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DEPARTEMENT BEDRYFS- EN SISTEEMINGENIEURSWESE
DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING

COVER PAGE FOR FINAL PROJECT DOCUMENT (BPJ 420) - 2012	
Information with regards to the mini-dissertation	
Title (e.g. A Contingency framework for the after-sales inventory at Xxxxx Part Distribution Centre)	Design of a inventory control/Production Planning and Scheduling System computer based at Apex Vales SA
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Date (year/month/day) e.g. (2012/10/08)	2012/10/17
Keywords (Provide keywords from your project (for searching purposes). The first word of two words must always have a capital first letter and the rest of the words following must be lower case. In the event of an abbreviation, use as it is known. E.g. Economic recession, ABSA, ERP, Simulation modelling)	Inventory Control, MRP(material requirements planning), EOQ(economic-order quantity), JIT(just-in-time)
Abstract (Provide an abstract of the mini-dissertation. An abstract is a short summary of the contents covered in the item.)	This projects handles about the use of different methodologies of implementing a design of an inventory control/production planning and scheduling system computer based
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Design of a inventory control/Production Planning and Scheduling System computer based at Apex Vales SA

By

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Submitted in partial fulfilment for the requirements for
the degree of

BACHELORS OF INDUSTRIAL ENGINEERING

in the

FACILTY OF ENGINEERING, BUILT AND ENVIRONMENT AND INFORMATION TECHNOLOGY

UNIVERSITY OF
PRETORIA

OCTOBER 2012

Executive Summary

The purpose of this document is to do a literature review on the production planning approaches, to inspect the best possible approach and choose an optimal approach then look for methodologies to formulate and design such a system using the literature at Apex Valves SA pty (Ltd). Then to formulate a plan for how the design are going to take place for the MRP system and to finally create such a system using the literature that was reviewed in this document. Implementing the design on paper is a must before actually implementing it computer based which will result in the final design. A conclusion is given on this document after the final design is made on what the end result is and whether or not it solves the Problem statement at Apex Valves SA. Data that was gathered from Apex Valves SA pty (Ltd) is given in appendix A and B.

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1. Chapter 1: Introduction and background

1.1.1 Company history

In 1996 Mr. Burt du Rand was involved at BESA (Brass Extruder South-Africa), a company that manufactured brass mostly in string press. Cobra Watertech which is also known as one of the biggest string press buyers and manufacturer companies in South-Africa also did some business with BESA. Apex Valves NZ was a large valves manufacturing company and in 1996 BESA started to trade string press brass to Apex Valves NZ. This is when Apex Valves NZ saw an opportunity to trade their own products with to South-Africa or even start a branch in South-Africa but Cobra watertech saw it as a big conflict. In July 1997 Mr Burt Du Rand saw this conflict and thought of the idea to start his own company Apex Valves South-Africa working in his garage at home with his brother Mr Deon Du Rand. Later Mr Du Rand and his brother bought shares in Apex Valves NZ and until today they use their technology and pay licenses. That is how the company Apex Valves South-Africa Started by the two Du Rand Brothers.

1.1.2 Company Background

Apex Valves South-Africa(Pty) Ltd is a leading manufacturing and supplying company in South-Africa that process, manufactures and supplies a complete range of pressure control valves for domestic hot water installations (geysers) (See Figure for valve types). Apex Valves South-Africa's main suppliers are Exipro (In swaziland), Apex Valves NZ, Cobra Watertech (which is the only company where to-and-from distributions takes place), Belmatech, Carlinmed and Spring Manufacturing. Apex Valves South-Africa do their receiving and distribution from a small-to-medium factory in Pretoria, Littleton. Some of the component ordered from Apex Valves NZ is fully manufactured but the most of the components they order is only in smaller components such as plastics, brass, caps, et. This is processed to the full Valve at Apex Valves South-Africa and then distributed. The inventory room of Apex valves South-Africa is where all the receiving, packaging and distribution take place. A truck delivers the product orders in boxes and is packed in the inventory room for counting. After it is counted it is send to the assembly line where it is processed and stored until the order is given for distribution then it is packed completed in the inventory room ones again to be dispatched.

Starting from his own garage Mr. Burt Du Rand did not have the engineering knowledge but his company has grown in which it is today. This project will focus on the inventory room of Apex Valves and the Production planning of the material management system (See figure 1.1 for a detailed flow of a material management system in a manufacturing facility) . Also see Figure 1.2, 1.3, 1.4 and 1.5 for a few different types of valves Apex Valves manufacture.

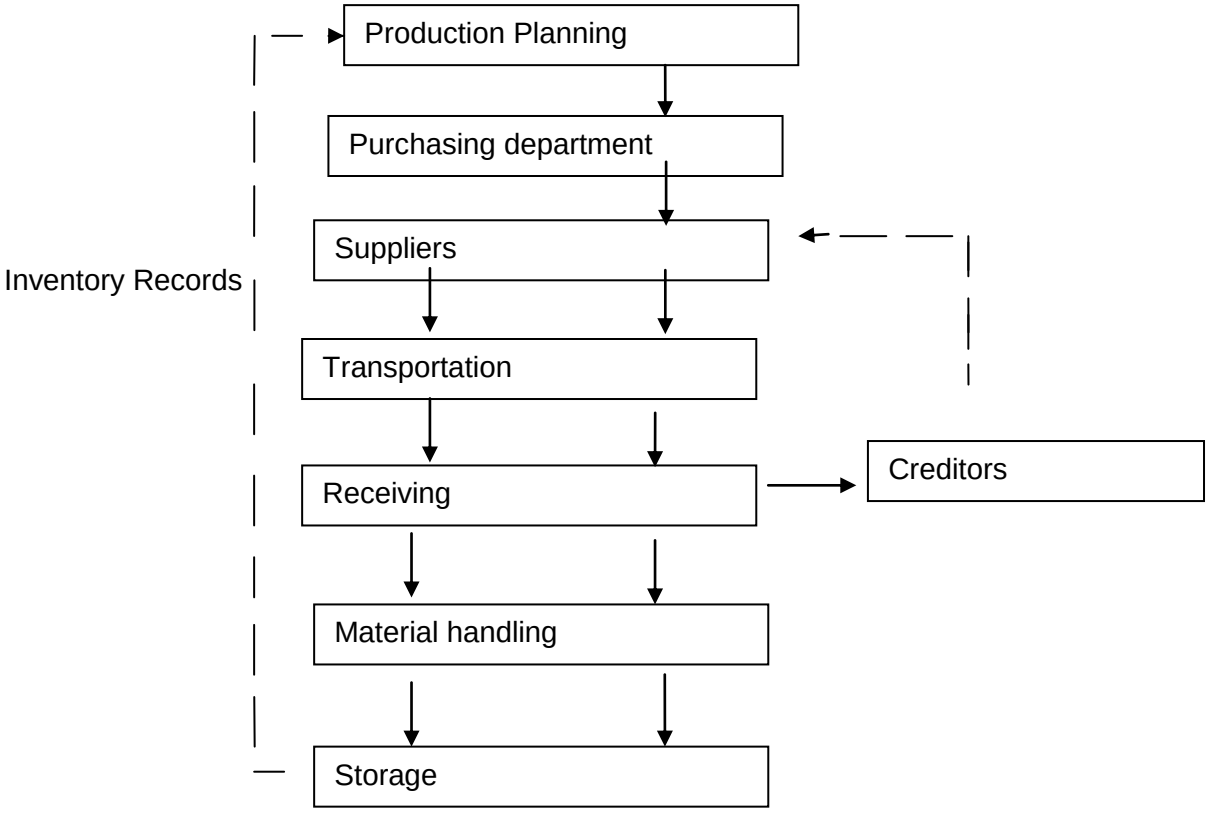


Figure 1.1 : Materials management system diagram. The flow of materials into the manufacturing facility

Figure 1.2 : Combi valve

Figure 1.3 : Pressure control valve

Figure 1.4 : Filter Stop

Figure 1.5 : Shutoff valve

1.2 Problem statement

The company was originally started in a garage and until this time material orders were only given on feeling and predictions of future quantities and varieties of materials. A Supplying company of a manufactured product needs production planning and a scheduling approach/system for efficient distribution of their products. The problems in the facility are:

- Apex Valves does not have such a system which is engineering formulated to calculate the exact future quantities and varieties of materials needed from orders from suppliers for the distribution of their products and to finally improve inventory control.

This problem has been noted in the facility and if something happens and Mr Burt Du Rand is not there anymore the company can suffer great consequences because no one else has this information.

1.3 Project Aim

The aim of this project is:

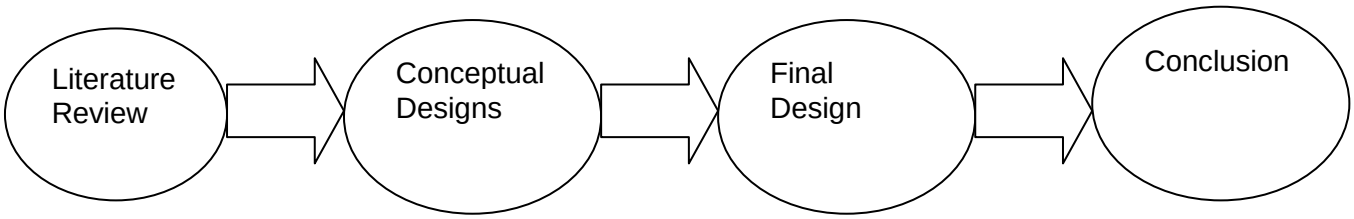
- To formulate a Production planning and scheduling approach/system (MRP) for the order quantities, varieties of materials in receiving and distribution into and from the inventory room.

1.4 Project Scope

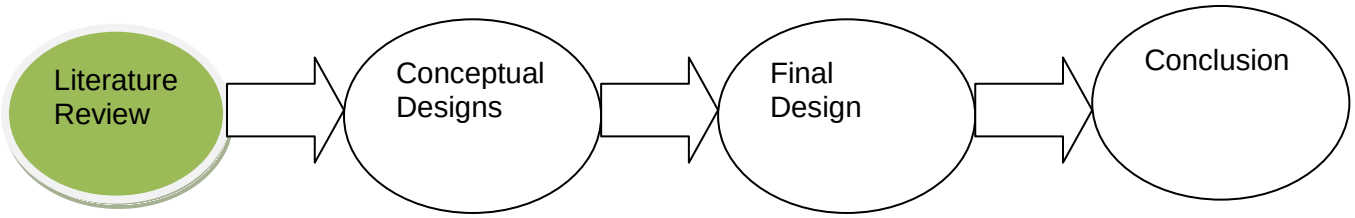
The scope of the project will comprise four predominant phases. A Research phase, a Design phase, a Documentation phase and a closeout phase.
Constant reviewing will ensure that the project is on track with the allocated tasks. The implementation of this project is not included in the scope and will be the responsibility of Apex Valves South-Africa. The final implementation relies on the financial viability and will be up to Apex Valves if they would want the facility design changed and use the certain system that is formulated. In doing research a literature review will be done. This entails studying and assessing the current methodology of the Production system at Apex Valves of the inventory room in the facility. A methodology for production planning and scheduling approaches/systems (MRP systems) will be researched and in the best applicable way for the company it will be documented. Finally a conceptual design will be documented and the final design will be developed and discussed with the conclusion on whether or not it satisfied the Problem statement. Limited factors to be considered are time, compatibility of the system to the company and flexibility within the facility.

1.5 Document Structure

In chapter 2 a literature is studied to create an overview of the understanding of the Production Planning and scheduling approach (MRP)(2.1) that can be used to be able to get a solution for the problem statement.



2. Chapter 2 : Literature Review



2.1.1 Overview of Inventory Control

Inventory is the stock of items used in an organization. An Inventory system is a set of controls that inspects the levels of inventory and decides on the levels that should be maintained, when stock should be replenished, and size of orders. Manufacturing inventory is typically classified into raw materials, finished products, component parts, supplies and work-in-process. Inventory analysis states exactly

- **WHEN** the items must be ordered and
- **HOW LARGE** orders should be

COSTS of inventory

In inventory control all calculations has to do with the following costs;

- **Holding costs**: This may be costs for storage facilities, handling, insurance, depreciation, taxes, and cost of capital. High holding cost will result in lower inventory levels in the inventory room.
- **Setup costs:** To make products a cost is involved like use of certain materials, setting up certain equipment, signing papers, this is the setup cost. The objective will be to lower setup cost to increase profit.
- **Ordering costs:** This is the cost where the managerial management comes in and the calls made, calculating order quantities, counting inventory all seen as ordering cost to get the product from the supplier.

Independent vs Dependant demand

The difference in demand is either the demand depends on another or on itself. Briefly, the difference between the two is this:

- In independent demand, the demand in not related to each other or dependent on another item.
- In dependant demand, the demand is related to another item and needs the other item demand or dependent on another.

Inventory systems

An inventory system is an organizational structure to maintain and control goods to be stocked. The system is responsible for ordering and receipt of goods; timing the order placement and keeping track of what has been ordered, how much and from whom.

2.1.2 Overview of Fixed-order quantity Models (also known as economic order quantity, EOQ)

EOQ models are designed to make sure items are available on an ongoing basis throughout the year. The item may be ordered anytime in the year where the system gives the actual quantity and timing of order .EOQ models are seen as “event triggered”. This means that when the model detects an event of a reorder level then the model makes the order. Depending on the demand of the item, it may take place at anytime.

Using the EOQ-Model (which places an order when the remaining inventory drops to a predetermined order point, R) on-hand inventory must be viewed more often. Thus, the model is a system which requires that every time changes are made from inventory,additions or withdrawals, records must be updated to reflect whether the reorder point has been reached.

Figure 2.1 shows what occurs when a EOQ model is put into use and becomes an operating system.

