100% reduction of orders unavailable per day, from 5 to 0 times, shows the effectiveness in new system.

3. Conflict among chefs

Numerical measure is not appropriate for this problem. The observation and personal interview is used to observe the improvement of relationship and working environment in the kitchen area. The results found that most employees are satisfied with new working culture and system. The power and workload among chefs and staffs are now flexible and fair. Everybody in same position gets to do the job equally at different time (due to various shift assignment from Head chef).

4. High workload of GM

General Manager used to be involved in nearly every working flow chart in daily operation. New organization chart and workflow cause smaller responsibility area of GM. GM is now not involved in purchasing decision making and planning. The activities can be run by the kitchen unit separately, GM only needs to keep purchasing records and summarize for the director to review. The comparison of purchasing flowcharts before and after improvement is shown in figure 4-45, showing less complexity in purchasing activities and GM is now not involved.

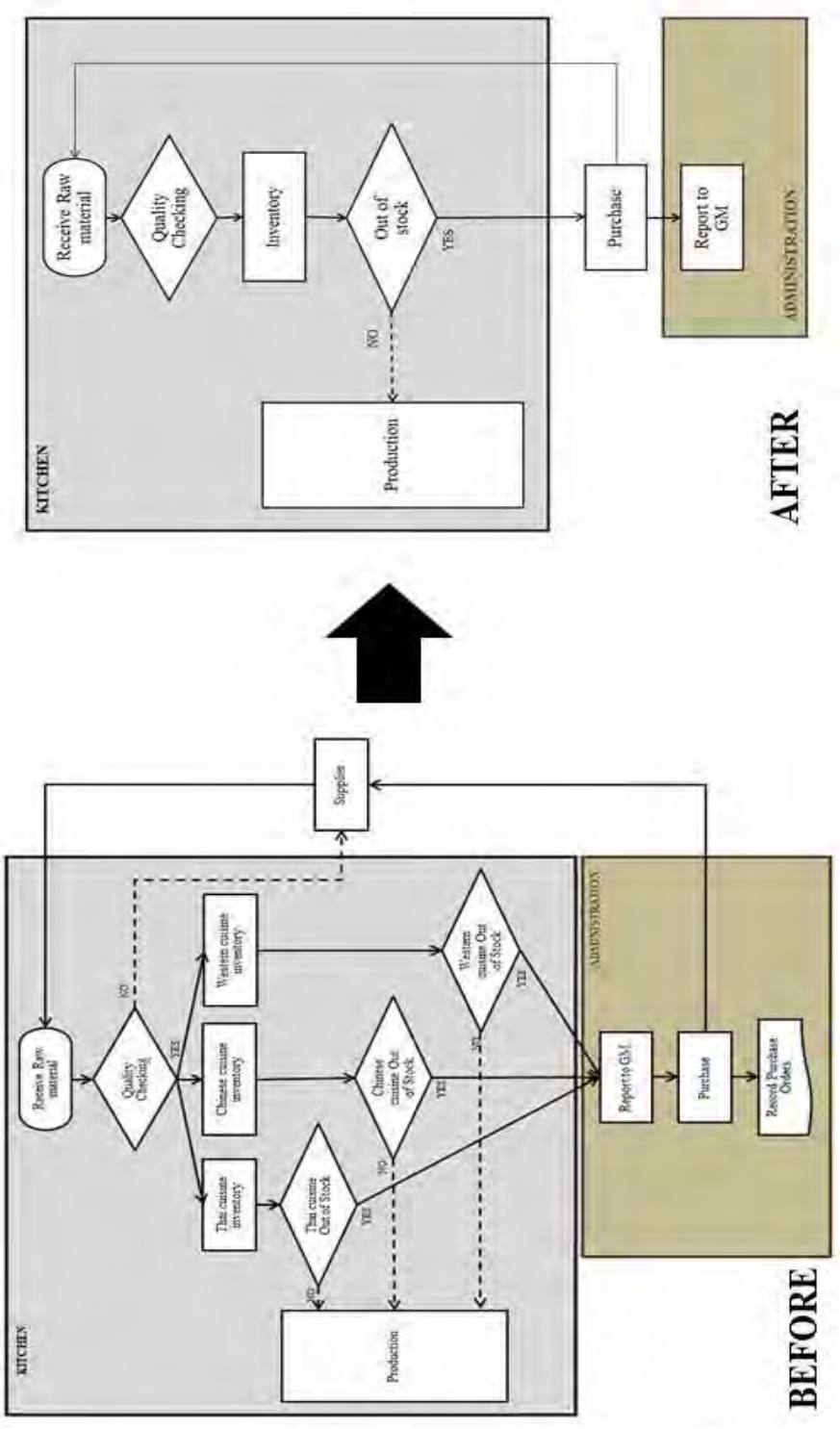


Figure 4-45. Comparison of flowchart before and after improvement.

The difference of GM‟s job descriptions is shown in table 4-16.

Table 4-16. Difference of GM‟s job description before and after improvement.

BEFORE	AFTER
1. Daily operation control, including receiving daily money from the cashier. 2. Day-to-day decision making. 3. Daily raw material purchase planning, cooperate with Thai/Chinese/Western cuisine chefs. 4. Purchase raw material & equipment. 5. Cooperate with suppliers for under standard food‟s quality (reject and refund). 6. Human resource control. 7. Monthly summary reports to the director.	1. Daily operation control, including receiving daily money from the cashier. 2. Day-to-day decision making. 3. Human resource control. 4. Monthly summary reports to the director.

5. Customer‟s complaints

ABC restaurant provides comment box for customers to return their comments to the restaurant. These comments are gathered and handed back to GM, who separates them into 2 groups; compliments and complaints. The improvement of restaurant is measured by the count of numbers of complaints from comment box. Average numbers of complaints before improvement were at 3.5 comments per week. However, after the training for staffs are provided and rearrangement in the kitchen area, production process and servicing style are more effective and can be operated faster. Complaints from comment box after implementation are at the average of 0.2 comments per week, as shown in comparison bar chart (figure 4-46).

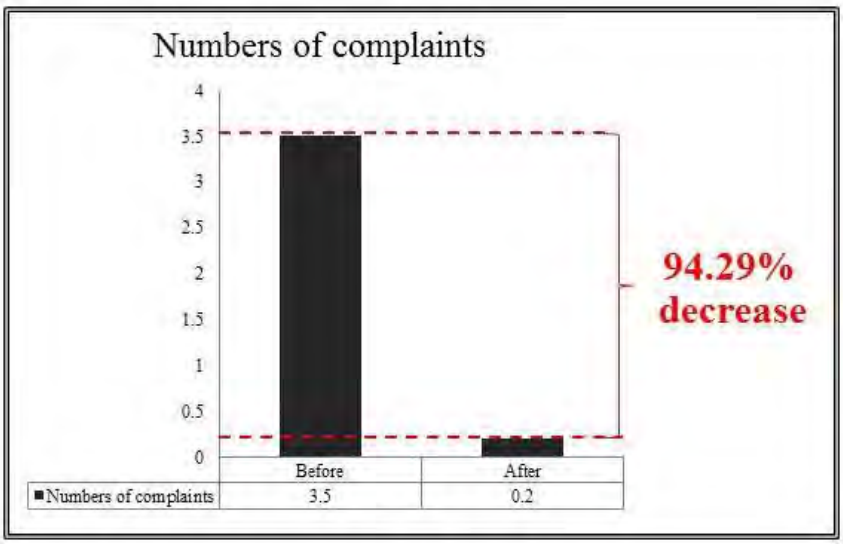


Figure 4-46. Bar chart showing reduction of average numbers of complaints per week.

