Chapter V

System Construction

In this chapter, the proposed solution and strategy from previous chapter will be elaborately established and implement to the case studied company. The proposed solution and strategy are demand policy, lot Sizing technique, and Material Requirement Planning. Finally, this chapter shows the analysis of the system, system evaluation, and project management.

5.1 Material Management System for HDD Manufacturing

The developed Material Management System for HDD Manufacturing consists of three implementations as follow:

1. Implementation of demand policy for establishing MPS: Frozen zone is considered to be implemented in order to improve the total supply chain management result.
2. MRP implementation: Developed MRP will consolidate HGA capacity into the calculation in order to improve the HGA produce and HGA purchase decision.
3. Lot sizing and scrap allowance implementation: Lot sizing and scrap allowance are consider to be implemented as one of MRP components in order to improve the effectiveness of MRP result.

5.2 Demand Policy for MPS Construction

The proposed demand management is to create the frozen zone in the demand, Master Production Schedule. The demand policy requires the attention of high level management, since the demand policy directly affect the company's income. The plan to implement demand management to high level management is by following steps:

1. Explain cause and effect: There are many causes that effect on part supply problem. However, one significant cause is demand fluctuation particularly the near period of time in planning horizon, as explain in chapter four. The following are the effects:

i. Part supply shortage
ii. Customer commitment cannot be satisfied
iii. Bullwhip effect
iv. Low utilization of production.

2. Proposed the solution and exception: The solution is to establish the frozen zone for the rolling MPS. The exception should also be established in the case of available supply and available capacity for instance demand change in frozen zone for mix down or even additional demand in frozen zone while part supply and capacity is available.
3. Illustrate the Benefit: This is the most important part to catch the attention of high level management. The benefits are as follows.
    i. Effective supply management both for company and supplier
    ii. Effective supply Chain: decreasing bullwhip effect
    iii. Optimum utilization of production

5.3 MRP Construction

From chapter four, one of the solutions for material management system is MRP system for HSA which consists of capacity information for build and buy decision.

5.3.1 System Requirements

System requirement of MRP system are

- Microsoft Excel 2002 or updated

5.3.2 Procedure for Developing MRP System

The procedure for developing MRP consists of four phases.

1. Parameter Input phase: The first phrase of proposed MRP is parameter input phrase. It is a crucial phrase since it will be the fundamental for the MRP calculation. The following is the parameter that is required to be input.
    1.1. Demand or MPS

1.2. MRP Start date: since the MPS will be divided into three part daily demand, weekly demand, and monthly demand, the start date of MRP will be available for these three categories.

1.3. Supplier Lead time: Supplier lead time is the lead time since purchased order released until the part deliver to cased studied company. The default service for transportation is SL2 which is the most economic price.

1.4. Scrap: Scrap ratio is provided by engineering department.

1.5. BOM: BOM information includes usage and BOM level and it provided by engineering department and available in SAP system.

1.6. Production Lead time: Production Lead time for propose MRP is a HSA and HGA production Lead time and the information again is provided by engineering department.

1.7. Beginning on hand Lead time: Inventory before MRP start is available in SAP system.

1.8. Supplier Sourcing: Supplier sourcing is the percentage of part the case studied company will purchase from each supplier. The information of supplier sourcing is provided by Procurement department.

1.9. Scheduled Receipt: Scheduled Receipt information is available in SAP system.

2. Capacity Input phase: Capacity Input phase is also the crucial step in order to create proposed MRP. Capacity is a new function that was decided to be added into MRP in order to solve the produce and purchase decision. The capacity details are provided by Engineering department. After input the capacity details into MRP spreadsheet, it will automatically calculate the gating work center and available capacity per day. Since the strategy is trying to satisfy the HGA production capacity first then the remaining demand will be satisfied by purchase from suppliers. The spreadsheet will responsible for purchase and produce decision automatically. The capacity constraint will directly be used in MRP calculation.

3. MRP Calculation phase: This phase is the core step for material management system. It will automatically retrieve the data from the existed parameter. Then calculated according to MRP logic.

4. PR and Work Order summary: After the calculation process was complete, PR summary will be establish by using sourcing percentage and retrieve the result data from MRP worksheet.
   4.1. PR summary for each part item will be categorized by date and supplier name. For Work Order summary, there will only available for HGA up and HGA down since the decision produce or purchase is available for HGA process.
   4.2. Work order summary is the summary of proposed production plan in order to satisfy the MPS. Work Order summary for HGA up and HGA down will be categorized by start date.

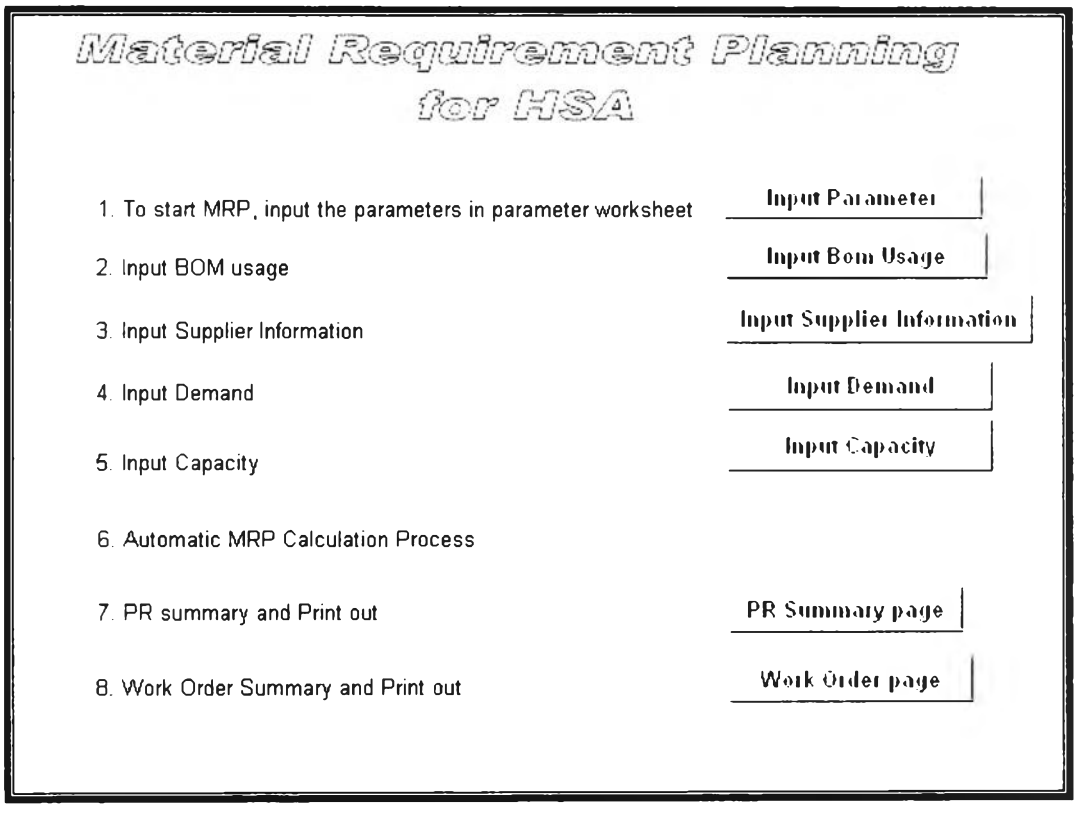
5.3.3 Work Procedure for the Newly Developed MRP System