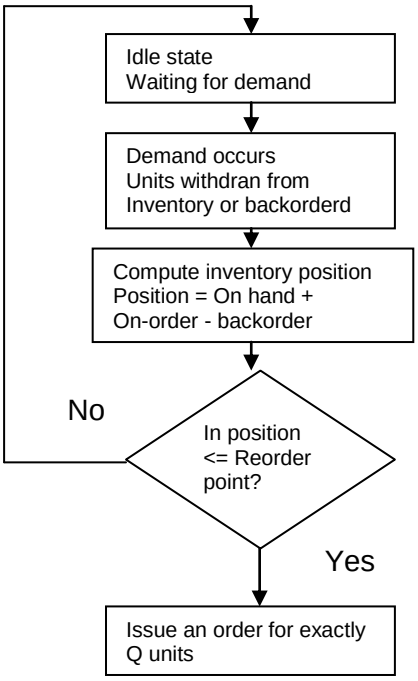


Figure 2.1: Q-Model, Fixed order quantity system

EOQ models determines the point(R) where an order will be placed as well as the size of the order(Q). The order point(R) is always in number of units. An order of size is placed when point R reaches inventory available. Inventory position is defined as the on-hand plus on-order minus backordered quantities. A solution to a EOQ model may stipulate something like this : When the inventory position drops to 30, place an order for 63 more units.
Figure 2.2 are based on the following characteristics of the model. These assumptions are unrealistic, but they represent a starting point and allow us to use a simple example.

- Demand for product is constant and uniform through time period
- Lead times (Time for ordering) are constant.
- Price per unit of product is constant
- Inventory holding cost is based on average inventory
- Ordering or setup costs are constant
- All demand for the product will be satisfied(No backorders are allowed)

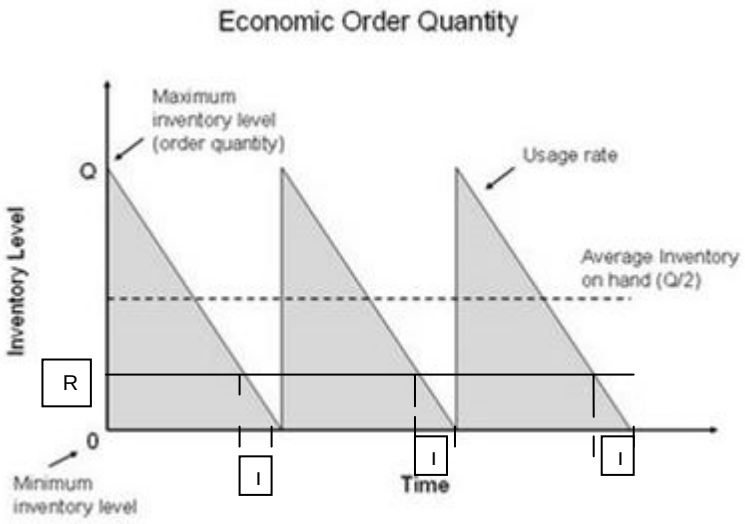


Figure 2.2 : Basic Fixed-order quantity model

The “sawtooth effect”,a reorder is placed when the inventory drops to point R relating to Q and R in figure 2.2. This order is received at the end of time period L, which does not change in this model.

2.1.3 Overview of Material Requirements Planning (MRP)

MRP (Material Requirements Planning)

Material requirements planning (MRP) is logical, easy to understand and a good approach to the problem of determining the number of parts, components, and material needed to produce end items. MRP also provides the schedule specifying when each of these materials, parts, and components should be ordered or produced.

MRP is based on dependant demand because of the dependents on other items .For example if part A takes 10 parts of B to make, the 5 parts of A require 30 parts of B.

MRP systems three interfaces to determine when and what items must be ordered :

- the master production schedule
- bill of materials
- Inventory records

Master production Schedule

Generally, the master production schedule deals with the final items and is a input to the MRP system. The Master Production Schedule includes quantities of products to be produced at a given time period. Quantities are included both at aggregate and detailed levels. Aggregate may refer to monthly production and detailed may refer to weekly or daily production. The master production schedule takes the form of a table in which rows represent products and columns represent time components

In figure 2.3 the upper portion shows an aggregate plan for the total number of chairs forecasted per month, without regard the type of the chair. The lower portion shows a master production schedule specifying the exact type of chair and the quantity forecasted for production by week. The next level down (not shown) will be the MRP program that develops detailed schedules showing when paint, seat covers and hardwood are needed to make chairs for example.

Master Production Schedule for Chairs Models

Month	1	2
Chairs Production	900	950

	1	2	3	4	5	6	7	8
Model 327	200			400		200	100	
Model 538		100	100		150		100	
Model 749			100			200		200

Figure 2.3 : Aggregate Production Plan for chairs

Where MRP can be used

MRP is most valuable in industries where a number of products are made in bathes using the same productive equipment.

Material requirements planning system structure

The MRP manufacturing activities interacts with the master schedule, bill of materials file, inventory records file, and the output reports.

The MRP systems work as follows: The master production schedule states the number of items to be produced during specific time periods. A Bill of materials file states the specific materials used to make each item and the quantities of each. The inventory records file contains data such as the number of units on hand and on order. These three sources become the data sources for material requirements planning, which expands the production schedule into a detailed order scheduling plan for the entire production sequence.

Demand for products

The product demand comes from two sources:

- Specific orders from customers.
- Forecast demand.

Bill of materials

The bill of materials (BOM) file contains the complete product description, listing not only the materials, parts, and components but also the sequence in which the product is created. As mentioned before the BOM file is one of the three main inputs to the MRP program. The BOM file is often called the product tree because it shows how a product is put together. It contains the information to identify each item and the quantity used per unit of the item of which it is a part.

Figure 2.4 illustrates an example of this: Product A is made of 4 units of part B and 5 units of part C. Part B is made of 1 unit of part D and 3 units of part E. Part C is made of 3 units of part F.

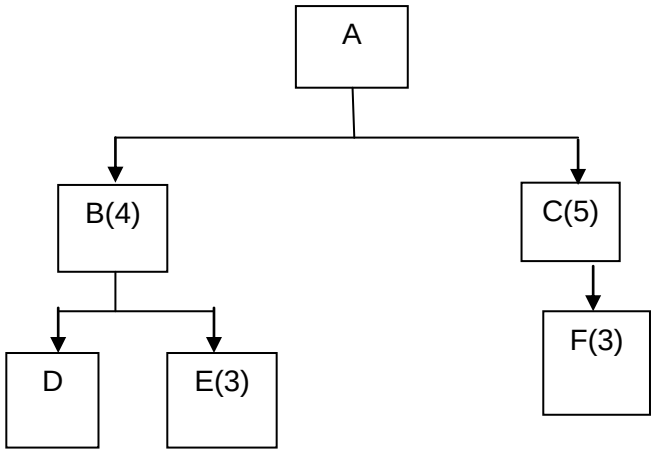


Figure 2.4 : Bill of Materials(Product structure tree)

Inventory records

The inventory records file can be lengthy because of the number of parts. Figure 2.5 shows the information that the inventory records contain.

	Allocated	Control balance	Period							TOTALS
			1	2	3	4	5	6	7	8	
INVENTORY STATUS SEGMENT	Gross requirements										
	Scheduled receipt										
	Projected available balance										
	Planned order releases										

Figure 2.5 : Part of the inventory Record for an Item in Inventory-

Performing the MRP calculations

MRP calculations are being done level by level, using the inventory data and the data from the master production schedule.

Figure 2.5 shows the order from the to of the calculations:

- Gross requirements are the total amount required for a certain item. These requirements can be from external customer demand and also from demand calculated due to manufacturing requirements.
- Schedule receipt represents orders that have already been released.

- Projected available balance is the total inventory that is expected as of the end of a period. This can be calculated as follows:

Projected available balance = Previous time projected available balance- gross requirements + scheduled receipt+Planned order receipt-safety stock.

- A Net requirement is the amount needed when the projected available balance + the scheduled receipt in a period does not cover the gross requirement.
- The Planned order receipt is the amount of an order that is required to meet a net requirement in the period.
- The Planned order release is the planned order receipt offset by the lead time.

Lot sizing in MRP systems

The determination of lot sizes in an MRP system is a complicated and difficult problem. Lot sizes are the part quantities issued in the planned order receipt and the planned order release sections of an MRP schedule. For parts that are purchased, these are the quantities ordered from the supplier. Lot sized generally meet part requirements for one or more periods.

Next is an explanation of four lot-sizing techniques. The lot-sizing techniques are:

- Lot-for-Lot(L4L)
- Economic order quantity(EOQ)
- Least total cost(LTC)
- Least unit cost(LUC)

Lot-for-Lot

Lot-for-Lot is the most common technique. It

- Sets planned orders to exactly match the net requirements.
- Produces exactly what is needed each week with none carried over into future periods.
- Minimizes carrying cost.
- Does not take into account setup costs or capacity limitations

Economic order quantity

Previously in the literature study (2.1.2) the EOQ model is reviewed. In an EOQ model, either constant demand must exist or safety stock must be kept to provide for demand variability. The EOQ model uses an estimate of total annual demand, the setup or order cost, and the annual holding cost. EOQ was not designed for a system with discrete time periods such as MRP. The lot-sizing techniques used for MRP assume that part requirements are satisfied at the start of the period. Holding costs are then charged only to the ending inventory for the period, not to the average inventory as in the case of the EOQ model. EOQ assumes that parts are used continuously during the period. The lot-sizes generated by EOQ do not always cover the entire number of periods.

Least Total Cost

This method is dynamic and calculates quantities of orders by setup cost and carry cost for various lot sizes and then the one closest to equal is selected.

Least unit cost

This method is also dynamic and adds the ordering and inventory carrying cost for each lot size and then divides it by each lot size's number of units, picking the lot size with the lowest unit cost.

2.4 Overview of Just-in-Time (JIT)

JIT is a 'pull' system of production, so a signal is provided from actual orders for when a product should be manufactured. Demand-pull enables a firm to produce only what is required, in the correct quantity and at the correct time.

This means that stock levels of raw materials, components, work in progress and finished goods can be kept to a minimum. This requires a carefully planned scheduling and flow of resources through the production process. Modern manufacturing firms use sophisticated production scheduling software to plan production for each period of time, which includes ordering the correct stock. Information is exchanged with suppliers and customers through EDI (Electronic Data Interchange) to help ensure that every detail is correct.

Supplies are delivered right to the production line only when they are needed.

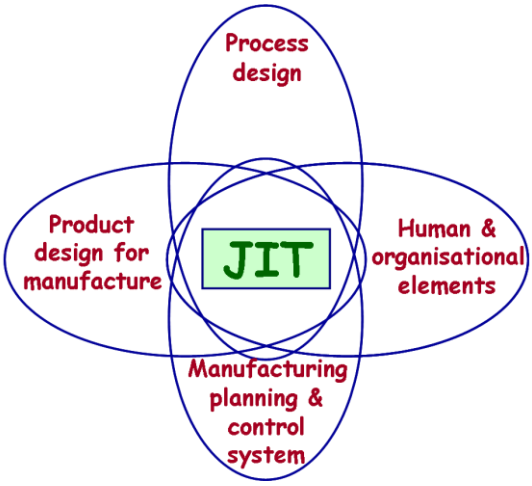


Figure 2.7: JIT process overlap

Advantages of JIT

- Lower stock holding means a reduction in storage space which saves rent and insurance costs
- As stock is only obtained when it is needed, less working capital is tied up in stock
- There is less likelihood of stock perishing, becoming obsolete or out of date
- Avoids the build-up of unsold finished product that can occur with sudden changes in demand

Disadvantages of JIT

- There is little room for mistakes as minimal stock is kept for re-working faulty product
- Production is very reliant on suppliers and if stock is not delivered on time, the whole production schedule can be delayed
- There is no spare finished product available to meet unexpected orders, because all product is made to meet actual orders – however, JIT is a very responsive method of production

2.5 Approaching the Problem

Comparing JIT and MRP

MRP system encourages protecting each part of the operation from disruption being more proactive. The JIT approach takes the opposite view. JIT allows the problems in the production process to be more evident and exposed so that the problems can be closely scrutinized. This is a reactive approach to the problems at the production line which is not always healthy.

For the implementation of this project to take place a decision must be made on which type of production system is going to be implemented. The decision is Materials Requirements Planning.

The different components of an MRP system are presented in the diagram below. A Company using this diagram as presented is seen as using a classical approach of MRP concentrating on the management of inventories – which suits Apex Valves SA;s problem perfectly.