The 94.29% reduction of complaints from customers assures more effective in production process.

Indirect benefits

The internal improvement aims to solve problems stated in fishbone diagrams. There are also other benefits from improvement activities as bulleted below.

1. Reduction of full time employees

   The elimination of non-profitable items and new working culture in the kitchen can reduce man-power needed for daily production. The new working culture needs less expertise and people, ABC can reduce 2 full time employees in the kitchen area. The result leads to reduction of monthly wages (the company saves 43,000 THB per month).

2. Elimination of expensive ingredients

   Costly ingredients of Western cuisine had always been problems to the restaurant especially when there is no demand planning system. The new menu list and categorization eliminate problems from over-stocking of these expensive ingredients.

3. Waste monitoring system in kitchen area

   Kitchen staffs avoid to record amount of waste before throwing them away, due to fear of punishment. The new system of „staff‟s ingredients‟ record doesn‟t make them feel like they are monitored from management level. The actual ingredient‟s waste can be monitored daily so that production planning can be adjusted to better match customer‟s demand.

Even though there is an enormous change in ABC restaurant‟s internal operation and system, the results from implementation summarized above are considered as a success. However, daily demand planning for the first 2 months is not very accurate due to big change of menu list. The problem of over stocking of some raw material still remains, with smaller amount per batch. Overall improvement after the 2 months implementation is obviously shown in more effective and smooth process operation, happier employees and satisfied customers.

4.9 Conclusion

Most activities in this chapter focus on analysis and improvement to solve stated final root causes from fishbone diagrams. These final root causes are grouped together based on their solution methods. New menu list is provided with less variety of menu items (from 233 items down to 47 items, based on its popularity). The cut off of Western items caused reduction of full time employee and change of working culture in the kitchen so that chef‟s expertise is no longer required in daily operation. All items are categorized based on ingredients required to complete each menu. There are 3 categorization; regular item, seasonal item and chef‟s special. Recipes of remaining menu items are gathered from all chefs. They are adjusted to standardize main ingredients used per dish and kept as records. All chefs are trained to be able to complete remaining regular menu items with an aid from standardized recipes. New organization chart, focusing on the kitchen area, is set so that all kitchen staffs can work more effectively. Each dish produced is counted as one project. Kitchen staff has various tasks in the kitchen depending on their shifts to prepare raw material for the cuisine chefs, instead of working for one specific cuisine chef as it used to be.

The admin has new responsibility of using Microsoft Excel for providing raw material requirement planning and purchasing plan to kitchen staff. The purchasing flowchart is rearranged so that GM is no longer involved in purchasing activities to reduce purchasing time and problem. All ingredients are purchased directly from local market and wholesalers to eliminate problem from suppliers. Inventory flowchart is generated to create new system of practical inventory in the kitchen for faster operation and longer shelf life of all ingredients. Standard forms are provided to keep important records about storage for management level. Kitchen staffs are required to attend training and acknowledged new storage methods and procedures. New job descriptions for all positions are identified.

Finally, production shop floor is studied to identify the linkage that can possibly cause errors in production process. Two points of working flow in servicing area are identified as possible error causes. Servicing training and ordering checklist are provided to waiters and waitresses to prevent the problems. Possible error point in the kitchen is also identified. New working habit in the kitchen is set to prevent the problems also.

The successful improvement is shown in KPIs of each fishbone. The KPIs are determined by team to measure improvement of overall performance in each aspect. Higher ratio of sales and raw material purchasing cost, reduction of unavailable items, happier kitchen staff, fewer job description of GM and fewer complaints from customers are results from implementation actions.

CHAPTER V
CONCLUSION & SUGGESTIONS FOR FURTHER STUDIES

To summarize the outcome of this thesis, three topics are presented in this chapter.

5.5 Conclusion
5.6 Benefits
5.7 Recommendations
5.8 Suggestions for further studies

5.1 Conclusion

In Thailand, restaurant business is highly competitive and has enormous numbers of competitors. ABC restaurant is used as a case study to be analyzed and improve its system to gain more success. This medium-sized restaurant is located in Bangkok. It has been operated for 2 years, facing monthly loss. Historical records are monitored and found out that the restaurant can generate high sales, but still suffers from high operational and raw material purchasing cost. ABC needs immediate actions to bring back its profit in a short time without more investment due to the growth of business area nearby, which may cause increasing number of customers.

Current system and working culture of the restaurant are studied and analyzed in chapter 3. The results show that ABC restaurant has these characteristics which lead to its problems.

- High variety of menu.
- Daily operation highly relies on employee‟s expertise (especially cuisine chef‟s cooking expertise).
- Lack of management skills from staffs in daily operation.

The analysis from chapter 3 is used in implementation of chapter 4 to improve internal working culture and generate systematic production process.

Team members are selected to attend weekly meeting to analyze current operation of the restaurant. Problems found in each area of operation are listed out. Discussion and brainstorming from discussion by team members are used to identify root causes of each problem by fishbone diagram so that appropriate actions can be taken to eliminate them. Results and benefits from each meeting are summarized in figure 5-1.

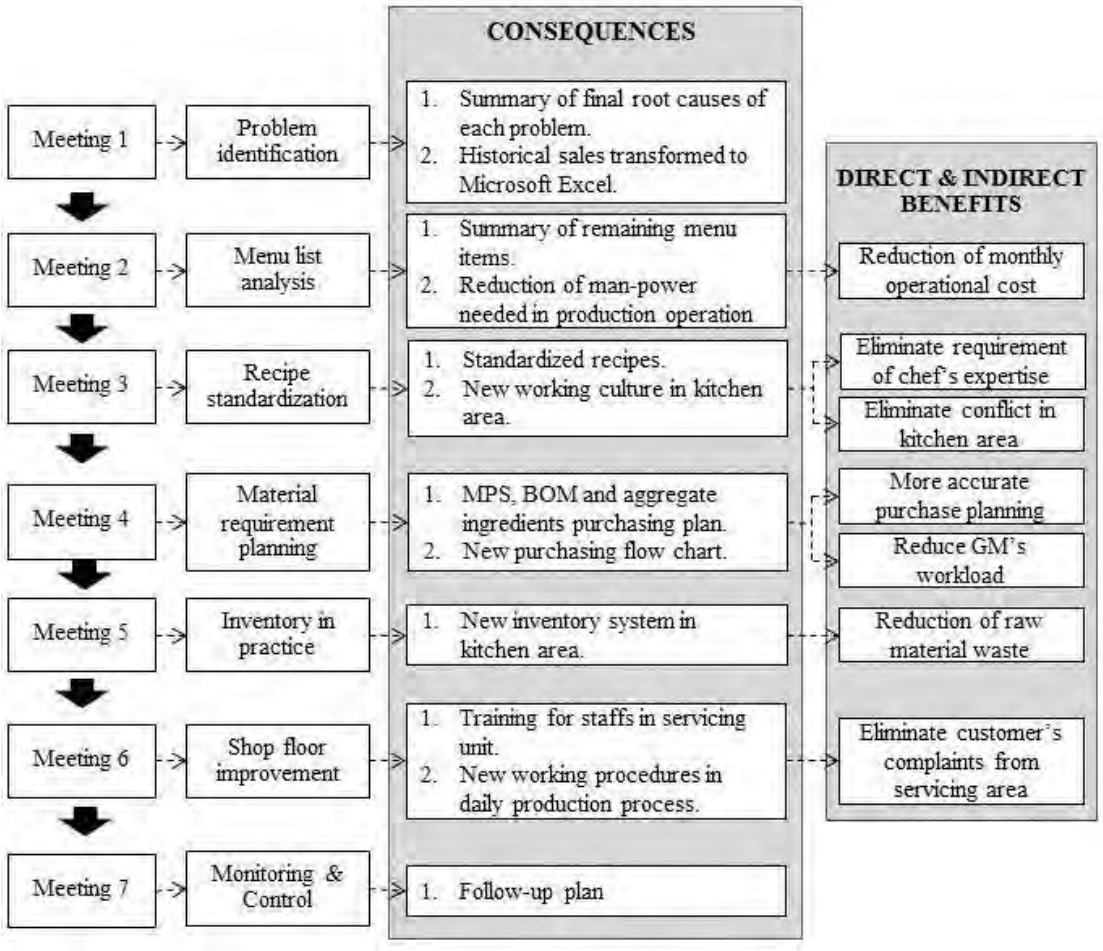


Figure 5-1. Consequences and benefits from meetings.