In the newly developed MRP System, the unit for all information is K units (number of unit x 1000 units)

Step 1 Follow the Procedure from Procedure worksheet

After open the file MRP.xls, the first worksheet will be the procedure worksheet. The objective of this worksheet is to assist the user to be able to follow the MRP step correctly. From the first step to the last step; there will be the button at the end of each step. To click at the button, system will automatically turn to the worksheet according to the defined step. After finish working with each step, there will be a "BACK" Button. By clicking at the "BACK" button, system will automatically turn to the procedure worksheet.

Example 1.1
Planning Period input



<u>Step 2</u> Set Planning Period for MRP

Example 1.2
Planning Period input

MRP Start Date	7/12/05
Week start	32
Month start	10

There are three time phase parameter beginning with date, week, and month. Typically, MRP start on Tuesday of every week. However, the case studied company has set Saturday as a first day of the week. However, the MRP start date will be on Tuesday.

	Work Days		July Wk	St	Su	Mo	Tu	We	Th	Fr	
	0		26							1	
	6.8		27	2	3	4	5	6	7	8	
	6		28	9	10	11	12	13	14	15	
	6.6		29	16	17	18	19	20	21	22	
25.90	6.5		30	23	24	25	26	27	28	29	25.90
		July 22	Buddhist Lent Day								

	Work Days		Aug Wk	St	Su	Mo	Tu	We	Th	Fr	
	6		31	30	31	1	2	3	4	5	
	5.5		32	6	7	8	9	10	11	12	
	6.65		33	13	14	15	16	17	18	19	
24.15	6		34	20	21	22	23	24	25	26	24.15
		Aug 12	H.M The Queen's Birthday								

	Work Days		Sep Wk	St	Su	Mo	Tu	We	Th	Fr	
	6.8		35	27	28	29	30	31	1	2	
	6.5		36	3	4	5	6	7	8	9	
	6.8		37	10	11	12	13	14	15	16	
	6		38	17	18	19	20	21	22	23	
32.90	6.8		39	24	25	26	27	28	29	30	32.90

Figure 5.4.3 Example of Case studied Company's Calendar

<u>Step 3</u> Enter MRP parameter

1. Demand or MPS: Demand from MPS will be input into demand worksheet. In the case that HGA capacity need to be share with other models, all demand is required to be input. For example, HGA capacity in newly developed MRP is sharing between Moraga B and Moraga Plus A so that Demand for Moraga B and Moraga Plus A are required to be input into Demand worksheet.

Example 1.3
Demand Input

Demand Summary of MPA and MRB

		Day													
		7/12	7/13	7/14	7/15	7/16	7/18	7/19	7/20	7/21	7/22	7/23	7/25	7/26	7/27
MPA	Total MPA	3	3	3	3	3	3	3	3	3	3	3	3	3	3
MRB	13G1737	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	13G1738	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	14R8838	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	13G1740	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Total	15	15	15	15	15	15	15	15	15	15	15	15	15	15

2. Supplier Lead time: Supplier lead time is not required to input every MRP cycle, only input at the first time in parameter worksheet. However, it requires the maintenance once the lead time information from Procurement department has been changed.

Example 1.4
Supplier Lead time Input

Item	Lead Time
HSA	1
WASHER	1
SPACER	5
CARRIAGE	1
SCREW	7
HSA SCREW	1
FLEX CABLE	1
HGA UP	1
HGA DOWN	1
DAMPER	1
SUSPENSION UP	4
SUSPENSION DOWN	4
SLIDER UP	4
SLIDER DOWN	4

3. Scrap: Scrap ratio is not required to input every MRP cycle just like supplier lead time, only input at the first time in parameter worksheet. However, it requires the maintenance once the lead time information from Engineering department has been changed. Scrap ratio is changing quiet often especially for sensitive parts like HGA or slider.

Example 1.5
Scrap ratio Input

Item	Scrap
HSA	0.1
WASHER	0.3
SPACER	0.3
CARRIAGE	0.3
SCREW	0.3
HSA SCREW	0.3
FLEX CABLE	0.3
HGA UP	0.3
HGA DOWN	0.3
DAMPER	0.3
SUSPENSION UP	0.3
SUSPENSION DOWN	0.3
SLIDER UP	0.3
SLIDER DOWN	0.3

4. BOM (Usage): BOM is fundamental information for MRP. BOM is required to input only one since there will not be any change for BOM that had been issued. BOM information is required to be input in BOM worksheet. BOM information is provided by Engineering department.

Example 1.6
BOM Input

	WASHER	SPACER	CARRIAGE	SCREW	HSA SCREW	FLEX CABLE	HGA UP	HGA DOWN	DAMPER
Low level code	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**
13G1737	1	1	1	1	1	1	1	1	1
13G1738	1	1	1	1	1	1	1	1	0
14R8838	1	1	1	1	1	1	1	1	2
13G1740	1	1	1	1	1	1	1	1	4

5. Production Lead time: Production Lead time is not required to input every MRP cycle just like supplier lead time, only input at the first time in parameter worksheet. However, it requires the maintenance once the lead time information from Engineering department has been changed. Production Lead time is barely changed only when there is an implementation of additional process or elimination of particular process.