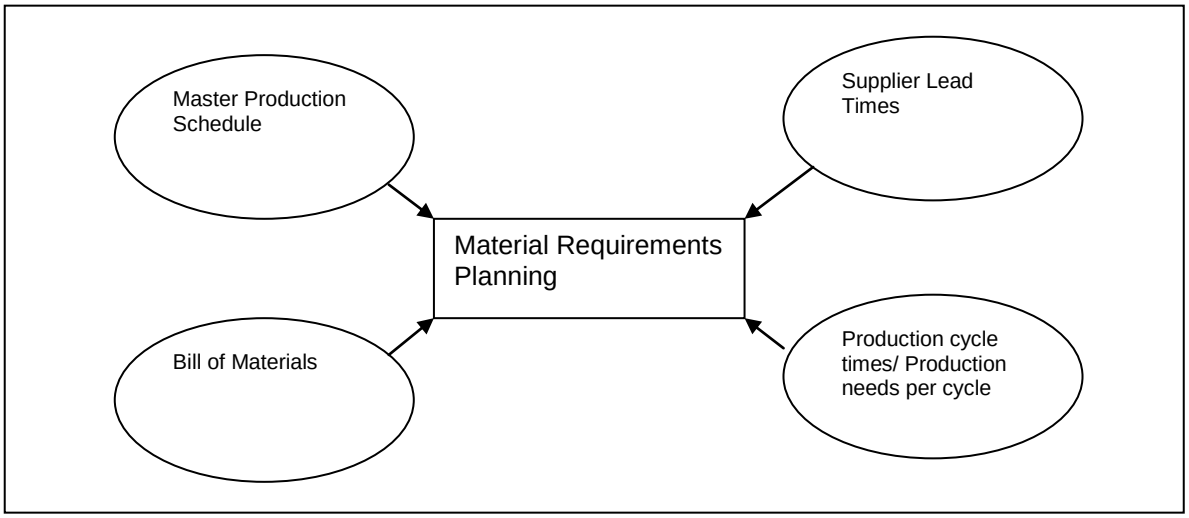


Figure 2.7: MRP in context with production management processes

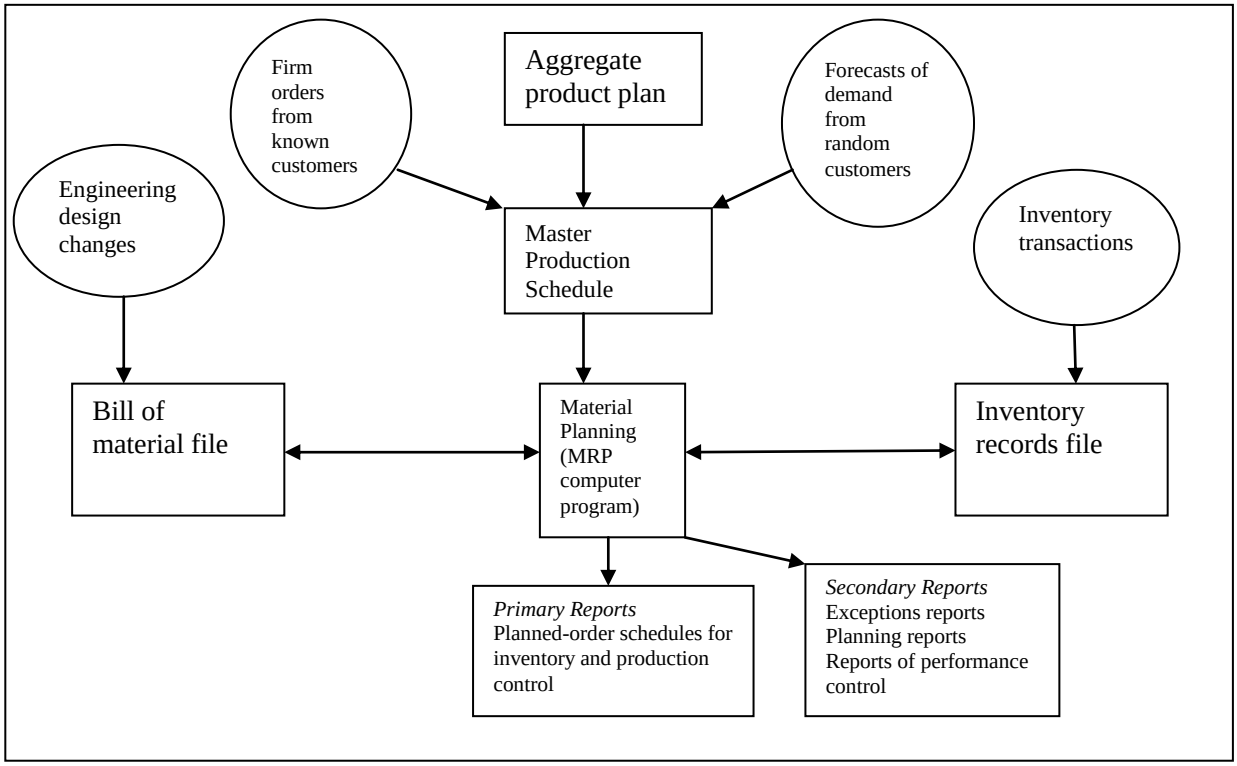


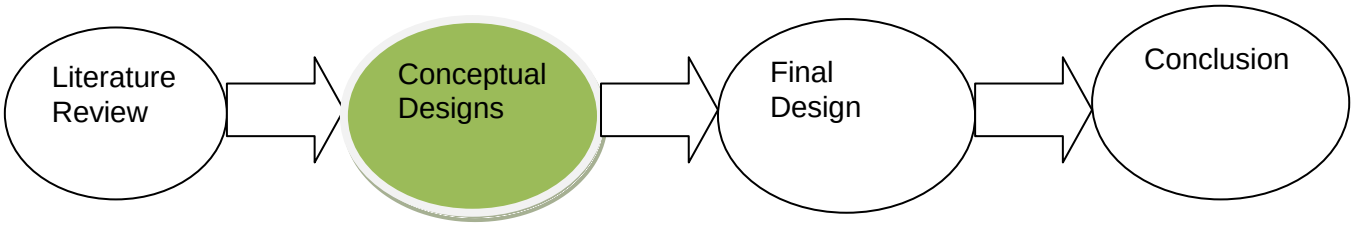
Figure 2.8: Overall view of inputs to a standard MRP system and reports as output

2.6 Project-specific methodologies

Activity
Assessment of present situation
Production Scheduling
BOM design
Design of MRP Processes and system
Design of MRP interfaces
Test and evaluation

Table 2.1 A Process model for implementing an MRP system

3. Chapter 3 : Conceptual design



3.1 Current Production Planning Approach/System

According to the business manager there is no current production planning system at Apex Valves SA (Pty) Ltd and all of the orders is done by forecasting how many of each part they think they might need and how many products they think they are going to be distributing. So everything is done by “gut” feeling which is a problem and is not how a business should be operating.

With experience in the industry Mr Burt has an idea of how many parts he will need before the orders from the distributers come in and if something may happen to him, the business will suffer severe consequences.

3.2 Designing of the MRP system

As seen in the literature study a certain methodology will be used (Refer to p20 – a process model for implementing an MRP system. The first part of the process was already looked at above. Before conceptually designing the second part of the process a few things should be looked at that is needed for the input and also transformation of the system. List of products, lot-sizing and lead times:

3.2.1 List of products

This is a list of products which a budget (Forecast on sales in a year's time is made and this list of products will be used in the project when implementing the MRP system.

List of products			
PRV Valves	Discription	Ander	Discription
LVEV400;22CxC	Pressure Control Valve; 22CXC; 400kPa	Geyser packs	TP Valve & Drain Cock Pack
LVEV400;15CxC	Pressure Control Valve; 15CXC; 400kPa	GEYSERP-600kPa	Geyer Pack; Safety Valve & Drain 600kPa
LVEV400;3/4"	Pressure Control Valve;3/4BSP 400kPa	TP Valve	Temp. & Press. Relief Valve; 400kpa ,600kPa
LVEV400P;22CxC	Press. Contr. Val. with 2 x VRV15CXC	Drain cock	Drain Cock with Thermocouple Pocket; 22
LVEV400P;15CxC	Press. Contr. Val. with 2 x VRV22CXC	Drain cock 15CxC	Drain Cock + Thermo Pocket; 15CxC
LVEV400P; 3/4"	Pres. Cont. Val. with 2 x VRV3/4 BSP	Solar TP Std	Solar Safety Valve; Std. Probe
MB-400;22CxC	MB-400; 22CXC PCV Set Loose	Solar TP L/P	TP-400; Long Probe; Pressure Relief Valv
MB-400;15CxC	Press. Contr. Val. with Shutoff + 2x VRV	Solar Draincock	Draincock Solar; 15CXC, 22CXC Port
LVEV-600; 22CXC	Pressure Control Valve;22CXC;600kPa	DC-½-¾FM Drain cock	Drain Cock ½ to ¾ FM
VRV		DC-THER;22CxC	Drain Cock + Thermo Pocket; 22CxC
VRV;22CxC	Vacuum Control Valve; 22CXC	TV-22 hp	Tempering Valve 22CXC; High Pressure
VRV;15CxC	Vacuum Control Valve; 15CXC	TV-15	Tempering Valve -15CXC; Excl. Non-Return
VRV;1/2"	Vacuum Control Valve; 1/2;BSP	TV Divert 22	Tempering Valve Diverter; 22CxC
VRV3/4"	Vacuum Control Valve; 3/4;BSP	TV Divert 15	Tempering Valve Diverter; 15CxC
		Isotec	Isotec Temperature Relief Valve; 400 kPa

Table 3.1: List of Products being sold at APEX Valves SA

3.2.2 Lot-Sizing

Lot sizing is important seen in the literature study that was done. A decision was made to use Lot-for-Lot because the planned orders must match the net requirements exactly in this situation. Also producing the needed amount each week is essential because it minimizes the cost of carrying goods. The Lot-sizing is important to know because it determines the change over from the planned order receipt to the planned order release in the inventory records which will be seen later on when designing the interfaces. This may change later in the project as the implementation takes place because of certain changes or realization of certain amounts et.

3.2.3 Lead Times

All the suppliers lead times was gathered and needs to be taken into account when constructing the final outputs of the MRP system:

SUpplier	Lead time
APEXNZ - Apex Valves Limited	4 weeks
AWC - African Water Controls CC	3 days
BELA - Belmatech CC	1 week
CARL - Carlin Medical Extrutions	1 week
COBRA - Cobra Watertech (Pty) Ltd	4 weeks
ELCO - Elco Marketing	3 days
EXI - EXIPRO SWAZILAND	3 weeks
MEDIAH - Centurion Hydraulics	1 day
SPRMAN - Spring Manufacturers of SA CC	2 weeks
SPRTEC - Springtech Spring Design and Manufacture	2 weeks
WRBOX - West Rand Box (Pty) Ltd.	2 weeks

Table 3.2: Data gathered - Suppler lead time

To link each item to a certain lead time each item must be linked to a certain supplier. The data was gathered of which items are being purchased from which supplier (SEE APPENDIX A)

This information is necessary to make the link later on in the Inventory records to move the amount of lead time earlier in the planned order release so the systems knows exactly to order a certain product earlier based on its lead time.

From here on the Process model mentioned in the literature review will be followed from the second step:

3.2.4 Production Scheduling

Apex Valves SA already has forecasting of the quantities of products being sold a few months in advance. Data was gathered for a full year in advance BUT may change every month by looking at the previous month's sales but according to the business manager these figures do not change by much:

By using these data the master production schedule can be designed and linked to the different items.

Budget													
	Jul-12	Aug-12	Sep-12	Okt-12	Nov-12	Des-12	Jan-13	Feb-13	Maart-13	April-13	Mei-13	Junie-13	TOTAAL
PRV Valves													
LVEV400;22CxC	1 899	1 691	2 176	2 260	3 072	2 105	2 001	2 381	2 100	1 777	1 500	3 010	25 972
LVEV400;15CxC	310	310	315	377	343	312	289	339	311	239	150	311	3 605
LVEV400;3/4"	40	54	220	210	240	218	202	207	217	167	152	217	2 142
LVEV400P;22CxC	490	791	371	368	404	419	388	590	417	321	292	417	5 267
LVEV400P;15CxC	30	12	15	75	16	17	16	24	17	13	12	17	263
LVEV400P; 3/4"	0	0	0	0	0	0	0	0	0	0	0	0	0
MB-400;22CxC	355	145	767	498	736	705	675	705	700	617	461	803	7 167
MB-400;15CxC	30	20	20	45	22	54	50	77	54	42	38	54	506
LVEV-600; 22CXC				70	0	12	11	17	12	9	8	12	151
VRV													
VRV;22CxC	1 815	1 754	3 101	2 385	2 800	3 068	2 841	3 326	3 058	2 352	2 138	2 750	31 388
VRV;15CxC	210	480	572	440	283	566	524	798	564	434	394	564	5 830
VRV;1/2"	60	410	260	200	520	257	238	363	256	197	179	256	3 197
VRV3/4"	220	318	477	367	2 180	472	437	665	470	362	329	470	6 768
Ander													0
Geyser packs	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	2 000	24 000
GEYSERP-600kPa	5 500	5 500	5 500	5 500	5 500	5 500	5 500	5 500	5 500	5 500	5 500	5 500	66 000
TP Valve	1 500	3 500	3 500	3 500	3 500	3 500	3 500	3 500	3 500	3 500	3 500	3 500	40 000
Drain cock	3 000	4 500	4 500	4 500	4 500	4 500	4 500	4 500	4 500	4 500	4 500	4 500	52 500
Drain cock 15CxC	400	400	400	400	400	400	400	400	400	400	400	400	4 800
Solar TP Std	150	150	150	150	150	150	150	150	150	150	150	150	1 800
Solar TP L/P	300	300	300	300	300	300	300	300	300	300	300	300	3 600
Solar Draincock	200	200	200	200	200	200	200	200	200	200	200	200	2 400
DC-½-¾FM Drain cock	500	500	500	500	500	500	500	500	500	500	500	500	6 000
DC-THER;22CxC	10	10	10	10	10	10	10	10	10	10	10	10	120
TV-22 hp	350	350	350	350	350	350	350	350	350	350	350	250	4 100
TV-15	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	120 000
TV Divert 22	200	200	200	200	200	200	200	200	200	200	200	200	2 400
TV Divert 15	100	100	100	100	100	100	100	100	100	100	100	100	1 200
Isotec	75	75	75	75	75	75	75	75	100	75	75	150	1 000

Table 3.3: Data gathered – Budget of sales forecasted and known orders for a full year

Adjusting the interface of certain types of products may be necessary for example a Master production schedule working in weeks OR days OR months based on the lead times. A Lead time of 3days will have a schedule on a daily bases. And because the forecasts in the table above are only monthly another forecast must be done to break it down to weekly and daily.