Meeting 1: Problem identification

All positions from all levels brainstorm for problems causing difficulty in their working process. They are informed about the possible changes which will occur in a

few weeks, but the objective of improving daily operations along with providing supports for their work is stated to gain cooperation from all positions. The problems from all working unit can be summarized into 6 main problems as stated below.

1. High raw material waste
2. Unavailability of raw material
3. Conflict among chefs
4. High workload of General Manager
5. High raw material purchasing cost
6. Customer‟s complaints

Final root causes are listed by team members using Why-why analysis. Team also plans for improvement actions, including determine timeline of improvement period.

Results from meeting 1:

- Final root causes of each problem and action plans.

  The summary of final root causes is very important because the problem can be solved directly from correct root causes.

Meeting 2: Menu list analysis

Reduction of high variety of products in the restaurant is done based on historical sales. Pareto analysis is used to remove 153 items from menu list. Pareto analysis is also applied to „Top revenues makers‟ items. The results from comparison of identical items from „Top hit‟ and „Top revenues makers‟ found that Western dishes generate high revenues but rarely sold. Team decided to cut off this menu category to eliminate these problems.

1. Requirement of high expertise from chefs.
2. Over-storage of costly ingredients.
3. Low sales rate.

Reduction of menu variety leads to less complication of further changes in the restaurant, including less information for team to monitor and analyze.

Results from meeting 2:

- Reduction of monthly operational cost.

  The wages of Western chefs and Western sous chef are eliminated, which could reduce 43,000 THB per month.

Meeting 3: Recipe standardization

The decision makes total of 61 items sold in ABC restaurant. To eliminate problems from no teamwork, all recipes of 61 items are recorded from chefs. Three important aspects are recorded; ingredients, cooking methods and serving presentation. Standardized recipes are kept in restaurant"s database and to be reviewed by the director and GM.

Working culture in kitchen is changed, from „Person-type" to „Functional-type", which creates balance workload in daily operation in the kitchen. There is no difference between each cuisine chef and kitchen staffs. New organization chart in the kitchen unit is also rearranged, from project organization chart to matrix organization chart, which creates teamwork in the kitchen. Staffs are rotated to be able to perform all tasks to support cuisine chefs and other supporting activities in the kitchen. The change of organization is shown in figure 5-2.

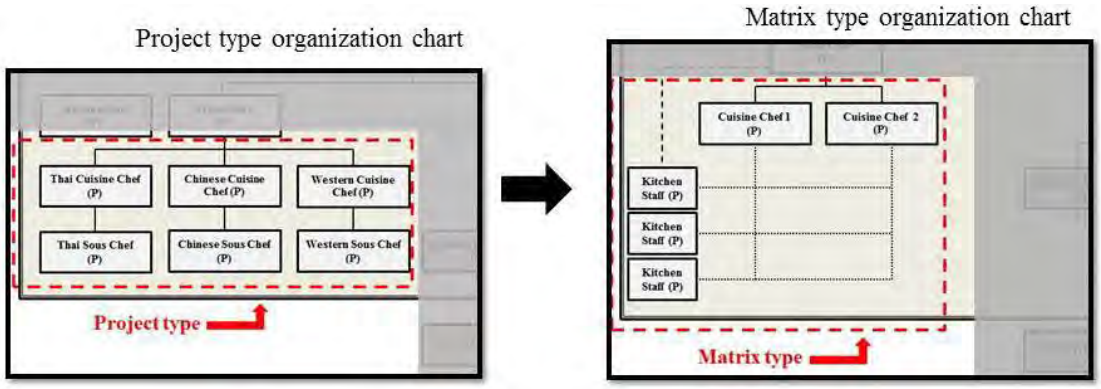


Figure 5-2. Comparison of old and new organization chart in the kitchen area.

Balance power and workload in kitchen area reduce conflict among kitchen staffs and chefs. Kitchen staffs are to be arranged into shift, rotating daily duties, by Head chef to make sure they can perform all tasks in the kitchen.

Results from meeting 3:

- Elimination of requirement of chef‟s expertise.

  Chef‟s expertise in production makes the absence of chefs and resignation of chefs affects product‟s availability and quality. Less variety and training for all chefs eliminate problems from relying too much on chefs for qualified products.

- Increase teamwork in kitchen area.
  Staffs are now feeling like they work as a same team, not separated by product‟s type. The equal ability needed to generate all products makes no difference among staffs.

Meeting 4: Material requirement planning

In order to reduce raw material waste from production operation, material requirement planning is vital. The restaurant never used any production planning, the estimation of sales and ingredients required are done based on chef‟s experience. Team decided to use average numbers of items sold in each day in week (separated by months) to predict the customer‟s demand in the future. However, the analysis of customers in the area is needed. The result shows that every last week of a month, customer‟s demand changes.

- Tuesday, Wednesday and Thursday: Average demand will be predicted 20% decreasing from average of other weeks of the same month.
- Friday, Saturday and Sunday: Average demand will be predicted 15% increasing from average of other weeks of the same month.

Team generates MRP system, composed of Master production schedule (MPS), Bill of material (BOM) and aggregate purchasing plan.

- MPS is a data sheet showing approximate numbers of each item to be sold during a month.
- BOM is created based on standardized recipes. It is used with MPS to break down ingredients needed for each day. BOM is revised once the recipes are changed.
- Aggregate purchasing plan is generated by MPS and BOM. It tells the amount of ingredients needed per day and when to purchase the raw material to match with ingredient‟s limitation of inventory system.

ABC also needs to train admin staffs to be able to use these materials for daily demand planning. The big change of menu items causes difficulty of demand planning at the beginning since they data used for future demand planning is based on historical data. Menu reduction causes inaccuracy references. However, numbers of four times remaining item sold in the past is initially applied for the first and second month of demand planning. Then, recorded sales from January and February will be used to compare with last year‟s data so that more accurate demand planning can be estimated by team in the future.

The purchasing flowchart is revised and recreated. GM is no longer involved in purchasing activities since one of ABC‟s strengths (local market and wholesalers nearby) provides opportunity to cut off suppliers. ABC can eliminate problems from suppliers and allows kitchen staffs to choose ingredients at standard quality freely. New purchasing flowchart is less complicated than the previous one.

Results from meeting 4:

- Reduce raw material waste from inaccurate planning.

  Over storage problem of ingredients in the kitchen can be eliminated by better references for demand planning rather than based on chef‟s experience. Even though the starting of this year may cause inaccurate planning due to the change of menu list, the systematic methods used for planning can be useful in the future when more stability is achieved.

- Reduce problem from raw material shortage.

Higher accuracy in demand planning can prevent shortage of raw material. Staff can prepare the adequate raw material without over stocking them based on reasonable raw material planning.

- Reduction of General Manger‟s workload.