Example 1.7
Production Input

Item	Production Leadtime
HSA	1
WASHER	N/A
SPACER	N/A
CARRIAGE	N/A
SCREW	N/A
HSA SCREW	N/A
FLEX CABLE	N/A
HGA UP	2
HGA DOWN	2
DAMPER	N/A
SUSPENSION UP	N/A
SUSPENSION DOWN	N/A
SLIDER UP	N/A
SLIDER DOWN	N/A

6. Beginning on hand Inventory: Beginning on hand Inventory is required to input every MRP cycle in parameter worksheet. The beginning on hand inventory data is provided by SAP system and input to MRP system on parameter worksheet

Example 1.8
Beginning on hand inventory Input

Item	Beginning Inventory
HSA	1
WASHER	2
SPACER	2
CARRIAGE	1
SCREW	2
HSA SCREW	1
FLEX CABLE	1
HGA UP	2
HGA DOWN	3
DAMPER	2
SUSPENSION UP	4
SUSPENSION DOWN	3
SLIDER UP	1
SLIDER DOWN	1

7. Supplier Information: Supplier information is included supplier sourcing and supplier lead time. For supplier sourcing percentage is not required to input every MRP cycle, only input every quarter in parameter worksheet. Supplier sourcing percentage will be change at the end of each quarter. The supplier sourcing information will be input to Supplier sourcing worksheet.

Example 1.9
Supplier sourcing percentage input

Item	Supplier	Percentage	Supplier Lead time (days)
WASHER	Minibea	100%	1
SPACER	NHK	50%	1
	Soode	50%	1
CARRIAGE	LTEC	70%	1
	Totoku	30%	3
SCREW	Katayama	100%	3
HSA SCREW	Katayama	100%	3
FLEX CABLE	Mektec	100%	1
HGA UP	TDK	60%	4
	HSPC	40%	3
HGA DOWN	TDK	60%	4
	HSPC	40%	3
DAMPER	Minibea	100%	1
SUSPENSION UP	NHK Japan	70%	4
	SCC	30%	4
SUSPENSION DOWN	NHK Japan	70%	4
	SCC	30%	4
SLIDER UP	ITP Japan	50%	4
	GDL Mexico	50%	5
SLIDER DOWN	ITP Japan	50%	4
	GDL Mexico	50%	5

8. Scheduled Receipt: Scheduled receipt information will be directly input on Calculation worksheet.

Example 1.10
Scheduled Receipt input

CARRIAGE

				Day									
				7/12	7/13	7/14	7/15	7/16	7/18	7/19	7/20	7/21	7/22
Technique	Lot for Lot	Gross Requirement		3.33	4.76	0	3.81	4.76	4.76	4.76	4.76	4.76	4.76
Order Qty		Scheduled Receipts				4							
Alloc Qty		Projected Available	1	0	0	4	0.19	0	0	0	0	0	0
Safety Stock	10	Net Requirements		2.33	4.76	0	0	4.57	4.76	4.76	4.76	4.76	4.76
Low Level Code	1	Planned Order Receipts		2.33	4.76	0	0	4.57	4.76	4.76	4.76	4.76	4.76
Lead Time	1												
Scrap Ratio	0.3												
Usage	1												

Step 4 Enter Capacity Parameter

From demand input in third step, the system will automatically calculate the ratio of each product or model.

Example 1.11
Ratio Calculation

Demand		Day													
Product	Model	7/9	7/10	7/11	7/12	7/13	7/14	7/15	7/16	7/17	7/18	7/19	7/20	7/21	7/22
MPA	Total MPA	3	3	3	3	3	3	3	3	3	3	3	3	3	3
MRB	13G1737	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	13G1738	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	14R8838	5	5	5	5	5	5	5	5	5	5	5	5	5	5
	13G1740	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Total	17	17	17	17	17	17	17	17	17	17	17	17	17	17
	Ratio														
	Total MPA	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	13G1737	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	13G1738	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	14R8838	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	13G1740	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	Total	1	1	1	1	1	1	1	1	1	1	1	1	1	1

0.2 = 3 / 17

0.3 = 5 / 17

For example: The ratio for 13G1740 = $\frac{\text{Demand of 13G1740}}{\text{Total Demand}} = \frac{3}{17} = 0.2$

After the ratio has been automatically calculated, Capacity details are required to be input in capacity worksheet. The following parameters are the data that required to be input:

1. Capacity/Line
2. No. of Line
3. Capacity/Team
4. No. of Team
5. Capacity of Quasi Up
6. Capacity of Quasi Down
7. ABS
8. Final Inspection

Example 1.12
Capacity Input

Capacity Summary

unit: KDGR

	Day									
	7/12	7/13	7/14	7/15	7/16	7/18	7/19	7/20	7/21	7/22
working days										
Capacity/Line	19	19	19	19	19	19	19	19	19	19
No. of Line	5	5	5	5	5	5	5	5	5	5
Line Capacity	95	95	95	95	95	95	95	95	95	95
Standard hour/ unit										
Capacity/Team	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
No. of Team	8	8	8	8	8	8	8	8	8	8
Team Capacity	76.8	76.8	76.8	76.8	76.8	76.8	76.8	76.8	76.8	76.8
Quasi Up	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8
Quasi Down	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8
Total Quasi	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6
ABS	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8
Final Inspection	76.44	76.44	76.44	76.44	76.44	76.44	76.44	76.44	76.44	76.44

Step 4 Capacity Calculation

After capacity parameter are completely input to the spreadsheet, then the gating capacity for specific part number will automatically calculate.

Example 1.13
Capacity Calculation
unit: KDGR

	Day									
	7/12	7/13	7/14	7/15	7/16	7/18	7/19	7/20	7/21	7/22
working days										
Capacity/Line	19	19	19	19	19	19	19	19	19	19
No. of Line	5	5	5	5	5	5	5	5	5	5
Line Capacity	95	95	95	95	95	95	95	95	95	95
Standard hour/ unit										
Capacity/Team	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
No. of Team	8	8	8	8	8	8	8	8	8	8
Team Capacity	76.8	76.8	76.8	76.8	76.8	76.8	76.8	76.8	76.8	76.8
Quasi Up	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8
Quasi Down	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8
Total Quasi	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6
ABS	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8
Final Inspection	76.44	76.44	76.44	76.44	76.44	76.44	76.44	76.44	76.44	76.44
Gating Capacity	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8
HGA UP	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9
HGA DOWN	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9
Available capacity for 14R8838										
HGA UP	7.58	7.58	7.58	7.58	7.58	7.58	7.58	7.58	7.58	7.58
HGA DOWN	7.58	7.58	7.58	7.58	7.58	7.58	7.58	7.58	7.58	7.58

Gating Capacity = Minimum (Line capacity, Team capacity, Total Quasi, ABS, Final Inspection)

Capacity for HGA UP = Capacity for HGA Down = $\frac{\text{Gating Capacity}}{2}$

Available capacity for 14R8838 HGA UP = Capacity for HGA UP x Demand Ratio

Available capacity for 14R8838 HGA DOWN = Capacity for HGA DOWN x Demand Ratio

Demand Ratio came from the ratio that had been calculated from Demand worksheet.