3.2.5 The Bill of materials design

(SEE APPENDIX B for data being gathered of bill of materials for ALL items).
An example of a product's BOM out of Appendix B:

The Bill of material design will be to link the Product with the PARTS it exists of. Certain products have only level 1 part and certain products has level 2 parts which will be discussed now:

Looking at an example of a Product follows:
The Following Product (Pressure Control Valve, 22CXC, 400kPa) exist out of 15 parts and 2 of those parts exists out of some more parts (the 2 parts in red)

Code :	B-LVEV-400;22CX	Pres. Contr. valve; 22CXC; 400kPa
Manufactured Item :	LVEV-400;22CXC	Pressure Control Valve; 22CXC; 400kPa
Item	**Description**	**Quantity**
5-EV-SA	EV Seat	1
SR22	Spare Ring; 22mm	2
CN15	Spare Cap Nut; 15mm	1
SR15	Spare Ring; 15mm	1
11-EV-SA400	EV Spring; 400kPa	1
12-EV-ADJ	EV Adjuster	1
3-EV-SA	EV Spring Housing	1
1-LVEV-C22	Pressure Control Valve Body; 22CXC	1
18-018	EV Seat O Ring	1
18-023	O Ring 23mm	1
ASSJUMPER	EV Assembled Jumper	1
LVC-400	Pressure Control Valve Cartridge; 400kPa	1
ISTALINS	Installation Instructions	1
CN22	Spare Cap Nut; 22mm	2
CAR-LVEV-IN	LVEV Inner Carton	1

Code :	BASSJUMPER	EV Assembled Jumper
Manufactured Item :	ASSJUMPER	EV Assembled Jumper
Item	**Description**	**Quantity**
20-EV-SA	EV Seal	1
10-EV-SA	EV Jumper	1
10-EVR-SA	EV Jumper Retainer	1

Code :	B-LVC-400	Pressure Control Valve Cartridge; 400kPa
Manufactured Item :	LVC-400	Pressure Control Valve Cartridge; 400kPa
Item	**Description**	**Quantity**
LVC-10-LVP	Cartridge Jumper	1
LVC-12-LV	Cartridge Adjuster	1
LVC-13-LVP	Cartridge Piston	1
LVC-15-LVP-M4	Cartridge Stainless Cap Screw	1
18-007	Cartridge O Ring; 7mm	1
18-023	O Ring 23mm	1
18-113	Cartridge O Ring; 113mm	1
18-121	Cartridge O Ring; 121mm	1
18-124	Cartridge O Ring; 124mm	1
18-130	LV Cartridges O Ring	1
LVC-20-LVP	Cartridge Washer	1
LVC-3-LVP	Cartridge Spring Housing	1
LVC-3-LVP-R	Cartrdige Lock Ring	1
LVC-4-LVP	Cartridge Pressure Plate	1
LVC-5-LVP	Cartridge Seat	1
LVC-7-LVP	Cartridge Filter	1
LVCSPR	Cartridge Spring	1
5-LV-RED	LV-400 Adjuster Screw Cap	1

Figure 3. : BOM link for a product (LVEV-400 valve)

To understand the Link and the difference between the level 1 and level 2 parts, a BOM structure tree is constructed to make a better view out of the above tables of BOM:

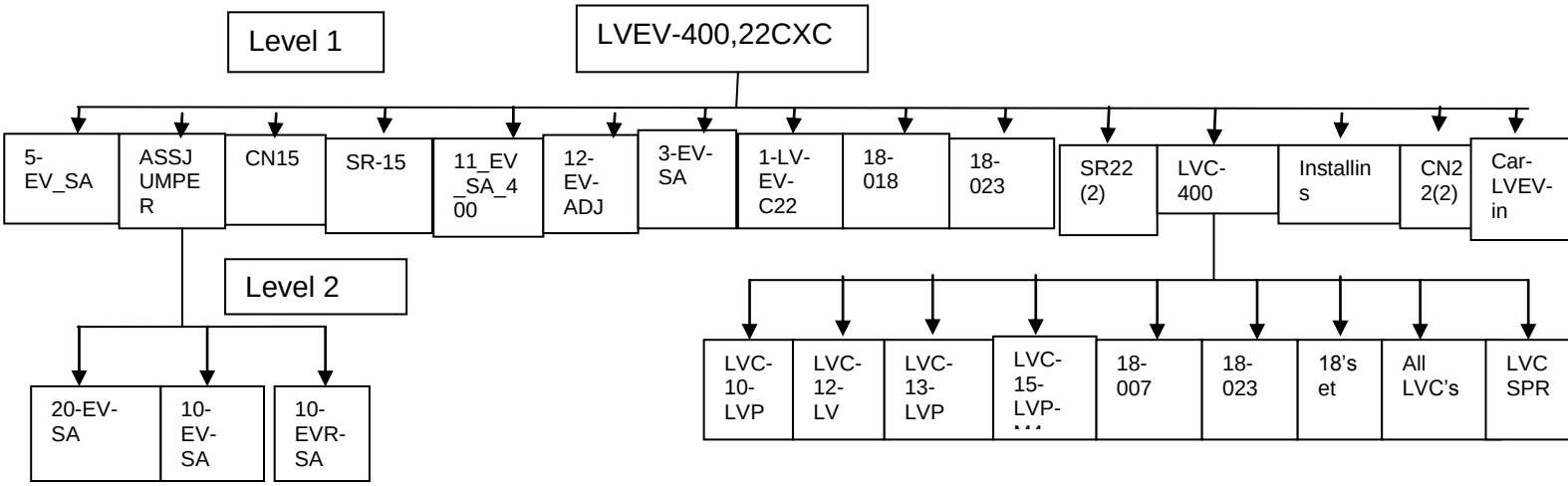


Figure 3.2: Product structure tree for BOM of LVEV-400 valve

This is only the drawing of one product that will be used as an example in the final design of the project as well. This is only to make the links of the Finished product and the raw materials it consists of easier to understand.

3.2.6 Design of MRP processes and system

The process in the MRP system is extremely important because links will have to be made and if links are wrong connected the whole program won't work properly. Links between the following processes must be made:

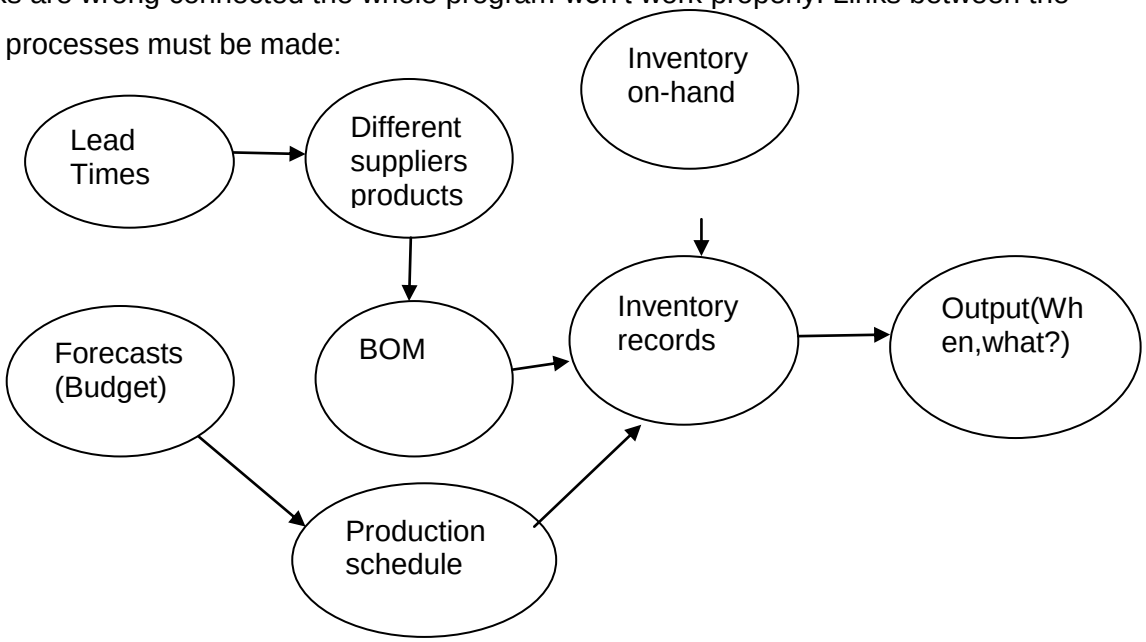


Figure 3.3: Process of MRP system with links

Inventory on hand

Looking at inventory on-hand: Apex Valves SA is getting new software to replace "pastel" the software they used for printing receipts, seeing BOM, seeing forecasts, sales, and finances and with the new software they are going to keep track of on-hand inventory day by day.

Using this on-hand inventory can work as an input into the MRP system with the inventory records.

The following Figure shows an abstract (small part) of the inventory on-hand for the "pastel" software which I got on a certain date:

Apex Valves S.A. (Pty) Ltd 27/08/2012 13:24 Page: 1

Prepared by: Apex Valves SA (Pty) Ltd

Inventory Quantities as at 31/08/2012

Code & Description	Store	Unit	Barcode	Balance	Unposted	On Hand	Sales Orders	Available	Purchase Orders
1-EV-SA	001	Each		5.000	0.000	5.000	0.000	5.000	0.000
1-EVRA-SA	001	Each		128.000	0.000	128.000	0.000	128.000	0.000
1-ISTC	001	Each		233.000	0.000	233.000	0.000	233.000	0.000
1-LVEV-3/4-22CX	001	Each		119.000	0.000	119.000	0.000	119.000	0.000
1-LVEV-C15	001	Each		138.000	0.000	138.000	0.000	138.000	0.000
1-LVEV-C15;COB	001	Each		232.000	0.000	232.000	0.000	232.000	0.000
1-LVEV-C22	001	Each		1,690.000	0.000	1,690.000	0.000	1,690.000	0.000
1-LVEV-C22;COB	001			622.000	0.000	622.000	0.000	622.000	0.000
1-LVEV-C33	001	Each		56.000	0.000	56.000	0.000	56.000	0.000
1-LVEV-SA	001	Each		1,195.000	0.000	1,195.000	0.000	1,195.000	0.000
1-SAVRV-20	001	Each		1,846.000	0.000	1,846.000	0.000	1,846.000	0.000
1-TP-3/4	001	Each		106.000	0.000	106.000	0.000	106.000	0.000

Figure 3.4: Data gathered: On hand inventory level on 27 Aug 2012

3.2.7 Design of MRP interfaces

Master Production schedule(input interface)

The interface so far looks like follows but may change in the final design as progress is

Master production Schedule

Month			12-Nov				12-Dec			13-Jan		
Production Quantities			0				0			0		
Week	1	2	3	4	5	6	7	8	9	10	11	12
LVEV400;22CxC												
LVEV400;15CxC												
LVEV400;3/4"												
LVEV400P;22CxC												
LVEV400P;15CxC												
LVEV400P; 3/4"												
MB-400;22CxC												
MB-400;15CxC												
LVEV-600; 22CXC												
VRV;22CxC												
VRV;15CxC												
VRV;1/2"												
VRV3/4"												

made in the project:

Figure 3.5: master Production schedule conceptual design

As I mentioned the interface may still change. This is only a week based schedule and the future design may have 3 different schedules OR the lead forecasts may be given weekly for all the products.

The different suppliers confirmed orders will be inserted for every product AND also the forecasting demand as an input into the Master production schedule.

Bill of materials (input interface)

The interface for the BOM and also the inventory is as follows:

LVEV-600; 22CXC	1-LVEV-C22	1	Pressure Control Valve Body; 22CXC
	3-EV-SA	1	EV Spring Housing
	12-EV-ADJ	1	EV Adjuster
	11-EV-SA600	1	EV Spring; 600kPa
	5-EV-SA	1	EV Seat
	18-018	1	EV Seat O Ring
	18-023	1	O Ring 23mm
	ISTALINS	1	Installation Instructions
	CN22	2	Spare Cap Nut; 22mm
	SR22	2	Spare Ring; 22mm
	CN15	1	Spare Cap Nut; 15mm
	SR15	1	Spare Ring; 15mm
	CAR-LVEV-IN	1	LVEV Inner Carton
	20-EV-SA	1	EV Seal
	10-EV-SA	1	EV Jumper
	10-EVR-SA	1	EV Jumper Retainer
	LVC-10-LVP	1	Cartridge Jumper
	LVC-12-LV	1	Cartridge Adjuster
	LVC-13-LVP	1	Cartridge Piston
	LVC-15-LVP-M4	1	Cartridge Stainless Cap Screw
	18-007	1	Cartridge O Ring; 7mm
	18-023	1	O Ring 23mm
	18-113	1	Cartridge O Ring; 113mm
	18-121	1	Cartridge O Ring; 121mm
	18-124	1	Cartridge O Ring; 124mm
	18-130	1	LV Cartridges O Ring
	LVC-20-LVP	1	Cartridge Washer
	LVC-3-LVP	1	Cartridge Spring Housing
	LVC-3-LVP-R	1	Cartrdige Lock Ring
	LVC-4-LVP	1	Cartridge Pressure Plate
	LVC-5-LVP	1	Cartridge Seat
	LVC-7-LVP	1	Cartridge Filter
	LVCSPR	1	Cartridge Spring
	5-LV-GREEN	1	LV-600 Adjuster Screw Cap
	STICK-LV-600	1	LV-600 Sticker

Figure 3.6: BOM interface of conceptual design

The BOM interface will also change in time of this project because a lot of BOM's must be linked with various parts and products.