  Being involved in all activities in daily operation causes high amount of workload for GM to complete each day. All functions have to wait for decision making from GM since he/she is the only person given authority to make decision. The tools used in demand planning can now be implemented by any admin staff to provide reasonable amount of purchasing amount to kitchen staff to purchase.

Meeting 5: Inventory in practice

Lack of knowledge of kitchen staffs leads to inappropriate storage methods in kitchen area, causing high amount of raw material waste. Team studies current inventory system, and found that there is no systematic approach in daily raw material checking and storage.

Coding system is identified for clearer identification of ingredient‟s characteristics. Types of ingredients, seasonal or non-seasonal and storage period are identified for each ingredient in the code. Inventory system is generated from team‟s discussion for systematic inventory checking. Practical methods for appropriate storage are introduced to kitchen staffs and relevant positions in order to apply them correctly.

Two main inventory forms are introduced to kitchen staffs.

- Inventory Form (IF-xx-xx-xx). This form is used to record remaining ingredients each day.
- Remaining Form (RF-xx-xx-xx). This form is used when any ingredients are transferred from storage shelves to staff‟s shelf when their qualities drop and can no longer used to cook for customers. Management level can monitor the raw material waste from this record.

Kitchen staffs need to attend inventory training from Head chef. They are also assigned into different shift to complete inventory tasks.

The storage space in the kitchen is rearranged to store similar type of ingredients in the same place so that appropriate temperature can be set to maintain longest shelf life.

Results from meeting 5:

- Longer shelf life of raw material.

  Appropriate storage methods and space create longer average shelf life to all kinds of ingredients. They are put in suitable temperature with their own types, not separated by cuisine"s type as it used to be. Vegetables are arranged into baskets to avoid stale from piling them up.

- Reduce confusion in daily production.

  The purchasing date and storage period of each ingredient are stated clearly so that there is no confusion in which ingredients are out of date or still fresh. Staffs can instantly tell by spotting the label on the fridges.

Meeting 6: Shop floor improvement

Team studied shop floor of production area of ABC restaurant. The production area can be divided into 2 areas. Team stated possible error points in operation in both working units in order to find out preventive methods.

- Servicing area: The only contact point between the company and its customers. Two points of possible causes of errors are mentioned in the linkage in working process. Weekly training and order checklist are provided to prevent errors from receiving orders from customers, and servicing them.
- Kitchen area: Standardized recipes can be used to confirm presentation of each dish. Apart from under standard quality, another possible cause of defects from restaurant production is producing wrong order, which causes waste of time and raw material from reproduction. Order slips printed from printing

machine are no longer put on the board since confusion of order sequence can be caused from mixing up orders. Cuisine chefs need to tear the slip from the machine themselves in order to prevent wrong calling out of orders and ordering sequence.

Results from meeting 6:

- Reduce customer‟s complaints

  Poor performance in servicing unit, long servicing time and waiting time of food can be reduced after preventive methods are introduced to production shop floor. Waiters can now deliver satisfied service to customers. Reduction of wrong order produced causes shorter time to deliver right orders to each table.

Meeting 7: Monitoring & Control

Team paid attention to follow-up plan in the last meeting. The continuous improvement needs continuous monitoring and control from supervisors of all functions. Team suggests monthly follow-up meeting to ensure that the implemented actions stay effective without internal errors.

Results from meeting 7:

- Continuous improvement.

  ABC restaurant can keep improving their internal operation with the follow-up meeting. Actions must be taken when new problems occur. Team needs to stay up-to-date in real operation after improvement. Therefore, monthly meeting is required.

5.2 Benefits

Direct and indirect benefits shown in summary diagram (figure 5-1) are shown in table 5-1 below to identify in which aspects they have improved restaurant‟s efficiency and effectiveness. Improvement of practical operation of a restaurant can be categorized into 3 aspects, which are „quality‟, „time‟and „cost‟.

Table 5-1. Three beneficial aspects from restaurant‟s improvement.

Benefits	**Beneficial aspects**			**Practical measurement**
	Quality	**Time**	**Cost**	
Reduction of monthly operational cost			√	Approx. 43,000 baht (per month)
Eliminate requirement of chef‟s expertise	√	√		Observation
Eliminate conflict in kitchen area	√	√		Individual interview
More accurate purchase planning		√	√	29.05% increased sales to raw material cost ratio
Reduce GM‟s workload	√	√		Reduction of 4 job descriptions of GM
Reduction of raw material waste			√	29.05% increased sales to raw material cost ratio
Eliminate customer‟s complaints from servicing area	√			94.29% reduction of average numbers of customer‟s complaints (per week)

Numerical measurement is stated in the table showing tangible benefits for the restaurant after improvement. The most obvious result shown in chapter IV is the change from monthly loss to monthly profit from the first month of implementation. The saving of raw material waste cannot be shown in numbers because there are changes in menu list which makes comparisons of raw material cost from last year unpractical. The ratio of sales and raw material cost is used instead to measure the improvement. The wider the gap, the more sales generated from raw material cost base. Some benefits cannot be measured numerically. Therefore observation and individual interview of relevant employees are used to indicate positive changes from implementation.

5.3 Recommendations

The implementation has improved effectiveness of restaurant‟s operation. The recommendations are suggested here in order to maintain and improve internal operation‟s efficiency.

- Follow-up the improvement activities

  Activities run by employees must be followed up to maintain best performance. The director and GM should monitor whether those rules and flow chart are strictly followed by employees. Internal audit is also required. Statistical data of daily operation needs to be recorded because restaurant is a dynamic business.

- Apply Plan-Do-Check-Act

  Real time problem solving ability is vital to run a successful restaurant. The dynamic business type causes changes of errors from operation. Staffs need to pay attention to daily operation and brainstorm for new preventive methods those are suitable for current problems.

- Financial control

  All activities (purchasing, sales, marketing etc.) of any restaurant involve cash flow. Therefore, it creates possibility of corruption in internal operation. Designs of flow chart and documentation system should put financial control in high priority.

5.4 Suggestions for further studies

For further studies and improvement for other restaurant‟s production, if there is no limitation of resources or timeline, following topics should be focused on to improve internal system.

- Synchronization of internal information flow

  The information flow between all functions is the most important thing to run the business effectively. Information linking software or systematic documentation system (such as barcode system) will prevent mistakes from misunderstanding between functions. The ability to check status of inventory level or sold items could be very useful for operation accuracy and smoothness.

- System standardization

  Improving the standard of all processes within the business unit in order to implement franchising and expanding the branches of the restaurant can generate enormous profit to the owner without over workload of internal operation. Higher standards makes business unit more attractive for business expansion. However, maintaining the same quality and cultural value are also vital.

- Risk management

  The risk assessment and preventive actions should be identified to prevent unpredicted errors in the future.

- Management of change

  Changes of working culture and system in the restaurant may cause resistance from employees. The resistance may lead to efficiency drop, low motivation, or quality drop. Therefore a detail study about management of change is necessary for implementation process.

REFERENCES

Ball, S., and Roberts, L. Chapter 2: Restaurants. International hospitality industry. (2003): 30-58.

Barrarini, D. and Archer, R. The risk ranking of projects: a methodology. International Journal Project Management. 19 (2001): 139-145.

Burapachayanont, A. Supply management of a contract manufacturer. Master"s Thesis, The Regional Centre for Manufacturing System Engineering, University of Warwick. 2007.

Chapman, R. The controlling influences on effective risk identification and assessment for construction design management. International Journal Project Management. 19 (2001): 147-160. Cited in Leopoulos, V.N., Kirytopoulos, K.A., and Malandrakis, C. Risk management for SMEs: Tools to use and how. Production Planning & Control. 17 (2006): 322-332.