Step 6 MRP Calculation

MRP format is the format for Material Requirement Planning. The planning horizon will be for one year but there are three kinds of time bucket, daily, weekly, and monthly.

First Column: Part name

Second Column: Parameter involved

Third Column: Parameter Value

Fourth Column: MRP calculation Items

Fifth Column: Beginning on hand inventory quantity

Example 1.14
MRP Format

					Day				
HGA UP					7M2	7M3	7M4	7M5	7M6
	Technique	Lot for Lot	Gross Requirement		3.33	4.76	0	3.81	4.76
	Order Qty		Scheduled Receipts				4		
	Alloc.Qty		Projected Available	2	0	0	4	0.19	0
	Safety Stock	10	Pre-Net Requirements		1.33	4.76	0	0	4.57
	Low Level Code	1	Net Requirements: Buy		0	0	0	0	0
			Planned Order Receipts		0	0	0	0	0
	Scrap Ratio	0.3							
	Usage	1	Net Requirements: Build		1.33	4.76	0	0	4.57
			Work Order Releases		0	0	4.57	4.76	4.76
	Production Leadtime	2							

1. Gross Requirements Coming from Independent Demand

Example 1.15
Gross Requirement Calculation

HGA DEMAND 14R8838
UNIT: KUNITS

				Day									
				7M2	7M3	7M4	7M5	7M6	7M8	7M9	7M20	7M21	7M22
				3	3	3	3	3	3	3	3	3	3
				Gross Requirement = Demand Quantity / (1 - Scrap Ratio)									
				Day									
				7M2	7M3	7M4	7M5	7M6	7M8	7M9	7M20	7M21	7M22
Technique	POQ		Gross Requirement	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33
Order Qty	N/A		Scheduled Receipts			4							
Alloc.Qty	N/A	1	Projected Available	0	0	0.67	0	0	0	0	0	0	0
Safety Stock	0		Net Requirements	2.33	3.33	0	2.67	3.33	3.33	3.33	3.33	3.33	3.33
Low Level Code	0		Planned Order Receipts	2.33	3.33	0	2.67	3.33	3.33	3.33	3.33	3.33	3.33
			Planned Order Released	3.33	0	2.67	3.33	3.33	3.33	3.33	3.33	3.33	3.33
Scrap Ratio	0.1												
Usage	1												

$$\text{Gross Requirement} = \frac{\text{(Demand quantity x Usage)}}{\text{(1- Scrap Ratio)}}$$

2. Determine Net Requirements and Planned Orders for Low Level code 0

Example 1.16
Net Requirement Calculation

HSA

				Day												
				7/12	7/13	7/14	7/15	7/16	7/18	7/19	7/20	7/21	7/22	7/23	7/25	7/26
Technique	POQ	Gross Requirement		3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33
Order Qty	N/A	Scheduled Receipts				4		3								
Alloc.Qty	N/A	Projected Available	1	0	0	0.67	0	0	0	0	0	0	0	0	0	0
Safety Stock	0	Net Requirements		2.33	3.33	0	2.67	0.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33
Low Level Code	0	Planned Order Receipts		2.33	3.33	0	2.67	0.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33
		Planned Order Released		3.33	0	2.67	0.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33	3.33
Scrap Ratio	0.1															
Usage	1															

Net Requirement = Gross Req. - Projected Available - Scheduled Rec.

0.33 = 3.33 - 0 - 3

Net Requirement day X = Gross Requirement day X– Scheduled Receipt day X – Projected Available day X – 1

When a requirement of each items are not covered by projected available inventory, a new order called planned order.