Inventory on hand and lead time (Input interface)

The inventory on hand and lead times will also have a interface and the inventory on hand must be updated every day. This is needed for the link from this input to the output interfaces following. Figure 3.7 shows a rough interface

List of products	Inventory on hand	Lead Times
LVEV400;22CxC		
LVEV400;15CxC		
LVEV400;3/4"		
LVEV400P;22CxC		
LVEV400P;15CxC		
LVEV400P; 3/4"		
MB-400;22CxC		
MB-400;15CxC		
LVEV-600; 22CXC		
VRV;22CxC		
VRV;15CxC		
VRV;1/2"		
VRV3/4"		

Figure 3.7 : Inventory on hand and lead times of conceptual design

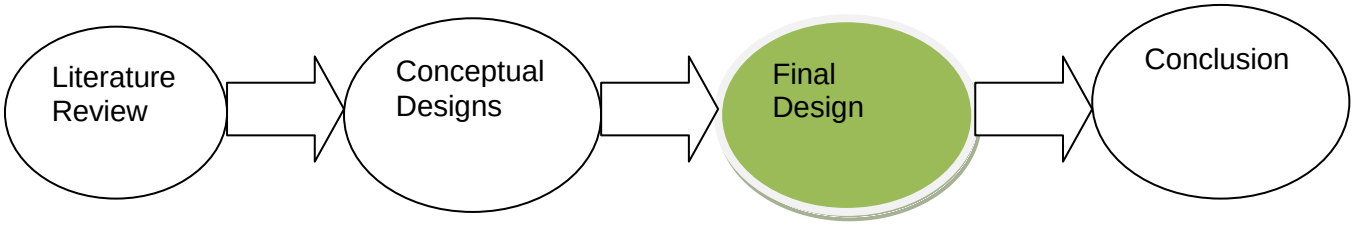
Inventory record (Output interface)

The structure of the inventory records is shown below and will be the base of the MRP system which will tell exactly how much and when the order should be placed

		Month1				Month2				Month 3			
	Week	1	2	3	4	5	6	7	8	9	10	11	12
A	Gross requirements			0			0						
	Scheduled receipt												
	Net requirement												
	Planned order receipt												
	Planned order release												
B	Gross requirements												
	Scheduled receipt												
	Net requirement												
	Planned order receipt												
	Planned order release												
C	Gross requirements												
	Scheduled receipt												
	Net requirement												
	Planned order receipt												
	Planned order release												
D	Gross requirements												
	Scheduled receipt												
	Net requirement												
	Planned order receipt												
	Planned order release												

Figure 3.8: Inventory Records of conceptual design

4. Chapter 4 : Final Design



The Design of the MRP system

The programming in the design of the MRP system is done in a way to always make adjustments, add items, add products, change inventory on hand, change suppliers et. Even if changes are made the output of the system will change according to the data being changed. In other words the output of the system adjusts as the inputs changes.

Design Interfaces

The design of the interfaces will be shown in steps to show exactly what and how the MRP system design was developed. An Interface in this case is known as a spreadsheet in Microsoft Excel. Each interface will be shown and discussed.

4.1 Input interface design

1st Interface

The First interface is the ***List of the Products*** to know exactly which products is being supplied by Apex Valves SA. As mentioned in the conceptual design, this is only a few products being supplied by Apex Valves SA or the most popular products.

List of products	
a List of all the products being supplied by Apex Valves SA with a description of each	
PRV Valves	**Discription**
LVEV400;22CxC	Pressure Control Valve; 22CXC; 400kPa
LVEV400;15CxC	Pressure Control Valve; 15CXC; 400kPa
LVEV400;3/4"	Pressure Control Valve;3/4BSP 400kPa
LVEV400P;22CxC	Press. Contr. Val. with 2 x VRV15CXC
LVEV400P;15CxC	Press. Contr. Val. with 2 x VRV22CXC
LVEV400P; 3/4"	Pres. Cont. Val. with 2 x VRV3/4 BSP
MB-400;22CxC	MB-400; 22CXC PCV Set Loose
MB-400;15CxC	Press. Contr. Val. with Shutoff + 2x VRV
LVEV-600; 22CXC	Pressure Control Valve;22CXC;600kPa
VRV	
VRV;22CxC	Vacuum Control Valve; 22CXC
VRV;15CxC	Vacuum Control Valve; 15CXC
VRV;1/2"	Vacuum Control Valve; 1/2;BSP
VRV3/4"	Vacuum Control Valve; 3/4;BSP
Ander	
Geyser packs	TP Valve & Drain Cock Pack
GEYSERP-600kPa	Geyer Pack; Safety Valve & Drain 600kPa
TP Valve	Temp. & Press. Relief Valve; 400kpa ,600kPa
Drain cock	Drain Cock with Thermocouple Pocket; 22
Drain cock 15CxC	Drain Cock + Thermo Pocket; 15CxC
Solar TP Std	Solar Safety Valve; Std. Probe
Solar TP L/P	TP-400; Long Probe; Pressure Relief Valv
Solar Draincock	Draincock Solar; 15CXC, 22CXC Port
DC-½-¾FM Drain cock	Drain Cock ½ to ¾ FM
DC-THER;22CxC	Drain Cock + Thermo Pocket; 22CxC
TV-22 hp	Tempering Valve 22CXC; High Pressure
TV-15	Tempering Valve -15CXC; Excl. Non-Return
TV Divert 22	Tempering Valve Diverter; 22CxC
TV Divert 15	Tempering Valve Diverter; 15CxC
Isotec	Isotec Temperature Relief Valve; 400 kPa

Figure 4.1 : Final interface – List of Products

2nd Interface

The 2nd interface is what I call the ***Item Master*** which consists of a list and description of all the items from the finished products to the raw materials that moves in and out at Apex Valves SA. This interface's main purpose is to display the Inventory on hand and the lead times by each supplier for each finished product and raw material. The raw material is all the items used to make each finished product, also shown in the conceptual design (Product structure tree).

Using the data given by Apex Valves SA a interface was designed to list all lead times from high to low of the raw materials. The reason why the finished products have no lead time is because it is not being ordered from a supplier directly. The finished products are being but together by its raw materials in certain operations in the factory.
This is also what you call a updatable interface because the inventory on hand must be updated every single day as the items move in and out of the inventory room. The inventory on hand and the lead time is also an input to the MRP output as will be explained later.

ITEM Master

Description of every item(Finished product and raw materials) at Apex Valves SA. This is mostly used for its inventory on hand and the lead time of each supplier of raw materials

The Inventory on hand must be updated every single day as products move in and out from the inventory room

						(update every day)
Item	**Description**	**Product Type**	**Supplier**	**Supplier Name**	**Lead Time(weeks)**	**Inventory on hand**
LVEV400;22CxC	Pressure Control Valve; 22CXC; 400kPa	Finished Product				26
LVEV400;15CxC	Pressure Control Valve; 15CXC; 400kPa	Finished Product				29
LVEV400;3/4"	Pressure Control Valve;3/4BSP 400kPa	Finished Product				133
LVEV400P;22CxC	Press. Contr. Val. with 2 x VRV15CXC	Finished Product				138
LVEV400P;15CxC	Press. Contr. Val. with 2 x VRV22CXC	Finished Product				0
LVEV400P; 3/4"	Pres. Cont. Val. with 2 x VRV3/4 BSP	Finished Product				0
MB-400;22CxC	MB-400; 22CXC PCV Set Loose	Finished Product				5
MB-400;15CxC	Press. Contr. Val. with Shutoff + 2x VRV	Finished Product				8
LVEV-600; 22CXC	Pressure Control Valve;22CXC;600kPa	Finished Product				2
ASSJUMPER	EV Assembled Jumper	Finished Product				0
LVC-400	Pressure Control Valve Cartridge; 400kPa	Finished Product				1147
VRV;22CxC	Vacuum Control Valve; 22CXC	Finished Product				38
VRV;15CxC	Vacuum Control Valve; 15CXC	Finished Product				376
VRV;1/2"	Vacuum Control Valve; 1/2;BSP	Finished Product				120
VRV3/4"	Vacuum Control Valve; 3/4;BSP	Finished Product				440
5-EV-SA	EV Seat	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	2809
18-018	EV Seat O Ring	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	4495
18-023	O Ring 23mm	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	6588
10-EV-SA	EV Jumper	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	2429
10-EVR-SA	EV Jumper Retainer	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	3444
LVC-10-LVP	Cartridge Jumper	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	1348
LVC-12-LV	Cartridge Adjuster	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	1157
LVC-13-LVP	Cartridge Piston	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	1498
LVC-15-LVP-M4	Cartridge Stainless Cap Screw	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	1006
18-007	Cartridge O Ring; 7mm	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	1586
18-113	Cartridge O Ring; 113mm	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	2316
18-121	Cartridge O Ring; 121mm	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	2655
18-124	Cartridge O Ring; 124mm	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	1526
18-130	LV Cartridges O Ring	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	1515

Figure 4.2 : Final interface – Item Master

LVC-20-LVP	Cartridge Washer	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	2250
LVC-3-LVP	Cartridge Spring Housing	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	7058
LVC-3-LVP-R	Cartrdige Lock Ring	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	2289
LVC-4-LVP	Cartridge Pressure Plate	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	1321
LVC-5-LVP	Cartridge Seat	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	1442
LVC-7-LVP	Cartridge Filter	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	1150
LVCSPR	Cartridge Spring	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	1886
5-LV-RED	LV-400 Adjuster Screw Cap	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	5165
5-LV-GREEN	LV-600 Adjuster Screw Cap	Raw Materials	APEXNZ	Apex Valves Limited(NZ)	4	5395
SR22	Spare Ring; 22mm	Raw Materials	EXI	Exipro Swaziland	3	2553
CN15	Spare Cap Nut; 15mm	Raw Materials	EXI	Exipro Swaziland	3	5072
SR15	Spare Ring; 15mm	Raw Materials	EXI	Exipro Swaziland	3	13633
12-EV-ADJ	EV Adjuster	Raw Materials	EXI	Exipro Swaziland	3	5602
3-EV-SA	EV Spring Housing	Raw Materials	EXI	Exipro Swaziland	3	6735
1-LVEV-C22	Pressure Control Valve Body; 22CXC	Raw Materials	EXI	Exipro Swaziland	3	1690
CN22	Spare Cap Nut; 22mm	Raw Materials	EXI	Exipro Swaziland	3	2947
1-LVEV-C15	Pressure Control Valve Body; 15CXC	Raw Materials	EXI	Exipro Swaziland	3	138
1-LVEV-SA	Pres. Contr. Valve Body; 3/4BSP	Raw Materials	EXI	Exipro Swaziland	3	1195
S/OFF-22CXC	Shut Off Valve; 22 CXC	Raw Materials	EXI	Exipro Swaziland	3	1239
S/OFF-15MM	Shut Off Valve; 15 CXC	Raw Materials	EXI	Exipro Swaziland	3	1050
1-VRV-C22	Vacuum Control Valve Body; 22CXC	Raw Materials	EXI	Exipro Swaziland	3	3520
1-VRV-C15	Vacuum Control Valve Body; 15CXC	Raw Materials	EXI	Exipro Swaziland	3	1820
1-SAVRV-20	Vacuum Control Valve Body; 3/4;BSP	Raw Materials	EXI	Exipro Swaziland	3	1846
ISTALINS	Installation Instructions	Raw Materials	ELCO	Elco Marketing	1	9734
STICK-LV-600	LV-600 Sticker	Raw Materials	ELCO	Elco Marketing	1	578
5-VRV-RET	Vacuum Relief Valve Seal Retaining Ring	Raw Materials	BELA	Belmatech CC	1	11835
5-VRV-CAP	Vacuum Relef Valve Cap	Raw Materials	BELA	Belmatech CC	1	10082
5-VRV-SEAT-UDL	Vacuum Relief Valve Seat UDL	Raw Materials	BELA	Belmatech CC	1	9649
20VRVWASHER	VRV Seal washers	Raw Materials	CARL	Carlin Medical Extrutions	1	3958
20-EV-SA	EV Seal	Raw Materials	CARL	Carlin Medical Extrutions	1	5383
11-EV-SA400	EV Spring; 400kPa	Raw Materials	SPRMAN	Spring manufacturers of SA CC	2	3761
11-EV-SA600	EV Spring; 600kPa	Raw Materials	SPRMAN	Spring manufacturers of SA CC	2	9817
11-VRV-SPR	Vacuum Relief Valve Insert Spring	Raw Materials	SPRMAN	Spring manufacturers of SA CC	2	16000
CAR-LVEV-IN	LVEV Inner Carton	Raw Materials	WRBOX	West Rand Box (Pty) Ltd	2	1878
CAR-UNI-IN	Multi Block Inner Carton	Raw Materials	WRBOX	West Rand Box (Pty) Ltd	2	3188
18-017	VAcuum Control Valve O Ring	Raw Materials	MEDIAH	Centurion Hydraulics	0.14	7240

Figure 4.2 Final interface – Item Master continues

4.2 Production Schedule design

Now that all the necessary starting interfaces were designed its time to start with the first interface input of an MRP system the ***Master Production Schedule*** which gives a list of all the products and the quantities needed at which stage of the year.

At Apex Valves SA a budget of forecasts of quantities for each month of each product was constructed (Refer to conceptual design p25) and this data was used to design the following interface.

This Production schedule was broken down in 3 months (November 2012, December 2012 and January 2012) and then broken down in weeks. The budget of Apex Valves SA goes further than 3 months but only 3 months was used in this system to make is easier to explain how it works and to see if the results solve the problem statement. The reason for broken down in weeks is because of the lead times which is mostly weeks apart AND in some cases companies may require a certain amount of quantities a certain week in a month.
As you can see in figure each product's quantities needed is listed under every fourth week which is the end of each month. This data will be an input to the output of each product explained later.

Master production Schedule

Month			12-Nov				12-Dec			13-Jan		
Production Quantities				10616				8205				7672
Week	1	2	3	4	5	6	7	8	9	10	11	12
LVEV400;22CxC				3072				2105				2001
LVEV400;15CxC				343				312				289
LVEV400;3/4"				240				218				202
LVEV400P;22CxC				404				419				388
LVEV400P;15CxC				16				17				16
LVEV400P; 3/4"				0				0				0
MB-400;22CxC				736				705				675
MB-400;15CxC				22				54				50
LVEV-600; 22CXC				0				12				11
VRV;22CxC				2800				3068				2841
VRV;15CxC				283				566				524
VRV;1/2"				520				257				238
VRV3/4"				2180				472				437

Figure 4.3 : Final interface – Master Production Schedule

4.3 Bill of Materials design

The Bill of Materials interface is also a very important input to the MRP system to make the output possible. A Lot of data was gathered at Apex Valves SA for all the Bill of materials for each finished product. In this interface the Bill of Materials is designed to make it easy for the user to understand which and what quantity of raw materials is used for each finished product.

Refer to Figure which is the Bill of materials of the first product on the Product list LVEV-400,22CxC. There are 2 levels in the Bill of materials structure. The First level shows what and the quantities of raw materials that the product is made of and the second level is two of the first level items is also made of other raw materials which has its quantities and what raw materials it is made of.