DLF. Electronic Resource Management Workflow Flowchart [Online]. Electronic Resource Management Initiative. Available from : www.library.cornell.edu [2010, November 7]

Dopson, L.R., Hayes, D.K., and Miller, J.E. Food and beverage cost control. Fourth edition, USA: John Wiley & Sons, 2008.

EdrawSoft. Standard symbols and their usage [Online]. EdrawSoft 2004-2011. Available from : http://www.edrawsoft.com/flowchart-symbols.php [2010, November 7]

Farsad, B., and LeBruto, S. A measured approach to food-inventory management. Food-service management (1993): 90-95.

Gaither, N. Production and operations management. Fifth edition, USA: York Graphic Services, 1980.

Gessner, R.A. Master production schedule planning. USA: John Wiley & Sons, Inc., 1986.

Hicks, B.J. Lean information management: Understanding and eliminating waste. International Journal of Information Management. 27 (2007): 233-249.

Hillson, D. Effective opportunity management for projects. New York: Marcel Dekker, 2003. Cited in Leopoulos, V.N., Kirytopoulos, K.A., and Malandrakis, C. Risk management for SMEs: Tools to use and how. Production Planning & Control. 17 (2006): 322-332.

Jiao, J., Tseng, M.M., Ma, Q., and Z, Y. Generic Bill-of-Materials-and-Operations for High-Variety production management. Concurrent engineering: Research and application. 8 (2000): 297-322.

Kendall, P., and Dimond, N. Food storage for safety and quality. Food and nutrition series 9.310 (1990).

Kieckhafer, R.M. Adapting Failure Mode and Effects Analysis (FMEA) to outcomes assessment [Online]. Department of Electrical and Computer Engineering, 2005. Available from : http://www.fmeainfocentre.com/presentations/PUB-FMEA-BAPS-05-slides.pdf [2010, November, 28]

Koller, G. Risk assessment and decision making in business and industry: a practical guide. Second edition, USA: Chapman & Hall/CRC, 2005.

Lee, S.S., Dugger, J.C., and Chen, J.C. Kaizen: an essential tool for inclusion in industrial technology curricula. Journal of Industrial Technology. 16 (2000): 1-7.

Lehtinen, U., and Torkko, M. The lean concept in the food industry: a case study of contract a manufacturer. Journal of Food Distribution Research. 36 (2005): 57-67.

Leopoulos, V.N., Kirytopoulos, K.A., and Malandrakis, C. Risk management for SMEs: Tools to use and how. Production Planning & Control. 17 (2006): 322-332.

Mazareanu, V.P. Risk management and analysis: Risk assessment (qualitative and quantitative) [Online]. Alexandru Ioan Cuza University, 2007. Available from : http://anale.feaa.uaic.ro/anale/resurse/06_Mazareanu_V__Risk_management_and_analysis-risk_assessment.pdf [2010, November 20]

Mills, A. A systematic approach to risk management for construction. Structural Survey. 19 (2001): 245-252.

Orlicky, J. Material requirements planning. New York: McGraw-Hill, 1994. Cited in Williams, P. A regulation evaluation system: a decision support system for the Building Code of Australia. Construction Management and Economics. 13 (1995): 197-208.

Payne-Palacio, J., and Theis, M. Introduction to foodservice. Eleventh edition, New Jersey: Pearson Education, 2009.

Raz, T., and Michael, E. Use and benefits of tools for project risk management. International Journal of Project Management. 19 (1999): 9-17.

Rotondaro, R.G., and Lopez de Oliveira, C. Using Failure mode effect analysis (FMEA) to improve service quality [Online]. University of Sao Paulo, 2001. Available from : http://ipek.deveci.org/images/FMEA-odevmakale.pdf [2010, November, 25]

Rowe, W.D. An anatomy of risk. USA: John Wiley & Sons, 1977.

Russell, R.S., and Taylor III, B.W. Operations management: Quality and comopetitiveness in a global environment. Fifth edition. USA: John Wiley & Sons, 2006.

Sanders, E.E., Hill, T.H., and Faria, D.J. Understanding foodservice cost control: an operational text for food, beverage, and labor costs. Third edition, New Jersey: Pearson Education, 2008.

Schroeder, R.G. Operations management. Third edition, University of Minnesota: McGraw-Hill/Irwin, 2007.

SiliconFarEast. Failure Modes and Effects Analysis (FMEA) Procedural Guide [Online]. SiliconFarEast, 2005. Available from : http://www.siliconfareast.com [2010, November, 25]

Spears, M.C., and Vaden, A.G. Foodservice organization: a managerial and system approach. New York: Collier Macmillan Canada, 1985.

TEAM. Shop floor control requirements guide. Technologies Enabling Agile Manufacturing. 1 (1995): 1- 27.

TubeSolution. 8 Disciplines (8D) process [Online]. Sanyo Tube Industry, 2010. Available from : http://www.steeltube.de/files/Others/8%20Disciplines.pdf [2010, October 25]

Walker, J.R., and Lundberg, D.E. The Restaurant: from concept to operation. Third edition: John Wiley & Sons, 2001.

Waters, D. Operations Strategy Thomson Learning, 2006.

Warwick WMG Course. Project Planning Management and Control: Managing Construction Projects. RCMSE, 2009. (Unpublished manuscript)

Williams, P. A regulation evaluation system: a decision support system for the Building Code of Australia. Construction Management and Economics. 13 (1995): 197-208.

Womack, J.P., and Jones, D.T. Lean thinking: Banish and create wealth in your corporation. London: Simon and Schuster, 1996.

Van Leeuwen, J.F., Nauta, M.J., De Daste, D., Oderkerken-Rombouts, Y.M.C.F., Oldenhof, M.T., Vredenbregt, M.J., and Barends, D.M. Risk analysis by FMEA as an element of analytical validation. Journal of Pharmaceutical and Biomedical Analysis. 50 (2009): 1085-1087.

APPENDIX A

(ITEM CODE & SALES PRICE)

Menu code & Sales price

CODE	Menu	Selling Price (THB)
10001	Deep fried red Tilapia fish with Thai herbs	209
10002	Deep fried seabass with fish sauce	255
10003	Fried seabass with garlic and chili	120
10004	Braised pork spareribs with Kale	120
10005	Steamed coconut cream rice, grilled chicken & papaya salad (set)	90
10006	Deep fried mased potatoes stuffed with bacon	90
10007	Lasagna pork	69
10008	Nacho pork	120
10009	Nacho beef	95
10010	Nacho chicken	100
10011	Fried prawn cake (set)	110
10301	Peanuts	60
10302	Hiyashi wagame	80
10303	Cashew nuts	80
10304	Deep fried sour port spareribs	90
10305	Deep fried shrimp wontons	95
10306	Deep fried shrimp spring rolls	95
10307	Northeastern style sour pork sausage	95
10308	Deep fried chicken breast	90
10309	Deep fried chicken wings	90
10310	Deep fried salted pork	90
10311	Deep fried salted beef	120
10312	Breaded deep fried squids	125
10313	Salmon sashimi	160
10314	Deep fried fish roll	70
10315	Baked spinach with cheese in the cup	80
10316	Tuna fish in the cup	70
10401	Deep fried tofu royal	75
10402	Stir-fried vermicelli with tofu	90
10403	Crispy morning glory spicy salad	90
10404	Stir-fried mushroom with chili paste	90
10405	Spicy combination mushroom salad	90
10406	Tofu in red chili coconut cream sauce	90
10407	Winged beans, spicy salad vegetarian	90
10408	Hot and sour combination mushroom soup	90
10409	Tofu and mushroom red chili sauce	100
10410	Seasonal vegetable curry	100
10501	Papaya and carrot salad	59
10502	Papaya salad with salted crab and preserved fish	59
10503	Papaya salad with salted crab	59
10504	Papaya salad with salted egg	69
10505	Papaya salad with salted crab, preserved fish and peanuts	69