3. Determine Planned Order for Low Level code 0

Example 1.16
Planned Order for low level code 0

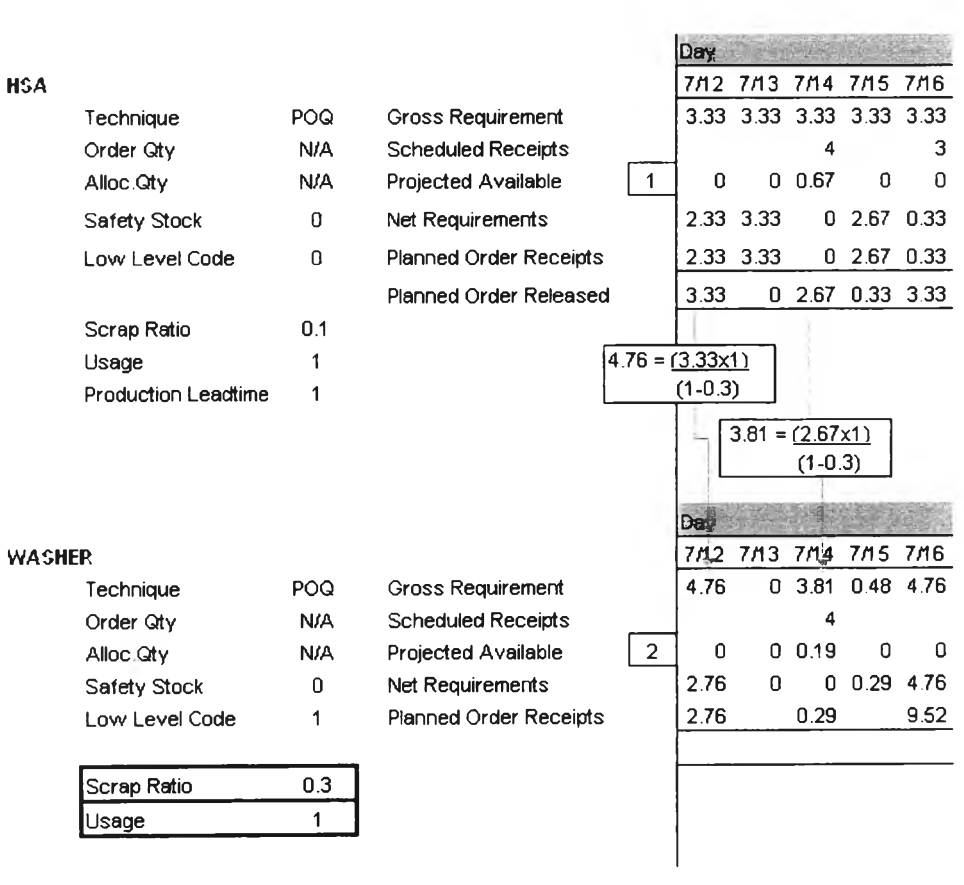
HSA

				Day			
				7/12	7/13	7/14	7/15
Technique	POQ	Gross Requirement		3.33	3.33	3.33	3.33
Order Qty	N/A	Scheduled Receipts				4	
Alloc.Qty	N/A	Projected Available	1	0	0	0.67	0
Safety Stock	0	Net Requirements		2.33	3.33	0	2.67
Low Level Code	0	Planned Order Receipts		2.33	3.33	0	2.67
		Planned Order Released		3.33	0	2.67	0.33
Scrap Ratio	0.1						
Usage	1						
Production Leadtime	1						

After Net Requirements was determined by previous step, planned order receipt is scheduled to support the requirement. After planned order receipts were scheduled, planned order released can be scheduled by offsetting production lead time to planned order receipt date. The planned order is a look ahead or an anticipated order to cover anticipated future requirement.

4. Determine Gross Requirement for Low Level code 1

Example 1.17
Gross Requirement for low level code 1



$$\text{Gross Requirement} = \frac{\text{(Demand quantity x Usage)}}{\text{(1- Scrap Ratio)}}$$

5. Determine Net Requirements and Planned Orders for Low Level code 1

Example 1.19
Net Requirements and Planned Order for low level code 1

WASHER

Technique	POQ	Gross Requirement
Order Qty	N/A	Scheduled Receipts
Alloc.Qty	N/A	Projected Available
Safety Stock	0	Net Requirements
Low Level Code	1	Planned Order Receipts

Scrap Ratio	0.3
Usage	1

	Day						
	7/12	7/13	7/14	7/15	7/16	7/18	7/19
	4.76	0	3.81	0.48	4.76	4.76	4.76
			4				
2	0	0	0.19	0	0	0	0
	2.76	0	0	0.29	4.76	4.76	4.76
	2.76			5.05		9.52	

Demand on 7/14 (3.81Kunits) can be covered by scheduled reciept (4Kunits) and Projected available is
0.19 Kunits = 4 - 3.81 Kunits

From the first day (7/12), gross requirement is 4.76Kunits while there is beginning on hand inventory; 2Kunits, and no scheduled receipts in future period.

Net Requirement on 7/12 = (Gross Requirement on 7/12 – Scheduled Receipt on 7/12 – Beginning on hand inventory)

2.76Kunits = 4.76Kunits – 0Kunits – 2Kunits

From 7/14, gross requirement is 3.81K units can be covered by scheduled receipts; 4Kunits. From scheduled receipts and gross requirement, projected available inventory can be calculated.

Projected Available on 7/14 = Project Available on 7/13 + Scheduled Receipt on 7/14 – Gross Requirement on 7/14

0.19Kunits = 0Kunits + 4Kunits – 3.81Kunits

For HSA MRP there are two type of lot sizing technique. One is Lot for Lot technique and another one is POQ. Example 1.19 is using POQ technique and POQ is equal two according to POQ calculation.

Example 1.20
Planned Order for POQ

WASHER				Day								
				7M2	7M3	7M4	7M5	7M6	7M8	7M9	7/20	7/21
Technique	POQ	Gross Requirement		4.76	0	3.81	0.48	4.76	4.76	4.76	4.76	4.76
Order Qty	N/A	Scheduled Receipts				4						
Alloc.Qty	N/A	Projected Available	2	0	0	0.19	0	0	0	0	0	0
Safety Stock	0	Net Requirements		2.76	0	0	0.29	4.76	4.76	4.76	4.76	4.76
Low Level Code	1	Planned Order Receipts		2.76			5.05		9.52		9.52	

From Example 1.20, POQ is equal to two, meaning that planned order always order two whole weeks of demand at the time.

Planned Order on 7/15 = Net Requirement on 7/15 + Net Requirement on 7/16
5.05Kunits = 0.29Kunits + 4.76Kunits

Example 1.21
Planned Order for Lot for Lot

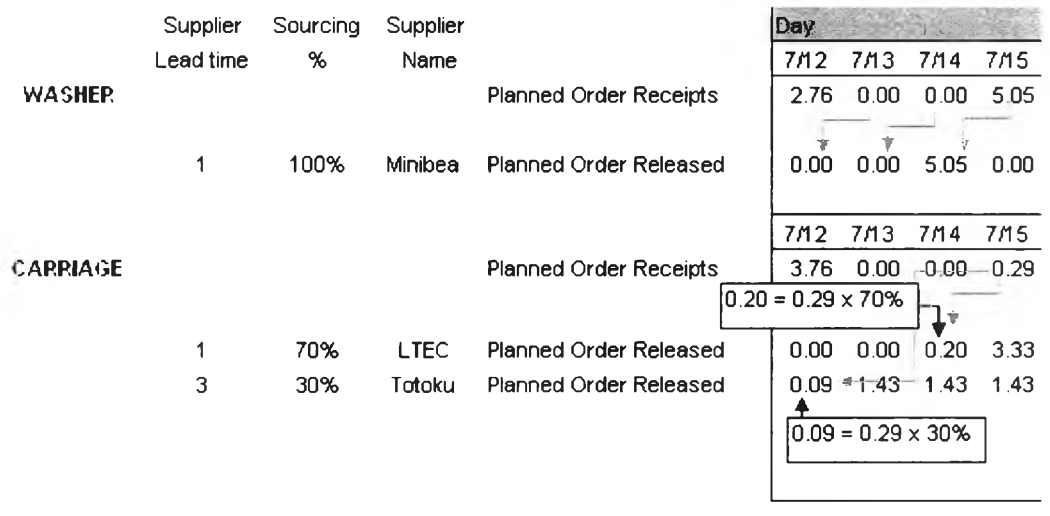
CARRIAGE				Day				
				7M2	7M3	7M4	7M5	7M6
Technique	Lot for Lot	Gross Requirement		4.76	0	3.81	0.48	4.76
Order Qty		Scheduled Receipts				4		
Alloc.Qty		Projected Available	1	0	0	0.19	0	0
Safety Stock	10	Net Requirements		3.76	0	0	0.29	4.76
Low Level Code	1	Planned Order Receipts		3.76	0	0	0.29	4.76
Lead Time	1							
Scrap Ratio	0.3							
Usage	1							

For some parts that are using Lot for Lot technique, it provides period by period coverage of net requirements, and the planned order quantity always equal the quantity of net requirements.