Bill of Materials

	1st LEVEL				2nd LEVEL		
Product	**Component**	**Quantity**	**Component description**				
LVEV400;22CxC	5-EV-SA	1	EV Seat				
	SR22	2	Spare Ring; 22mm				
	CN15	1	Spare Cap Nut; 15mm				
	SR15	1	Spare Ring; 15mm				
	11-EV-SA400	1	EV Spring; 400kPa				
	12-EV-ADJ	1	EV Adjuster				
	3-EV-SA	1	EV Spring Housing				
	1-LVEV-C22	1	Pressure Control Valve Body; 22CXC				
	18-018	1	EV Seat O Ring				
	18-023	1	O Ring 23mm				
	ISTALINS	1	Installation Instructions				
	CN22	2	Spare Cap Nut; 22mm				
	CAR-LVEV-IN	1	LVEV Inner Carton				
	ASSJUMPER	1	EV Assembled Jumper	>>>	**Component**	**Quantity**	**Component description**
					20-EV-SA	1	EV Seal
					10-EV-SA	1	EV Jumper
					10-EVR-SA	1	EV Jumper Retainer
	LVC-400	1	Pressure Control Valve Cartridge; 400kPa	>>>	**Component**	**Quantity**	**Component description**
					LVC-10-LVP	1	Cartridge Jumper
					LVC-12-LV	1	Cartridge Adjuster
					LVC-13-LVP	1	Cartridge Piston
					LVC-15-LVP-M4	1	Cartridge Stainless Cap Screw
					18-007	1	Cartridge O Ring; 7mm
					18-023	1	O Ring 23mm
					18-113	1	Cartridge O Ring; 113mm
					18-121	1	Cartridge O Ring; 121mm
					18-124	1	Cartridge O Ring; 124mm
					18-130	1	LV Cartridges O Ring
					LVC-20-LVP	1	Cartridge Washer
					LVC-3-LVP	1	Cartridge Spring Housing
					LVC-3-LVP-R	1	Cartrdige Lock Ring
					LVC-4-LVP	1	Cartridge Pressure Plate
					LVC-5-LVP	1	Cartridge Seat
					LVC-7-LVP	1	Cartridge Filter
					LVCSPR	1	Cartridge Spring
					5-LV-RED	1	LV-400 Adjuster Screw Cap

Figure 4.4 : Final interface – Bill of Materials

The next Figure shows the Bill of materials interface continuing for the second product on the product list's Bill of materials. For the Purpose of space only these two will be shown in this document. Each product Bill of Materials looks like this more or less and is in the Microsoft Excel Program electronically.

LVEV400;15CxC	Component	Quantity	Component description
	5-EV-SA	1	EV Seat
	CN15	3	Spare Cap Nut; 15mm
	SR15	3	Spare Ring; 15mm
	11-EV-SA400	1	EV Spring; 400kPa
	12-EV-ADJ	1	EV Adjuster
	3-EV-SA	1	EV Spring Housing
	1-LVEV-C15	1	Pressure Control Valve Body; 15CXC
	18-018	1	EV Seat O Ring
	18-023	1	O Ring 23mm
	ISTALINS	1	Installation Instructions
	CAR-LVEV-IN	1	LVEV Inner Carton
	ASSJUMPER	1	EV Assembled Jumper

>>>

Component	Quantity	Component description
20-EV-SA	1	EV Seal
10-EV-SA	1	EV Jumper
10-EVR-SA	1	EV Jumper Retainer

	LVC-400	1	Pressure Control Valve Cartridge; 400kPa

>>>

Component	Quantity	Component description
LVC-10-LVP	1	Cartridge Jumper
LVC-12-LV	1	Cartridge Adjuster
LVC-13-LVP	1	Cartridge Piston
LVC-15-LVP-M4	1	Cartridge Stainless Cap Screw
18-007	1	Cartridge O Ring; 7mm
18-023	1	O Ring 23mm
18-113	1	Cartridge O Ring; 113mm
18-121	1	Cartridge O Ring; 121mm
18-124	1	Cartridge O Ring; 124mm
18-130	1	LV Cartridges O Ring
LVC-20-LVP	1	Cartridge Washer
LVC-3-LVP	1	Cartridge Spring Housing
LVC-3-LVP-R	1	Cartrdige Lock Ring
LVC-4-LVP	1	Cartridge Pressure Plate
LVC-5-LVP	1	Cartridge Seat
LVC-7-LVP	1	Cartridge Filter
LVCSPR	1	Cartridge Spring
5-LV-RED	1	LV-400 Adjuster Screw Cap

Figure 4.5 : Final interface – Bill of materials (LVEV-400,15 CxC)

The Bill of Materials interface is also n important input to the MRP system's output which will be illustrated next.

4.4 Output interface design

First output Interface

The next interface is the ***Inventory records*** of a finished product which is the output of the MRP system.

Calculations take place with all the **inputs**:

- The inventory on hand
- Quantities of master production schedule
- Lead times

And calculates the **outputs**:

- WHAT QUANTITY and
- WHEN

Each raw material required by each finished product must be ORDERED at their various suppliers.

See figure for the interface of the first product on the product list. As seen it is quite a lengthy procedure of calculations which will be explained step by step after the figure.

OUTPUTS of MRP system														
Product	LVEV400;22CxC													
	Product													
	Component with 2nd level													
			12-Nov					12-Dec					13-Jan			
Item	Week	0	1	2	3	4	5	6	7	8	9	10	11	12
LVEV400;22CxC	Gross requirements		0	0	0	3072	0	0	0	2105	0	0	0	2001
	Scheduled receipt													
	Projected Available Balance	26			26	-3046			0	-2105			0	-2001
	Net requirement					3046				2105				2001
	Planned order receipt					3046				2105				2001
0	Planned order release					3046				2105				2001
5-EV-SA	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	2809			2809	-237			0	-2105			0	-2001
	Net requirement					237				2105				2001
	Planned order receipt					237				2105				2001
4	Planned order release	237				2105				2001				
SR22	Gross requirements					6092				4210				4002
	Scheduled receipt													
	Projected Available Balance	2553			2553	-3539			0	-4210			0	-4002
	Net requirement					3539				4210				4002
	Planned order receipt					3539				4210				4002
3	Planned order release		3539				4210				4002			
CN15	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	5072			5072	2026			2026	-79			0	-2001
	Net requirement					0				79				2001
	Planned order receipt									79				2001
3	Planned order release						79				2001			
SR15	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	13633			13633	10587			10587	8482			8482	6481
	Net requirement					0				0				0
	Planned order receipt													
3	Planned order release													
11-EV-SA400	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	3761			3761	715			715	-1390			0	-2001
	Net requirement					0				1390				2001
	Planned order receipt									1390				2001
2	Planned order release							1390				2001		
12-EV-ADJ	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	5602			5602	2556			2556	451			451	-1550
	Net requirement					0				0				1550
	Planned order receipt													1550
3	Planned order release										1550			
3-EV-SA	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	6735			6735	3689			3689	1584			1584	-417
	Net requirement					0				0				417
	Planned order receipt													417
3	Planned order release										417			
1-LVEV-C22	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	1690			1690	-1356			0	-2105			0	-2001
	Net requirement					1356				2105				2001
	Planned order receipt					1356				2105				2001
3	Planned order release		1356				2105				2001			
18-018	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	4495			4495	1449			1449	-656			0	-2001
	Net requirement					0				656				2001
	Planned order receipt									656				2001
4	Planned order release					656				2001				
18-023	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	6588			6588	3542			3542	1437			1437	-564
	Net requirement					0				0				564
	Planned order receipt													564
4	Planned order release									564				
ISTALINS	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	9734			9734	6688			6688	4583			4583	2582
	Net requirement					0				0				0
	Planned order receipt													
1	Planned order release													

Figure 4.6 : Final interface – Inventory records (LVEV-400,22 CxC)

CN22	Gross requirements					6092				4210				4002
	Scheduled receipt													
	Projected Available Balance	2947			2947	-3145			0	-4210			0	-4002
	Net requirement					3145				4210				4002
	Planned order receipt					3145				4210				4002
3	Planned order release		3145				4210				4002			
CAR-LVEV-IN	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	1878			1878	-1168			0	-2105			0	-2001
	Net requirement					1168				2105				2001
	Planned order receipt					1168				2105				2001
2	Planned order release			1168				2105				2001		
ASSJUMPER	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	0			0	-3046			0	-2105			0	-2001
	Net requirement					3046				2105				2001
	Planned order receipt					3046				2105				2001
0	Planned order release					3046				2105				2001
20-EV-SA	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	5383			5383	2337			2337	232			232	-1769
	Net requirement					0				0				1769
	Planned order receipt													1769
1	Planned order release												1769	
10-EV-SA	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	2429			2429	-617			0	-2105			0	-2001
	Net requirement					617				2105				2001
	Planned order receipt					617				2105				2001
4	Planned order release	617				2105				2001				
10-EVR-SA	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	3444			3444	398			398	-1707			0	-2001
	Net requirement					0				1707				2001
	Planned order receipt									1707				2001
4	Planned order release					1707				2001				
LVC-400	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	1147			1147	-1899			0	-2105			0	-2001
	Net requirement					1899				2105				2001
	Planned order receipt					1899				2105				2001
0	Planned order release					1899				2105				2001
LVC-10-LVP	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	1348			1348	-551			0	-2105			0	-2001
	Net requirement					551				2105				2001
	Planned order receipt					551				2105				2001
4	Planned order release	551				2105				2001				
LVC-12-LV	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	1157			1157	-742			0	-2105			0	-2001
	Net requirement					742				2105				2001
	Planned order receipt					742				2105				2001
4	Planned order release	742				2105				2001				
LVC-13-LVP	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	1498			1498	-401			0	-2105			0	-2001
	Net requirement					401				2105				2001
	Planned order receipt					401				2105				2001
4	Planned order release	401				2105				2001				
LVC-15-LVP-M4	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	1006			1006	-893			0	-2105			0	-2001
	Net requirement					893				2105				2001
	Planned order receipt					893				2105				2001
4	Planned order release	893				2105				2001				
18-007	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	1586			1586	-313			0	-2105			0	-2001
	Net requirement					313				2105				2001
	Planned order receipt					313				2105				2001
4	Planned order release	313				2105				2001				
18-023	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	6588			6588	4689			4689	2584			2584	583
	Net requirement					0				0				0
	Planned order receipt													
4	Planned order release													

18-113	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	2316			2316	417			417	-1688			0	-2001
	Net requirement					0				1688				2001
	Planned order receipt									1688				2001
4	Planned order release					1688				2001				
18-121	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	2655			2655	756			756	-1349			0	-2001
	Net requirement					0				1349				2001
	Planned order receipt									1349				2001
4	Planned order release					1349				2001				
18-124	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	1526			1526	-373			0	-2105			0	-2001
	Net requirement					373				2105				2001
	Planned order receipt					373				2105				2001
4	Planned order release	373				2105				2001				
18-130	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	1515			1515	-384			0	-2105			0	-2001
	Net requirement					384				2105				2001
	Planned order receipt					384				2105				2001
4	Planned order release	384				2105				2001				
LVC-20-LVP	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	2250			2250	351			351	-1754			0	-2001
	Net requirement					0				1754				2001
	Planned order receipt									1754				2001
4	Planned order release					1754				2001				
LVC-3-LVP	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	7058			7058	5159			5159	3054			3054	1053
	Net requirement					0				0				0
	Planned order receipt													
4	Planned order release													
LVC-3-LVP-R	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	2289			2289	390			390	-1715			0	-2001
	Net requirement					0				1715				2001
	Planned order receipt									1715				2001
4	Planned order release					1715				2001				
LVC-4-LVP	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	1321			1321	-578			0	-2105			0	-2001
	Net requirement					578				2105				2001
	Planned order receipt					578				2105				2001
4	Planned order release	578				2105				2001				
LVC-5-LVP	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	1442			1442	-457			0	-2105			0	-2001
	Net requirement					457				2105				2001
	Planned order receipt					457				2105				2001
4	Planned order release	457				2105				2001				
LVC-7-LVP	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	1150			1150	-749			0	-2105			0	-2001
	Net requirement					749				2105				2001
	Planned order receipt					749				2105				2001
4	Planned order release	749				2105				2001				
LVCSPR	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	1886			1886	-13			0	-2105			0	-2001
	Net requirement					13				2105				2001
	Planned order receipt					13				2105				2001
4	Planned order release	13				2105				2001				
5-LV-RED	Gross requirements					1899				2105				2001
	Scheduled receipt													
	Projected Available Balance	5165			5165	3266			3266	1161			1161	-840
	Net requirement					0				0				840
	Planned order receipt													840
4	Planned order release									840				

Step by Step procedure

In the previous figure the Output (inventory records) were shown of the product LVEV-400,22CxC.The following describes the step by step procedure of calculations of the design.

The inventory records was described in the literature study.

It always starts with the finished product at the top followed by all its raw materials as seen in figure. The interface is broken down into three months with four weeks each like the master production schedule. It can be extended but for the purpose of length and to explain the concept easier it is broken down.

Top of interface – Finished product

Refer to Figure where the top of the interface is shown

			12-Nov				12-Dec				13-Jan			
Item	Week	0	1	2	3	4	5	6	7	8	9	10	11	12
LVEV400;22CxC	Gross requirements		0	0	0	3072	0	0	0	2105	0	0	0	2001
	Scheduled receipt													
	Projected Available Balance	26			26	-3046			0	-2105			0	-2001
	Net requirement					3046				2105				2001
	Planned order receipt					3046				2105				2001
0	Planned order release					3046				2105				2001

Figure 4.7 : Top of interface – Inventory records (LVEV-400,22 CxC)

In the above figure the section circled for November 2012 with colours uses Microsoft excel coding. In Figure the code for each colour is given.