10506	Mixed fresh fruit salad	89
10507	Spicy corn salad	69
10508	Grilled chicken with lemongrass sauce (Half)	80
10509	Grilled chicken with coconut milk sauce (Half)	80
10510	Minced pork spicy salad	90
10511	Minced chicken spicy salad	90
10512	Deep fried dumpling minced pork in spicy salad	100
10513	Minced squid spicy salad	100
10514	Grilled Thai-French beef spicy salad	100
10515	Papaya spicy salad with deep-fried crabs	150
10601	Fried rice with sour garlic sausage	65
10602	Fried rice with pork (small)	65
10603	Fried rice with chicken (small)	65
10604	Fried rice with beef (small)	75
10605	Fried rice with shrimp (small)	75
10606	Fried rice with crab (small)	75
10607	Fried rice with squid (small)	75
10608	Fried rice with pork (large)	180
10609	Fried rice with chicken (large)	180
10610	Fried rice with beef (large)	200
10611	Fried rice with shrimp (large)	200
10612	Fried rice with crab (large)	200
10613	Fried rice with squid (large)	200
10614	Boiled Rice or Congee (pork)	65
10615	Boiled Rice or Congee (chicken)	65
10616	Boiled Rice or Congee (fish)	75
10617	Boiled Rice or Congee (shrimp)	75
10618	Boiled Rice or Congee (squid)	75
10619	Fried rice basil leaves with pork	65
10620	Fried rice basil leaves with chicken	65
10621	Fried rice basil leaves with beef	75
10622	Fried rice basil leaves with shrimp	75
10623	Fried rice basil leaves with squid	75
10624	Fried rice with chili paste, sweeten pork and salted boiled egg	75
10625	Fried Rice with shrimps paste	75
10626	Fried rice with salted fish and kale	75
10627	Fried rice with chicken green curry	75
10628	Fried rice with pork green curry	75
10629	American fried rice	95
10701	Stir-fried noodle with chicken	65
10702	Fried rice noodle topped with gravy sauce (pork)	75
10703	Fried rice noodle topped with gravy sauce (chicken)	75
10704	Fried rice noodle topped with gravy sauce (beef)	85
10705	Fried rice noodle topped with gravy sauce (shrimp)	85
10706	Fried rice noodle topped with gravy sauce (squid)	85
10707	Fried rice noodle topped with gravy sauce (braised pork spareribs)	85

10708	Fried rice noodle topped with gravy sauce (deep fried fish fillet)	120
10709	Stir-fried noodle with pork	70
10710	Stir-fried noodle with chicken	70
10711	Stir-fried noodle with beef	80
10712	Stir-fried noodle with shrimp	80
10713	Stir-fried noodle with squid	80
10714	Egg noodle with chicken and shrimps gravy sauce	80
10715	Thai style stir-fried vermicelli with prawns & tofu	80
10716	Thai style stir-fried rice noodle with proawns & tofu	80
10717	Fried rice noodle with minced beef gravy sauce topped with sunny side up egg	80
10718	Thai style fried crispy prok wantons	85
10801	Chili shrimps paste & deep fried siam tuna fish	105
10802	Minced prok, dried shrimps chili paste with salted egg	105
10803	Minced Pork, tamarind chili paste, crispy salted fish and boiled egg	115
10901	Minced prok with Chinese cabbage clear soup	80
10902	Minced pork, vermicelli with egg clear soup	90
10903	Minced pork with fried egg clear soup	90
10904	Minced pork, tofu and seaweed clear soup	90
10905	Green curry with pork	90
10906	Green curry with chicken	90
10907	Green curry with Thai-French beef	120
10908	Spicy & sour clear curry with shrimps & vegetables	95
10909	Spicy & sour clear curry with herbs & omelets	95
10910	Galingale chicken coconut cream soup	95
10911	Jungle curry with pork	90
10912	Jungle curry with chicken	90
10913	Jungle curry with Thai-French beef	120
10914	Tom Yum with fish fillet	120
10915	Tom Yum with prawns	120
10916	Stir-fried morning glory with garlic and chili	70
10917	Stir-fried Kale with garlic and chili	70
10918	Stir-fried mixed vegetables	80
10919	Stir-fried Broccoli with Oyster sauce	80
10920	Stir-fried crispy pork with Kale	95
10921	Stir-fried baby corn and mushroom with shrimps	95
10922	Stir-fried Croccoli with shrimps	95
10923	Stir-fried Asparagus with shrimps	95
10924	Stir-fried salted fish with Kale	95
10925	Thai herbs curry with shrimps	95
10926	Tom Yum with seafood	160
11001	Vermicelli spicy salad with seafood	95
11002	Fresh Kale spicy salad with seafood, minced pork	95
11003	Winged Beans, spicy salad with seafood, mincced pork	95
11004	Crispy Morning glory spicy salad with seafood, minced pork	95
11005	Cashew nuts spicy salad	95

11006	Sour sausage, spicy salad with peanuts & ginger	95
11007	Crispy Fluffy catfish salad with raw mango	95
11008	Lemon grass spicy salad with minced pork, shrimps	95
11009	Grilled Thai-French beef spicy salad	120
11010	Fresh raw prawns in spicy fish sauce	120
11011	Fresh raw salmon in spicy fish sauce	150
11101	Stir-fried sliced Thai-French beef tenderloin with oyster sauce	120
11102	Dried red curry with Thai-French beef	120
11103	Stir-fried sliced beef tenderloin with red chili paste	120
11104	Stir-fried sliced beef tenderloin with onion, capsicum and black pepper	120
11105	Stir-fried sliced or minced beef tenderloin with basil leaves	120
11106	Dried red curry with pork	90
11107	Stir-fried pork with sweet and sour sauce	90
11108	Stir-fried sliced pork with oyster sauce	90
11109	Stir-fried pork with red chili paste	90
11110	Stir-fried pork with black pepper	90
11111	Stir-fried minced pork with basil leaves	90
11112	Stir-fried crispy pork with curry paste	95
11113	Stir-fried chicken with sweet and sour sauce	85
11114	Stir-fried sliced chicken with oyster sauce	85
11115	Stir-fried chicken with red chili sauce	85
11116	Stir-fried minced chicken with basil leaves	90
11117	Dried red curry with chicken	90
11118	Stir-fried chicken with cashew nuts	105
11201	Stir-fried crispy fluffy catfish with curry paste	95
11202	Stir-fried seabass fillet with basil leaves, young pepper corn and chili	120
11203	Stir-fried seabass fillet with ginger and chili	120
11204	Salmon in red curry sauce	160
11205	Deep fried red tilapia in spicy salad	209
11206	Deep fried red tilapia with garllic and pepper	209
11207	Deep fried seabass with garlic and pepper	255
11208	Deep fried red tilapia with sweet sour and spicy sauce	209
11209	Deep fried seabass with sweet sour and spicy sauce	255
11210	Steamed red tilapia with soya sauce	209
11211	Steamed seabass with soya sauce	255
11212	Steamed red tilapia with lime sauce	209
11213	Steamed seabass with lime sauce	255
11214	Deep fried red tilapia with chili sauce	209
11215	Deep fried seabass with chili sauce	255
11216	Stir-fried prawns with curry powder	160
11217	Stir-fried prawns with shrimp chili paste	160
11218	Stir-fried prawns with black pepper	160
11219	Fried prawns with garlic and pepper	160
11220	Stir-fried prawns with red chili paste	160
11221	Baked prawns with vermicelli	190
11222	Steamed prawns with lime sauce	300