6. Determine Planned Order Released for Low Level code 1

From the planned order receipt that had been calculated from MRP worksheet, planned order receipt data will automatically sent to sourcing calculation worksheet.

Example 1.22
Planned Order Released for Low Level code 1



	Supplier Lead time	Sourcing %	Supplier Name		Day 7/12	7/13	7/14	7/15
WASHER				Planned Order Receipts	2.76	0.00	0.00	5.05
	1	100%	Minibea	Planned Order Released	0.00	0.00	5.05	0.00
					7/12	7/13	7/14	7/15
CARRIAGE				Planned Order Receipts	3.76	0.00	0.00	0.29
					0.20 = 0.29 x 70%			
	1	70%	LTEC	Planned Order Released	0.00	0.00	0.20	3.33
	3	30%	Totoku	Planned Order Released	0.09	1.43	1.43	1.43
					0.09 = 0.29 x 30%			

From example 1.22, Planned Order Released is scheduled by offsetting the supplier lead time and Planned Order Released quantity is calculated by applying sourcing percentage.

Planned Order Receipts for Carriage on 7/15 = 0.29Kunits

Planned Order Released for LTEC on 7/14 = 0.29 x 70% = 0.20Kunits; Supplier Lead time = 1 day

Planned Order Released for Totoku on 7/12 = 0.29 x 30% = 0.09Kunits; Supplier Lead time = 3 days

7. Produce and Purchase Decision on Low level code 1

Example 1.23
Available capacity for HGA UP and HGA down

unit: KDGR	Day							
	7/12	7/13	7/14	7/15	7/16	7/18	7/19	7/20
Gating Capacity	75.8	75.8	75.8	75.8	75.8	75.8	75.8	75.8
HGA UP	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9
HGA DOWN	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9
Available capacity for 14R8838								
HGA UP	7.58	7.58	7.58	7.58	7.58	7.58	7.58	7.58
HGA DOWN	7.58	7.58	7.58	7.58	7.58	7.58	7.58	7.58

Example 1.24
Produce and purchase decision

HGA UP			Day					
			7/12	7/13	7/14	7/15	7/16	
Technique	Lot for Lot	Gross Requirement	4.76	10.2	15.9	3.65	4.76	
Order Qty		Scheduled Receipts			4			
Alloc.Qty		Projected Available	2 0	0	0	0	0	Avail Capacity = 7.58 KDGR
Safety Stock	10	Pre-Net Requirements	2.76	10.2	11.9	3.65	4.76	Net Req't: Buy = 10.2 - 7.58
Low Level Code	1	Net Requirements: Buy	0	2.58	4.29	0	0	= 2.58 Kunits
		Planned Order Receipts	0	2.53	4.29	0	0	Net Req't: Build = 7.58 Kunits
Scrap Ratio	0.3							
Usage	1	Net Requirements: Build	2.76	7.58	7.58	3.65	4.76	
		Work Order Releases	7.58	3.65	4.76	4.76	4.76	
Production Leadtime	2							

Pre-Net Requirement on 7/13 = Gross Requirement on 7/13 – Scheduled Receipt on 7/13 – Projected Available on 7/12

10.2Kunits = 10.2Kunits – 0Kunits – 0Kunits

From Example 1.23, available capacity for HGA UP on 7/13 is 7.58 KDGR. The produce and purchase policy of case studied company is to consume HGA capacity as a priority then if the capacity is not able to cover the pre-net requirement then case studied company is required to purchased HGA from suppliers.

Net Requirements: Buy 7/13 = Pre-Net Requirement 7/13 – Available Capacity 7/13

2.58Kunits = 10.2Kunits – 7.58Kunits

After Net Requirements: Buy was determined, Planned Order Receipt will automatically assign. Planned Order Receipt has the same quantity with Net Requirements: Buy and also scheduled in the same day.

Net Requirement: Build on 7/13 = 7.58Kunits

After Net Requirement: Build was assigned then Work Order Released can also be assigned by offsetting the production lead time. From Example 1.24, HGA Production lead time is two days. Therefore, Net Requirement: Build on 7/14 will automatically offset to Work Order Released on 7/12.

8. Determine Gross Requirement for Low Level code 2

Example 1.25
Gross Requirement for Low Level code 2

HGA DOWII				Day					
				7M2	7M3	7M4	7M5	7M6	7M8
Technique	Lot for Lot	Gross Requirement		4.76	10.2	15.9	3.65	4.76	4.76
Order Qty		Scheduled Receipts				4			
Alloc.Qty		Projected Available	3	0	0	0	0	0	0
Safety Stock	10	Pre-Net Requirements		1.76	10.2	11.9	3.65	4.76	4.76
Low Level Code	1	Net Requirements: Buy		0	2.58	4.29	0	0	0
Lead Time	1	Planned Order Receipts		0	2.58	4.29	0	0	0
Scrap Ratio	0.3								
Usage	1	Net Requirements: Build		1.76	7.58	7.58	3.65	4.76	4.76
Capacity: DGR	38.8	Work Order Releases		7.58	3.65	4.76	4.76	4.76	4.76
Production Leadtime	2								

10.8 = (7.58 x 1) / (1-0.3)

6.8 = (4.76 x 1) / (1-0.3)

SUSPENSION DOWII				Day					
				7M2	7M3	7M4	7M5	7M6	7M8
Technique	Lot for Lot	Gross Requirement		10.8	5.22	6.8	6.8	6.8	6.8
Order Qty		Scheduled Receipts				4			
Alloc.Qty		Projected Available	3	0	0	0	0	0	0
Safety Stock	10	Net Requirements		7.83	6	3	7	7	7
Low Level Code	2	Planned Order Receipts		7.83	6	3	7	7	7
Scrap Ratio	0.3								
Usage	1								

Gross Requirement for low level code2= (Work Order Released x Usage) / (1- Scrap Ratio)

For Gross Requirement for low level code2, demand came from work order released of low level code1. From Example 1.25, work order released of low level code1 acts as a demand for low level code 2.