	'Master Production Schedule'!E8
	'Item Master'!G6
	F11-G9
	IF(G11<0,ABS(G11),0)
	IF(G12>0,G12,"")
	G13

Figure 4.8 Circled area – November 2012 coding

Explanation of coding of calculations (See above figure)

- The Gross requirements(yellow) – Uses the Input of the Master Production interface for that product
- The scheduled receipt – orders that is already written out(Apex Valves do not use such orders)
- The Projected Available Balance(Green) – Uses the Input from Item Master interface which is the Inventory on hand for that Item which is also updated everyday
  (Purple) – Takes the inventory on hand (green) minus the gross requirements at the end of the month
- The Net requirements (Dark blue) – Ask the question if the projected available balance at the end of the month is negative then make it positive(absolute value) and if not then make it a value of 0 because then there is still enough quantities to move into next month.
- Planned order receipt (Orange) – Asks the question if the net requirements is positive and larger than 0 then use that value just as it is otherwise just leave an open space.
- The Planned order release(Red) – Uses the lead time as input and moves the Planned order receipt(orange) the amount of weeks it takes for an order to be delivered at Apex Valves SA(lead time) to the left. In this case the lead time of the finished product is 0 because it is not a raw material that is ordered at the suppliers. ALSO: Just next to the planned order release block there is a 0. This is the lead time of that product to make it easier on the coding.

The following figure will show the coding for December and how the calculations progress from month to month.

			12-Nov				12-Dec				13-Jan			
Item	Week	0	1	2	3	4	5	6	7	8	9	10	11	12
LVEV400;22CxC	Gross requirements		0	0	0	3072	0	0	0	2105	0	0	0	2001
	Scheduled receipt													
	Projected Available Balance	26			26	-3046			0	-2105			0	-2001
	Net requirement					3046				2105				2001
	Planned order receipt					3046				2105				2001
0	Planned order release					3046				2105				2001

Figure 4.9 : Top of interface – Inventory records(December 2012, LVEV-400,22 CxC)

The above figure shows the calculations of December 2012. The following figure gives the coding of each colour in the sectioned circle.

	'Master Production Schedule'!I8
	IF(G11>=0,G11,0)
	J11-K9
	IF(K11<0,ABS(K11),0)
	IF(K12>0,K12,"")
	K13

Figure 4.10 Circled area – December 2012 coding

Explanation of coding of calculations (See above figure)

- The gross requirements (yellow) – Uses the Input of the Master production schedule interface of that product.
- Projected available balance (light blue) – Asks the question if the quantities of the previous month (Purple) is larger than 0 and if it is then use that value and move it there and If not then use the value 0 because then all the items is used and new ones must be ordered.
  (Dark Blue) – Take the quantity left of the previous month (light blue) minus the gross requirements for that month (December).
- Net requirements(green) – Uses the same coding as the previous month
- Planned order receipt(Orange) – Uses the same coding as the previous month
- Planned order release(Red) – Uses the same coding as the previous month

The same coding as in December 2012 is used in January 2013 and will continue if the system is expanded.

The second part of interface – First Raw material

The following figure shows the first raw material (5-EV-SA) that the finished product LVEV-400,22CxC consists of

			12-Nov				12-Dec				13-Jan			
Item	Week	0	1	2	3	4	5	6	7	8	9	10	11	12
LVEV400;22CxC	Gross requirements		0	0	0	3072	0	0	0	2105	0	0	0	2001
	Scheduled receipt													
	Projected Available Balance	26			26	-3046			0	-2105			0	-2001
	Net requirement					3046				2105				2001
	Planned order receipt					3046				2105				2001
0	Planned order release					3046				2105				2001
5-EV-SA	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	2809			2809	-237			0	-2105			0	-2001
	Net requirement					237				2105				2001
	Planned order receipt					237				2105				2001
4	Planned order release	237				2105				2001				

Figure 4.11 : Second part of interface – Inventory records (November 2012,LVEV-400,22CxC)

The same as the previous Top part of the interface the circled part(November 2012) has Microsoft Excel coding and is given in the figure below.

	G14*'Bill of Materials'!C6
	'Item Master'!G22
	F17-G15
	IF(G17<0,ABS(G17),0)
	IF(G18>0,G18,"")
	IF(G19>0,G19,"")
	IF(K19>0,K19,"")

Figure 4.12 : Circled area of figure 4.11

Explanation of coding of calculations (See above figure and figure)

- The gross requirements (yellow) – Now the Bill of materials is used as input. It takes the quantity of the planned order release of the product it completes (Grey) and multiplies it with the quantity amount that is needed to make one of those products in as seen in the Bill of materials.

- Projected Available balance (green) – Uses the input of the Item master interface and enters the inventory on hand of that raw material.
  (Purple) – The inventory on hand (green) minus the gross requirement for that month.
- Net requirements(Dark blue) - Uses the same coding as the Finished product discussed earlier
- Planned order receipt(Orange) - Uses the same coding as the Finished product discussed earlier
- Planned order release (Dark red) – NOW a different lead time is present. In this case 4weeks which means 4 weeks earlier the raw material must be ordered. In this case at week 0 which means at the beginning of week 1 is the coding : If the planned order receipt(Orange) is larger than 0 then it uses that value in that block(4weeks left)
  (Red) - The same is for the next month (December) if the planned order receipt of the end of that month(Light blue) is larger than 0 then that value must be used at the end of November(4weeks earlier).
  ALSO: Next to planned order release is a number 4 which is the lead time of that raw material to make the coding easier.

Moving further down the Interface of the same product shown in the figure below

			12-Nov				12-Dec				13-Jan			
Item	Week	0	1	2	3	4	5	6	7	8	9	10	11	12
LVEV400;22CxC	Gross requirements		0	0	0	3072	0	0	0	2105	0	0	0	2001
	Scheduled receipt													
	Projected Available Balance	26			26	-3046			0	-2105			0	-2001
	Net requirement					3046				2105				2001
	Planned order receipt					3046				2105				2001
0	Planned order release					3046				2105				2001
5-EV-SA	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	2809			2809	-237			0	-2105			0	-2001
	Net requirement					237				2105				2001
	Planned order receipt					237				2105				2001
4	Planned order release	237				2105				2001				
SR22	Gross requirements					6092				4210				4002
	Scheduled receipt													
	Projected Available Balance	2553			2553	-3539			0	-4210			0	-4002
	Net requirement					3539				4210				4002
	Planned order receipt					3539				4210				4002
3	Planned order release		3539				4210				4002			
CN15	Gross requirements					3046				2105				2001
	Scheduled receipt													
	Projected Available Balance	5072			5072	2026			2026	-79			0	-2001
	Net requirement					0				79				2001
	Planned order receipt									79				2001
3	Planned order release						79				2001			

Figure 4.13 : Top three materials interface – November 2012

In the above figure is the first three raw materials of the finished product. The coding is the same as it goes down further. The things that may change is shown in the figure below

	G14*'Bill of Materials'!C7
	IF(G29<0,ABS(G29),0)

Figure 4.14 : Circled area of Figure 4.13

- The gross requirements of the SR22(grey) – Here the finished product needs 2 quantities of the SR22 seen in the Bill of materials and is therefore the planned order release of the finished product multiply by 2(Bill of materials interface)
- The net requirements of the CN15(red) – In this case it is 0 because the Projected available balance for that month is larger than 0 and that means there is still enough quantities of that material left to be transferred into the next month

First output interface conclusion

As seen there is a lot of links being made between the interfaces so if data is being change like the inventory on hand then the whole output of each product changes.

In this project only a few products output interfaces were designed to illustrate how it is being done. There are a lot more products but time will not allow creating all. For the purpose of the project only a few were designed to see if the MRP system works according to plan.

Final output Interface

The Final output interface is the ***Total orders.*** This is the interface which will tell the user WHEN and the Quantity of each raw material to order from the various supplier.
In will contain a table in which a list of raw materials with its supplier and the quantities of each and when it must be ordered shows. A Histogram of that table will be drawn to show the amount and when each material must be ordered.

See the figure below which shows the Table

TOTAL ORDERS

		Weeks	12-Nov				12-Dec				13-Jan			
Item	**Supplier**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
5-EV-SA	APEXNZ	726				8420				8004				
SR22	EXI		10131				12630				12006			
CN15	EXI		4057				6394				9972			
SR15	EXI						1811				6003			
11-EV-SA400	SPRMAN							5338				8004		
12-EV-ADJ	EXI										5978			
3-EV-SA	EXI										1446			
1-LVEV-C22	EXI		5202				8420				8004			
18-018	APEXNZ					2402				8004				
18-023	APEXNZ									2034				
ISTALINS	ELCO													
CN22	EXI		8949				12630				12006			
CAR-LVEV-IN	WRBOX			4450				8420				8004		

Figure 4.15 Final interface – Total orders Table

Only the top few raw materials were taken for each product for length purposes and for the purpose of this project but electronically all the items is in the output. In the Table above the calculations were simple. Each item was searched for in the First output interface(Inventory records) and then the sum of all the quantities for each period were taken. As the inventory on hand changes every day this output will change as well.

In the figure below a graph were drawn for each of the items in the table above to show a schematic presentation of the output.

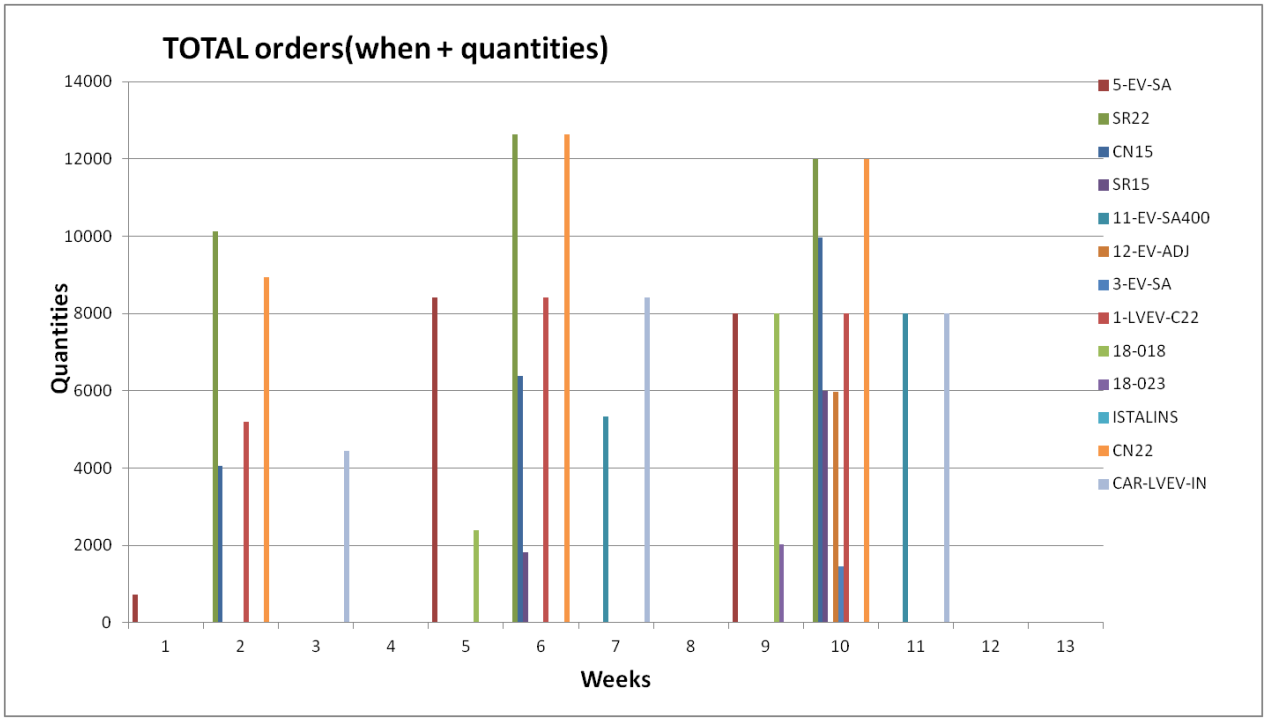


Figure 4.16 Final interface – Total orders Histogram

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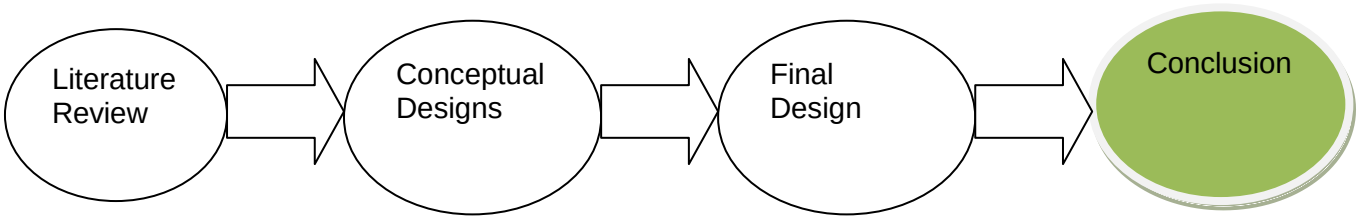

5.1 Overview

Through thorough research it was found that an MRP system was the best inventory system to design. In designing the MRP system it was found to make the inventory control much easier and effective to keep records of all items in the facility. The final design proves to solve the problem statement and all the interfaces is very user friendly. The user will just have to make changes to the inventory on hand and the quantities needed each month according to their budget and the system gives a fairly accurate output of how much and when orders must be made.
There are key benefits using this MRP system which is better control of inventory, computer based order quantities that must be made, always having the material when needed, no delay in orders due to material needed, no excess of material in inventory.

5.2 Recommendations

Apex Valves SA must consider using safety stock as it only makes it safer for when something goes wrong and there is a shortage of stock. The system must be updated every day (Inventory on hand) by a user. If there are scheduled receipts (orders that are made ahead in time it can also be inserted in the system.