11223	Steamed prawns with soya sauce	300
11224	Fresh water prawns in red curry sauce	300
11225	Stir-fried crab meat with curry powder	190
11226	Stir-fried crab meat with shrimp chili paste	190
11227	Stir-fried crab meat with black pepper	190
11228	Stir-fried squids with curry powder	130
11229	Stir-fried squids with shriimp chili paste	130
11230	Stir-fried squids with black pepper	130
11231	Fried squids with butter and garlic	130
11232	Stir-fried squids with red chili paste	130
11233	Stir-fried crab with curry powder	280
11234	Fried crab with garlic and chili	280
11235	Stir-fried crab with black pepper	280
11236	Fried crab with garlic and pepper	280
11237	Deep fried Seabass with Thai herbs	255
11501	Garlic Toast	100
11502	Tuna sandwich	95
11503	Club sandwich	120
11504	House salad	80
11505	Caesar salad	95
11506	Tuna salad	95
11507	Chef salad	110
11508	Crispy prawns cream salad	130
11509	Chinese mushroom soup	95
11510	Spinach soup	95
11511	Corn soup	95
11512	Stir-fried spaghetti with pork	120
11513	Stir-fried spaghetti with chicken	120
11514	Stir-fried spaghetti with beef	130
11515	Stir-fried spaghetti with prawns	130
11516	Stir-fried spaghetti with squid	130
11517	Stir-fried spaghetti with salted fish	130
11518	Spaghetti concase sauce with mushroom and ham	130
11519	Spaghetti cancase sauce with chicken	130
11520	Spaghetti cancase sauce with bacon	140
11521	Spaghetti cream sauce with mushroom and ham	130
11522	Spaghetti meat sauce	130
11523	Spaghetti white wine seafood	160
11524	Fettucini pesto seafood	160
11525	Fettucini carbonara bacon	160
11526	Fish and chips	160
11527	Pork chop with prune sauce	190
11528	Chicken breast with mushroom cream sauce	190
11529	Seabass fillet steak	230
11530	Salmon steak	250
11531	Sirloin steak	250

11532	Thai-French tenderloin steak	285
11533	Stir-fried spaghetti with seafood	130
11534	Deep-fried crabs salad	280
11536	Fruit salad with deep fried shrimp in crepe bowl	150
11537	Fruit salad (vegetarian) in crepe bowl	150
11538	Fruit salad with deep fried shrimp	150

APPENDIX B

(EXAMPLE OF PLATE CARD OF STANDARD RECIPE)

Example of standardized recipe

Item code: 10512

Name: Deep fried dumpling minced pork in spicy salad (ลาบหมูทอด)

INGREDIENTS (วัตถุดิบ)					
No.	Code	วัตถุดิบ	Ingredients	Amount	Unit
1	MN-03-113	เนื้อหมูสับ	Pork	200	gram
2	VN-14-135	หอมแดงซอย	Shallot	20	gram
3	VS-03-151	ต้นหอมซอย	Spring onion	20	gram
4	VS-03-104	ผักชีฝรั่งซอย	Parsley	20	gram
5	VN-03-075	ใบมะกรูดซอย	Kaffir lime leaves	20	gram
6	VN-03-094	ใบสะระแหน่	Mint	5	gram
7	VN-03-012	กะหล่ำปลี	Cabbage	10	gram
8	VS-03-038	ถั่วฝักยาว	Cow-pea	20	gram
9	VN-03-157	โหระพา	Sweet basil	10	gram
10	DN-XX-045	พริกขี้หนูแห้งทอด	Dried Hot chilli	5	gram

11	VS-07-084	น้ำมะนาว	Lime juice	2	tablespoon
12	DN-XX-050	น้ำปลา	Fish sauce	1	tablespoon
13	DN-XX-064	พริกป่น	Ground dried chillies	1	tablespoon
14	DN-07-112	ข้าวคั่ว	Poprice	1	tablespoon
15	DN-XX-095	ผงชูรส	Monosodiumglutamate	0.25	teaspoon
16	DN-14-047	ไข่ไก่	Egg	1	egg
17	DN-14-010	เกล็ดขนมปัง	Bread crumbs	40	gram

COOKING PROCEDURES (วิธีทำ)		
No.	Procedures	Remarks
1	นำเนื้อหมูสับ หอมแดงซอย ต้นหอมซอย ผักชีฝรั่ง ใบมะกรูด โหระพา พริกขี้หนูแห้งทอด น้ำมะนาว น้ำปลา พริกป่น ข้าวคั่ว ผงชูรส และไข่ไก่โขลกเข้าด้วยกันจนเนียน	
2	ปั้นส่วนผสมจากข้อ 1 เป็นก้อนกลม แบ่งออกเป็นก้อนเท่าๆ กัน	
3	นำส่วนผสมจากข้อ 2 ไปคลุกกับเกล็ดขนมปัง และทอดในน้ำมันจนเปลี่ยนเป็นสีน้ำตาลทอง	
4	เสิร์ฟในจานใบบัว พร้อมตกแต่งด้วยสะระแหน่ กะหล่ำปลี ถั่วฝักยาว	

Last revision date: 27/12/2010

APPENDIX C

(INGREDIENT CODE & TYPE)

Ingredient Code & Type

No.	Ingredient	Type	No.	Ingredient	Type
1	Asparagus	S	47	Egg Tofu	S
2	Baby corn	S	48	Egg white	S
3	Bacon	N	49	Fish meat	N
4	Bamboo shoot	S	50	Fish sauce	N
5	Banana blossom	S	51	Flour	N
6	Bean sprouts	S	52	Fried egg with Cha-om	N
7	Beef	N	53	Fried garlic	N
8	Black bean garlic sauce	N	54	Frillice Iceberg	S
9	Braised Pork Spareribs	N	55	Galingale	S
10	Bread crumbs	N	56	Garlic	N
11	Broccoli	S	57	Ginger	N
12	Cabbage	N	58	Goat pepper	N
13	Capsicum	S	59	Golden mountain sauce	N
14	Carrot	N	60	Grated carrot	N
15	Cashew nuts	N	61	Grated raw papaya	N
16	Celery	S	62	Grated ripe coconut	S
17	Cherry tomatoes	S	63	Green apple	S
18	Chicken	N	64	Green curry paste	N
19	Chicken breast	N	65	Green lid Japanese sauce	N
20	Chicken thigh	N	66	Ground dried chillies	N
21	Chilli	N	67	Guava	S
22	Chilli paste	N	68	Hot basil leaves	S
23	Chinese cabbage	N	69	Hot chilli	N
24	Chinese egg noodle	N	70	Italian parsley	S
25	Chinese gravy sauce powder	N	71	Ivy gourd	S
26	Chinese leek	S	72	Japanese seaweed	N
27	Chinese soya sauce	N	73	Japanese soya sauce	N
28	Chinese sweet pickle	S	74	Jew's ear mushroom	N
29	Chinese sweet soya sauce	N	75	Jinda chilli	N
30	Chinese wine	N	76	Jungle curry paste	N
31	Cinnamon	N	77	Kaffir lime leaves	N
32	Cocktail sausage	N	78	Kale	N
33	Coconut milk	N	79	Ketchup	N
34	Coriander root	S	80	Knorr	N
35	Corn flour	N	81	Lard cube	N
36	Cow-pea	S	82	Lasagna sheet	N
37	Crab	S	83	Lemongrass	S
38	Crab meat	S	84	Lettuce	S
39	Cucumber	S	85	Lime	S
40	Curry powder	N	86	Lime juice	S
41	Dong quai	S	87	Long cucumber	S
42	Dried cabbage leaves	S	88	Luffa gourd	S