9. Determine Net Requirements and Planned Orders for Low Level code 2

Example 1.26
Net Requirements and Planned Orders for Low Level code 2

SUSPENSION DOWN				Day				
				7M2	7M3	7M4	7M5	7M6
Technique	Lot for Lot	Gross Requirement		10.8	5.22	6.8	6.8	6.8
Order Qty		Scheduled Receipts				4		
						3 = 6.8- 4 - 0		
Alloc.Qty		Projected Available	3	0	0	0	0	0
Safety Stock	10	Net Requirements		7.83	5.22	2.8	6.8	6.8
Low Level Code	2	Planned Order Receipts		7.83	5.22	2.8	6.8	6.8
Scrap Ratio	0.3							
Usage	1							

Net Requirement on 7/14 = Gross Requirement on 7/14 – Scheduled Receipt on 7/14
– Projected Available on 7/13

3Kunits = 6.8Kunits – 4Kunits – 0Kunits

Planned Order receipts quantity is equal to Net Requirement quantity and scheduled at the same day.

Net Requirement on 7/14 = 3Kunits

Planned Order Receipt on 7/14 = 3Kunits

10. Determine Planned Order Released for Low Level code 2

From the planned order receipt that had been calculated from MRP worksheet, planned order receipt data will automatically sent to sourcing calculation worksheet.

Example 1.26
Net Requirements and Planned Orders for Low Level code 2

					7/12	7/13	7/14	7/15	7/16
SUSPENSION UP				Planned Order Receipts	6.83	6.00	3.00	7.00	7.00
					4.90 = 7.00 x 70%				
	4	70%	NHK Japan	Planned Order Released	4.90	4.90	4.90	4.90	4.90
	4	30%	SCC	Planned Order Released	2.10	2.10	2.10	2.10	2.10
					2.10 = 7.00 x 30%				

From example 1.26, Planned Order Released is scheduled by offsetting the supplier lead time and Planned Order Released quantity is calculated by applying sourcing percentage.

Planned Order Receipts for Carriage on 7/16 = 7.00Kunits

Planned Order Released for NHK Japan on 7/12 = 7.00Kunits x 70% = 4.90Kunits; Supplier Lead time = 4 days and sourcing percentage for NHK Japan is 70%

Planned Order Released for SCC on 7/12 = 7.00Kunits x 30% = 2.10Kunits; Supplier Lead time = 4 days and sourcing percentage for SCC is 30%

11. PR Summary

After MRP calculation and Supplier sourcing process are completed, the planned order released categorized by date, part number, and supplier name will be automatically pull to PR Summary worksheet. By click at the Print PR Summary, the report will automatically print out.

Example 1.27
PR Summary Report

PR SUMMARY REPORT

		WASHER	SPACER		CARRIAGE		SCREW
		Minibea	NHK	Soode	LTEC	Totoku	Katayama
	7/12	0.00	0.00	0.00	0.00	1.37	0.00
	7/13	4.57	2.29	2.29	0.00	1.43	9.52
	7/14	0.00	0.00	0.00	3.20	1.43	0.00
	7/15	9.52	4.76	4.76	3.33	1.43	9.52
	7/16	0.00	0.00	0.00	3.33	1.43	0.00
	7/18	9.52	4.76	4.76	3.33	1.43	9.52
	7/19	0.00	0.00	0.00	3.33	1.43	0.00
	7/20	9.52	4.76	4.76	3.33	1.43	9.52
	7/21	0.00	0.00	0.00	3.33	1.43	0.00
	7/22	9.52	4.76	4.76	3.33	1.43	9.52
	7/23	0.00	0.00	0.00	3.33	1.43	0.00
	7/25	9.52	4.76	4.76	3.33	1.43	9.52
	7/26	0.00	0.00	0.00	3.33	1.43	0.00
	7/27	9.52	4.76	4.76	3.33	1.43	9.52
	7/28	0.00	0.00	0.00	3.33	1.43	0.00
	7/29	9.52	4.76	4.76	3.33	1.43	9.52
	7/30	0.00	0.00	0.00	3.33	1.43	0.00
	8/1	9.52	4.76	4.76	3.33	1.43	17.99
	8/2	0.00	0.00	0.00	3.33	3.97	0.00
	8/3	17.99	8.99	8.99	3.33	3.97	13.23
	8/4	0.00	0.00	0.00	9.26	3.97	13.23
	8/5	26.46	13.23	13.23	9.26	3.97	13.23
week	32	39.68	19.84	19.84	37.04	7.94	26.46
	33	79.37	39.68	39.68	55.56	23.81	79.37
	34	33.51	16.75	16.75	25.56	10.95	36.51
	35	79.37	39.68	39.68	55.56	23.81	79.37
	36	79.37	39.68	39.68	55.56	23.81	79.37
	37	79.37	39.68	39.68	55.56	23.81	79.37
	38	79.37	39.68	39.68	55.56	23.81	79.37
	39	79.37	39.68	39.68	55.56	23.81	79.37
month	10	357.14	178.57	178.57	250.00	107.14	357.14
	11	357.14	178.57	178.57	250.00	107.14	357.14
	12	284.29	142.14	142.14	199.00	85.29	284.29
	1	357.14	178.57	178.57	250.00	107.14	357.14
	2	357.14	178.57	178.57	250.00	107.14	357.14
	3	357.14	178.57	178.57	250.00	107.14	357.14
	4	357.14	178.57	178.57	250.00	107.14	357.14
	5	357.14	178.57	178.57	250.00	107.14	357.14
	6	357.14	178.57	178.57	250.00	107.14	357.14
	Total	3816.02	1908.01	1908.01	2673.31	1145.70	3814.44

From Example 1.27, the purpose for weekly and monthly PR is only for the planning point of view not for the purchasing purpose.

12. Work Order Summary

After the work order released of low level 1 calculation is completed, the work order released categorized by date and part name will be automatically pull to work order Summary worksheet. By click at the Print Work order Summary, the report will automatically print out.

Example 1.28
Work Order Summary Report

BUILD SUMMARY REPORT

		HGA UP	HGA DOWN
	7/12	0.00	0.00
	7/13	4.57	4.57
	7/14	4.76	4.76
	7/15	4.76	4.76
	7/16	4.76	4.76
	7/18	4.76	4.76
	7/19	4.76	4.76
	7/20	4.76	4.76
	7/21	4.76	4.76
	7/22	4.76	4.76
	7/23	4.76	4.76
	7/25	4.76	4.76
	7/26	4.76	4.76
	7/27	4.76	4.76
	7/28	4.76	4.76
	7/29	4.76	4.76
	7/30	4.76	4.76
	8/1	4.76	4.76
	8/2	4.76	4.76
	8/3	7.58	7.58
	8/4	11.02	11.02
	8/5	11.02	11.02
week	32	44.09	44.09
	33	66.75	66.75
	34	36.51	36.51
	35	66.75	66.75
	36	66.75	66.75
	37	66.75	66.75
	38	64.97	64.97
	39	64.97	64.97
month	10	174.47	174.47
	11	182.05	182.05
	12	219.98	219.98
	1	157.09	157.09
	2	157.09	157.09
	3	157.09	157.09
	4	157.09	157.09
	5	157.09	157.09
	6	157.09	157.09
	Total	**2111.75**	**2111.75**

5.4 Lot Sizing and Scrap Allowance Construction

5.3.1 Lot Sizing

From chapter four, the proposed lot sizing technique for all parts had been identified. For some parts that will be used Lot for Lot technique, there is no need to calculate the specific lot size. However, for some parts that will be used the Period Order quantity, lot size is required to be calculated according to the formula.

$$POQ = \frac{P}{A/EOQ} = \frac{P \times EOQ}{A}$$

$$POQ = \frac{P \times \sqrt{2AS/Ci}}{A}$$

P = Planning Period

A = Annual Usage; generally determined as twelve times monthly usage

S = Cost per Order; consists of ordering cost and setup cost

C = Cost of Item; typically the standard cost

I = Annual Cost to Carry

For case studied company, the parameter was assigned as follow

P = 52 weeks

A = 102,273 units

S = 50 dollars

C = 0.01 dollars

I = 100 dollars

$$POQ = \frac{52 \times \sqrt{((2 \times 102273 \times 50)/ (0.01 \times 100))}}{102273}$$

$$POQ = 1.62 \approx 2$$

POQ is equal to two, meaning that case studied company always order two whole weeks of demand at the time.

Week Number	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9
Demand In units	100	0	175	50	0	125	75	300	0
Cumulative Demand	100	0	275	325	325	450	525	825	825
Inventory Beginning on hand	25	0	0	50	0	0	75	0	0
Qty received during week									
Inv. On hand end of week	0	0	50	0	0	75	0	0	0

Table 5.4.1 Example of POQ

225 = 175 + 50

200 = 125 + 75

The POQ order will cover two whole weeks of demand as shown in Table 5.3.1. There is no demand in week number five. Therefore, week number five will be ignored according to the concept of POQ. Week number five will be considered as a week without demand. From Chapter four, there are four parts that were decided to use POQ as an order review methodology. Moreover after considering the price and other parameters for POQ calculation, it can be found that they are the same. As a consequent, all part will be exploited the same POQ number.

Part Item	Supplier
Washer	NHK Japan
Spacer	NHK, Soode
Screw M1	Katayama Singapore
HSA Screw	Katayama Singapore

Table 5.4.1.1 POQ Number for HSA Part

5.4.2 Scrap Allowance

Instead of identify safety stock quantity for each item, forecast scrap ratio with safety factor had been decided to be used as a parameter to create scrap allowance. The methodology to create scrap allowance was illustrated in chapter four.

Actual Scrap Ratio from June 2004 - May 2005

	June	July	August	September	October	November	December	January	February	March	April	May	Forecast
WASHER	0.3	0.2	0.2	0.3	0.2	0.1	0.2	0.2	0.2	0.4	0.15	0.15	0.3
SPACER	0.03	0.035	0.03	0.03	0.025	0.035	0.025	0.025	0.03	0.03	0.025	0.04	0.03
CARRIAGE	0.025	0.035	0.03	0.03	0.03	0.037	0.04	0.07	0.03	0.022	0.055	0.05	0.03
SCREW	0.2	0.22	0.32	0.5	0.5	0.4	0.26	0.3	0.3	0.25	0.25	0.35	0.2
HSA SCREW	0.2	0.22	0.32	0.5	0.5	0.4	0.26	0.3	0.3	0.25	0.25	0.35	0.2
FLEX CABLE	0.03	0.03	0.035	0.028	0.04	0.052	0.035	0.04	0.03	0.058	0.062	0.058	0.03
HGA UP	0.045	0.06	0.06	0.062	0.061	0.072	0.055	0.05	0.047	0.065	0.055	0.069	0.05
HGA DOWN	0.042	0.062	0.075	0.077	0.06	0.05	0.055	0.06	0.062	0.05	0.057	0.072	0.05
DAMPER	0.05	0.05	0.055	0.05	0.055	0.056	0.05	0.05	0.055	0.045	0.05	0.05	0.05
SUSPENSION UP	0.067	0.062	0.077	0.073	0.068	0.055	0.056	0.057	0.05	0.055	0.058	0.054	0.05
SUSPENSION DOWN	0.071	0.082	0.055	0.058	0.062	0.06	0.055	0.076	0.067	0.055	0.057	0.06	0.05
SLIDER UP	0.05	0.05	0.06	0.065	0.06	0.062	0.07	0.071	0.066	0.068	0.069	0.05	0.05
SLIDER DOWN	0.05	0.065	0.066	0.056	0.057	0.06	0.058	0.066	0.072	0.08	0.078	0.081	0.05

Table 5.4.2 Actual Scrap Ratio from June 2004 – May 2005

The data of actual and forecast scrap ratio was provided by Engineering department. The decided service level is 99%. After finish calculating the scrap allowance, the result is in Table 5.4.2.1.

	Scrap Allowance
WASHER	0.31642
SPACER	0.04087
CARRIAGE	0.03031
SCREW	0.23509
HSA SCREW	0.23028
FLEX CABLE	0.03035
HGA UP	0.05017
HGA DOWN	0.05026
DAMPER	0.05001
SUSPENSION UP	0.05024
SUSPENSION DOWN	0.05031
SLIDER UP	0.05025
SLIDER DOWN	0.05044

Table 5.4.2.1 Scrap Allowance