43	Dried Chilli	N	89	Mackerel	N
44	Dried Hot chilli	N	90	Mango	S
45	Dried salted prawn	N	91	Mashed potatoes	N
46	Egg	S	92	Mayonnaise	N
93	Medium sized shrimp	N	139	Shallot	N
94	Milk	N	140	Shiitake mushroom	N
95	Minced Pork with Garlic Coriander root	N	141	Shrimp meat	N
96	Mint	N	142	Shrimp paste	N
97	Monosodiumglutamate	N	143	Sliced Ham	N
98	Mozzarella cheese	N	144	Small eggplant	S
99	North-eastern style sausage	N	145	Small sized shrimp	N
100	Oil	N	146	Snake-head fish	N
101	Onion	N	147	Soft-shell crab	N
102	Oyster sauce	N	148	Soup stock	N
103	Pad-Thai sauce	N	149	Sour curry soup	N
104	Palm sugar	N	150	Sour Pork	N
105	Parmesan cheese	N	151	Sour Pork Spareribs	N
106	Parsley	S	152	Soya sauce	N
107	Pea	S	153	Spinach	S
108	Pea eggplant	S	154	Sprig roll sheet	N
109	Peanuts	N	155	Spring onion	S
110	Pepper	N	156	Squid	N
111	Pickled fish juice	N	157	Star anise	N
112	Pickles	N	158	Steamed rice	N
113	Pineapple	S	159	Straw mushroom	S
114	Poprice	N	160	Sugar	N
115	Pork	N	161	Sweet basil	S
116	Pork Spareribs	N	162	Sweet pepper	N
117	Porkloin	N	163	Sweetened pork	N
118	Pumpkin	N	164	Tamarind Chilli paste	N
119	Radish	S	165	Tamarind juice	N
120	Raisin	N	166	tapioca flour + Corn flour	N
121	Red apple	S	167	Tenderloin	N
122	Red Chilli	N	168	Thai parsley	S
123	Red coral	S	169	Thai wide rice noodle	N
124	Red radish	S	170	Tiger herbal	N
125	Red Tilapia	N	171	Tomatoes	S
126	Rice cooked with chicken soup	N	172	Trichogaster pectoralis	N
127	Ripe mango	N	173	Tuna meat	N
128	Ripe Tamarind juice	N	174	Undiluted coconut milk	S
129	Salmon	N	175	Unsalted butter	N
130	Salt	N	176	Unsweetened condensed milk	N
131	Salted egg	N	177	Vermicelli	N
132	Salted fish	N	178	Wasabi	N
133	Salted soya beans	N	179	Water	N
134	Seabass	N	180	Water morning glory	S

135	Seabass (in pieces)	N	181	Whipping cream	N
136	Seasoning sauce	N	182	White wine	N
137	Seaweed	N	183	Wide rice noodles	N
138	Sesame oil	N	184	Winged Bean	S
185	Wonton sheet	N			
186	Yellow soybean curd	S			
187	Yodson chilli	N			
188	Young turmeric	N			

S = Seasonal-based type
N = Non-seasonal-based type

APPENDIX D

(STANDARD FORMS FOR INVENTORY RECORDS)

Inventory Form (IF-xx-xx-xx)

Form code: IF-__-___-___

Staff:___________________________

No.	Code	Name	Amount	Unit	Purchasing date	Remarks

Removal Form (RF-xx-xx-xx)

Form code: RF-__-___-___

Staff:__________________________

No.	Code	Name	Amount	Unit	Purchasing date	Remarks

APPENDIX E

(CHECKLIST FOR ORDER RECIEVING)

Order List (รายการอาหาร)

Table (โต๊ะ)_____ **Staff**(บริกร)_____

Numbers of customers (จำนวนลูกค้า)_____

จำนวน	อาหารแนะนำ	จำนวน	ก๋วยเตี๋ยว	จำนวน	อาหารนอกฤดูกาล
	เนื้อปลากะพงคั่วพริกเกลือ		ก๋วยเตี๋ยวคั่วไก่		น้ำพริกกะปิ ปลาทูทอด
	ซี่โครงหมูอบยอดผัก		ก๋วยเตี๋ยวราดหน้าทอดซี่โครงหมูอบ		น้ำพริกลงเรือ
	ข้าวมันส้มตำไก่ย่าง (ชุด)		ก๋วยเตี๋ยวราดหน้าทอดเต้าซี่ปลา		น้ำพริกมะขาม ปลาสลิดทอดกรอบ
	มันฝรั่งอบขัดไส้เบคอนทอด		ผัดซีอิ๊วหมู		
	ทอดมันกุ้ง (ชุด)		โกยซีหมี่		
	ยำสาหร่ายญี่ปุ่น		ผัดไทยกุ้งสด		
	แหนมซี่โครงหมูทอด		ก๋วยเตี๋ยวเนื้อสับไข่ดาว		
	เกี๊ยวกุ้งทอดกรอบ	จำนวน	แกงต่างๆ		
	ไส้กรอกอีสาน		แกงจืดเต้าหู้หมูสับสาหร่ายทะเล		
	ปีกไก่ทอด		แกงเขียวหวานเนื้อโคขุน		
	ปลาดิบแซลมอน		แกงส้มกุ้งผักรวม		
	ปลาซ่อนรูป		แกงส้มชะอมทอดกุ้งสด		
	ผักโขมคนละคำ		ต้มข่าไก่		
	ทูน่าในถ้วย		แกงป่าหมู		
จำนวน	มังสวิรัติ		ต้มยำเนื้อปลาน้ำใส		
	ยำสามเห็ด		ต้มยำกุ้งแม่น้ำ		
	ต้มยำสามเห็ด	จำนวน	ผัดผัก/ยำ/ทั่วไป		
จำนวน	อาหารอีสาน		ผัดผักบุ้งไฟแดง		
	ส้มตำไทย		ผัดผักรวมมิตร		
	ส้มตำไทย ปู		หน่อไม้ฝรั่งผัดกุ้ง		
	ส้มตำโคราช		แกงเลียงกุ้งสด		
	ส้มตำผลไม้รวม		ยำวุ้นเส้น		
	ไก่ย่างตะไคร้ (ครึ่งตัว)		ยำคะน้าสดกรอบ		
	ลาบหมูทอด		ยำถั่วพลูสดกรอบ		
จำนวน	อาหารจานเดียว		ยำผักบุ้งทอดกรอบ		
	ข้าวผัดแหนม		ยำปลาดุกฟู		
	ข้าวผัดกุ้ง		ปลากะพงนึ่งซีอิ๊ว		
	ข้าวผัดปู		ปูนิ่มทอดกระเทียมพริกไทย		
	ข้าวผัดคลุกกระเพราหมู				
	ข้าวผัดน้ำพริกลงเรือ				
	ข้าวคลุกกะปิ				
	ข้าวผัดคะน้าปลาเค็ม				
	ข้าวผัดอเมริกัน				

BIOGRAPHY

Punjaporn Chinchanachokchai was born on 7th July 1986, Bangkok, Thailand. She was graduated from Chulalongkorn University, faculty of Engineering, majoring in Industrial engineering in 2009. She continued Master degree in Engineering Business Management at Regional Centre for Manufacturing Systems Engineering (RCMSE), a dual Master"s degree program of Chulalongkorn University (Thailand), cooperates with University of Warwick (United Kingdom).