5.3 Implementation Plan

The Implementation of the MRP system is up to Apex Valves SA if they would want to use a system like this and if it would benefit them. It will follow the following process:

- Install it on a computer
- Train a user and show how it works
- Add items where necessary
- Change data if necessary
- Make period of output longer
- Wait for a new month to start
- Start using the MRP system

5.4 References

- Jacobs FR, Chase RB & Lummus RR,(2011) ,***Operations and Supply Chain Management***, McGraw-Hill ,13th edition
- Freivalds A, Niebel BW,(2009), ***Niebel's Methods, Standards, and Work design***, McGraw ,12th edition
- Tomphins JA, White JA, Bozer YA, Tanchoco JMA,(2010), ***Facilities Planning***, John Wiley & Sons,Inc ,4th edition

5.5 Appendix A: List of products from each supplier

Supplier : APEXNZ - Apex Valves Limited
10-EV-SA - EV Jumper
10-EVR-SA - EV Jumper Retainer
10-EVRSA-P - Isotech Polysulfone
10-EVSA-P - Isotech Polysulfone Jumper
11-FV-3.7 - Feed Valve Spring; 3.7
11-TV-MSPR - Tempering Valve Main Spring
11-TV20-NR - Temp. Val. Non Return Cartridge Retainer
13-ISTC - Isotech Polysulfone Plunger
13-TV - Tempering Valve Control Piston
13-TV-D - Tempering Valve Diverter
14-FS - Shut Off Valve Handle
15-TV-RET - Tempering Valve O Ring Retainer
18-007 - Cartridge O Ring; 7mm
18-012 - Shut Off Valve Spindle O Ring
18-018 - EV Seat O Ring
18-020 - 20 mm Shut Off Valve Bonnet O Ring
18-023 - O Ring 23mm
18-029 - Tempering Valve Diverter O Ring 29mm
18-113 - Cartridge O Ring; 113mm
18-120 - Isotech Spindle 'O' Ring
18-121 - Cartridge O Ring; 121mm
18-124 - Cartridge O Ring; 124mm
18-127 - Tempering Valve Bonnet O Ring 127mm
18-130 - LV Cartridges O Ring
22-OV-15 - Tempering Val. 15mm Non-Return Cartridge
22-OV-20 - Tempering Valve 20mm Non-Return Cartridg
22-OV-20HT - High Temp 20mm Non Return
23-ISTC - Isotech Element
23-TV-ELEM - Tempering Valve Element
23-TVA;DIVELEM - TV-Diverter Element
5-EV-SA - EV Seat
5-LV-GREEN - LV-600 Adjuster Screw Cap
5-LV-GREEN:COBR - LV-600 Adjuster Screw Cap; COBRA
5-LV-RED - LV-400 Adjuster Screw Cap
5-LV-RED;COBRA - LV-400 Adjuster Screw Cap; COBRA
5-TV-CAP - Tempering Valve Cap
5-TV-CAP;COBRA - Tempering Valve Cap; Cobra
5-TVCAPCOB - Cobra Diverter Valve Cap
8-FS-15 - 15 mmShut Off Bonnet
8-FS-20 - 20mm ShutOff Bonnet
8-TV-BONNET - Tempering Valve Bonnet Sub Assembly
9-FS-15 - 15mm Shut Off Spindle
9-FS-20 - 20 mm Shut Off spindle
9-TV-SPIN - Tempering Valve Spindle Sub Assembly
APT-20 - Acetal Trough Float Valve; 20mm
APT-25 - Acetal Trough Float Valve; 25mm
FMP-350 - Filtamate Control Valve; 350kPa
FMP-600 - Filtamate Control Valve; 600kPa
LVC-10-LVP - Cartridge Jumper
LVC-12-LV - Cartridge Adjuster
LVC-13-LVP - Cartridge Piston
LVC-15-LVP-M4 - Cartridge Stainless Cap Screw
LVC-20-LVP - Cartridge Washer
LVC-3-LVP - Cartridge Spring Housing
LVC-3-LVP-R - Cartrdige Lock Ring
LVC-4-LVP - Cartridge Pressure Plate
LVC-5-LVP - Cartridge Seat
LVC-7-LVP - Cartridge Filter
LVCSPR - Cartridge Spring
M-15 - Ball Float Insert
RA-20 - Rainaid Valve 20mm
RES-40 - Resevoir Valve; 40mm
RESDL-40 - Reservoir Twin Float Valve; 40mm
RESDL-50 - Reservoir Twin Float Valve; 50mm
TV15P - Tempering Valve 15mm; Point of Use
TV20P - Tempering Valve 20mm; Point of Use
TVM-20 - Thermostatic Mixing Valve; Point of Use
XF-20 - XtraFlo Trough Valve & Float - 20mm
XF-25 - XtraFlo Trough Valve & Float - 25mm
XF-32 - XtraFlo Trough Valve & Float - 32mm

Supplier : AWC - African Water Controls CC
20-OV-15VRV - Non-Return Cartridge; VRV15
Supplier : BELA - Belmatech CC
5-VRV-CAP - Vacuum Relef Valve Cap
5-VRV-CAP;GREEN - Vacuum Control Valve Cap; Green
5-VRV-RET - Vacuum Relief Valve Seal Retaining Ring
5-VRV-SEAT-UDL - Vacuum Relief Valve Seat UDL
DC-THPOCKET - Thermo Pocket
FLTB-150B - Ball Float ex Bela
TP-CAP - Temp. & Press. Relief Valve Cap
TP-CAP;GREEN - Temp & Press Relief Valve Cap; Green
Supplier : CARL - Carlin Medical Extrutions
20-EV-SA - EV Seal
20VRVWASHER - VRV Seal washers
TP-SEAL - Temp. & Press. Relief Valve Seal
Supplier : COBRA - Cobra Watertech (Pty) Ltd
C-PA4.832 - Cobra Master Flow II Cartridge; 400kPa
CN15 - Spare Cap Nut; 15mm
CN22 - Spare Cap Nut; 22mm
COBRA1090-15 - Cobra Shutoff; 15mm
SR22 - Spare Ring; 22mm
TP-PROBE - Temp. & Press. Relief Valve Probe
TP-PROBE-LONG - TP-400 Long Probe
VRV.2;22CXC - Spring Loaded Vacuum Breaker; Body
Supplier : ELCO - Elco Marketing
INSTAL-TV15CXC - Installation Instructions TV15CXC
INSTHEATPUMP - Installation Instructions Heat Pump
INSTTV - Installation Instructions TemperingValve
ISTALINS - Installation Instructions
STICK-LV-600 - LV-600 Sticker
STICK-LVC400;CO - Cartridge Sticker; 400kPa COBRA
STICK-LVC600;CO - Cartridge Sticker; 600kPa COBRA
STICK-LVEV-400 - LVEV-400 Sticker
STICK-S/OFF - Shut Off Valve Sticker
STICK-TP-400 - Temp.& Press. Relief Valve Sticker; 400
STICK-TP-600 - Temp.& Press. Relief Valve Sticker; 600
STICK-VRV-15X15 - Vacuum Breaker 15x22CxC with Takeoff
STICK-VRV-15X22 - Vacuum Breaker 15x22CxC with Takeoff
TPCORES - TP Valve Probe Protectors

Supplier : EXI - EXIPRO SWAZILAND
1-ISTC - Isotech Body
1-LVEV-C15 - Pressure Control Valve Body; 15CXC
1-LVEV-C15;COB - Pressure Control Valve Body; 15CXC COBRA
1-LVEV-C22 - Pressure Control Valve Body; 22CXC
1-LVEV-C22;COB - Pressure Control Valve Body; 22CXC COBRA
1-LVEV-C33 - Pressure Control Valve Body; UNI
1-LVEV-SA - Pres. Contr. Valve Body; 3/4BSP
1-SAVRV-20 - Vacuum Control Valve Body; 3/4;BSP
1-TVSA-15CXC;EL - Tempering Valve Body-15CXC; Equal Lenght
1-TVSA-22COB;EX - Tempering Valve Body -22CxC; Cobra Ex
1-TVSA-22CXC;CO - Tempering Valve Body -22CxC; Cobra
1-TVSA-22CXC;EL - Tempering Valve Body-22CXC; Incl
1-TVSA-22CXC;EX - Tempering Valve Body - 22CXC; Excl
1-VRV-15X15 - Vacuum Breaker 15x15CxC with Takeoff
1-VRV-15X22 - Vacuum Breaker 15x22CxC with Takeoff
1-VRV-C15 - Vacuum Control Valve Body; 15CXC
1-VRV-C22 - Vacuum Control Valve Body; 22CXC
12-EV-ADJ - EV Adjuster
12-ISTC - Isotech Spring Disc
14-ISTCPOCKET - Isotech Valve Extension Tube
15-ISTCNUT - Isotech Valve end nut
20-FIBREWAS-25 - Fibre Washer; 25mm
28-DIVNR;22 - Diverter Non-Return; 22CXC
3-EV-SA - EV Spring Housing
3/4X1/2BUSH - 3/4 1/2 BSP Brass Bush FXF
3/4X1/2BUSHMALE - 3/4 1/2 BSP Brass Bush Male
9-ISTC - Isotech Adjusting Spindle
CN15 - Spare Cap Nut; 15mm
CN22 - Spare Cap Nut; 22mm
DC-THER - Drain Cock with Thermocouple Pocket; 22
DC-½-¾FM - Drain Cock ½ to ¾ FM
DC-½-¾MALE - Drain Cock ½ to ¾ Male
DRAINCOCK - Drain Cock 3/4 In/Out
DRCOCK-S - Solar Draincock with port
DRCOCK15MM - Drain Cock 15mm
DRCOCK15MM3/4FE - Drain Cock 15mm 3/4 Female
DRCOCK15MM3/4MA - Drain Cock 15mm 3/4 Male
FIT-S;15CXC - Solar Adaptor; 15CXC
FIT-S;22CXC - Solar Adaptor; 22CXC
LVPLUG - LV Conversion Plug
PALLETS - Pallets
S/OFF-15MM - Shut Off Valve; 15 CXC
S/OFF-22CXC - Shut Off Valve; 22 CXC
SR15 - Spare Ring; 15mm
SR22 - Spare Ring; 22mm
TP-ADJNUT - Temp. & Press. Relief Valve Adj. Nut
TP-ADJSCREW - Temp. & Press. Relief Valve Adj. Screw
P-BOD CXC - Temp. & Press. Relief Valve Body; CXC
TP-BOD-S - Solar Temp. Press Relilef Body with Port
TP-BUSH1/2 - TP Socket; 1/2 BSP
TP-BUSH3/4 - Solar TP Socket; 3/4 BSP
TP-PIN-LONG - TP Pin Long Probe
TP-S;JUMP - Temp. & Press. Relief Valve Jumper
TP-S;JUMPRETAIN - Temp. & Press. Relief Valve Jumper Retai

Supplier : MEDIAH - Centurion Hydraulics
18-017 - VAcuum Control Valve O Ring
Supplier : SPRMAN - Spring Manufacturers of SA CC
11-EV-SA400 - EV Spring; 400kPa
11-EV-SA600 - EV Spring; 600kPa
11-TP-600 - Safety Valve Spring; 600kPa
11-VRV-SPR - Vacuum Relief Valve Insert Spring
LVCSPR - Cartridge Spring
SAMPLES - Samples
TP-SPR;400 - Temp. & Press Relief Valve Spr.; 400 kPa
Supplier : SPRTEC - Springtech Spring Design and Manufacture
11-EV-SA400 - EV Spring; 400kPa
11-EV-SA600 - EV Spring; 600kPa
11-LV-200 - Cartridge Spirng; 200 / 300 kPa
Supplier : WRBOX - West Rand Box (Pty) Ltd.
27-LVEV10 - LVEV BOX
27-LVEV5 - LVEV BOX
CAR-LVEV-IN - LVEV Inner Carton
CAR-STOCK-3 - Stock 3 Outer Carton
CAR-TV - Carton Tempering Valve
CAR-UNI-IN - Multi Block Inner Carton

5.6 Appendix B : Data of BOM's for items being sold at Apex Valves SA

Code :	B-LVEV-400;22CX	Pres. Contr. valve; 22CXC; 400kPa
Manufactured Item :	LVEV-400;22CXC	Pressure Control Valve; 22CXC; 400kPa
Item	**Description**	**Quantity**
5-EV-SA	EV Seat	1
SR22	Spare Ring; 22mm	2
CN15	Spare Cap Nut; 15mm	1
SR15	Spare Ring; 15mm	1
11-EV-SA400	EV Spring; 400kPa	1
12-EV-ADJ	EV Adjuster	1
3-EV-SA	EV Spring Housing	1
1-LVEV-C22	Pressure Control Valve Body; 22CXC	1
18-018	EV Seat O Ring	1
18-023	O Ring 23mm	1
ASSJUMPER	EV Assembled Jumper	1
LVC-400	Pressure Control Valve Cartridge; 400kPa	1
ISTALINS	Installation Instructions	1
CN22	Spare Cap Nut; 22mm	2
CAR-LVEV-IN	LVEV Inner Carton	1
2		
Code :	B-LVEV-400;15CX	Press. Contr. Valve; 15CXC; 400kPa
Manufactured Item :	LVEV-400;15CXC	Pressure Control Valve; 15CXC; 400kPa
Item	**Description**	**Quantity**
12-EV-ADJ	EV Adjuster	1
11-EV-SA400	EV Spring; 400kPa	1
5-EV-SA	EV Seat	1
18-018	EV Seat O Ring	1
18-023	O Ring 23mm	1
ASSJUMPER	EV Assembled Jumper	1
LVC-400	Pressure Control Valve Cartridge; 400kPa	1
ISTALINS	Installation Instructions	1
CN15	Spare Cap Nut; 15mm	3
SR15	Spare Ring; 15mm	3
3-EV-SA	EV Spring Housing	1
1-LVEV-C15	Pressure Control Valve Body; 15CXC	1
CAR-LVEV-IN	LVEV Inner Carton	1
3		
Code :	B-LVEV-400;3/4	Pres. Contr. Valve;3/4BSP 400kPa
Manufactured Item :	LVEV-400;3/4	Pressure Control Valve;3/4BSP 400kPa
Item	**Description**	**Quantity**
1-LVEV-SA	Pres. Contr. Valve Body; 3/4BSP	1
3-EV-SA	EV Spring Housing	1
12-EV-ADJ	EV Adjuster	1
11-EV-SA400	EV Spring; 400kPa	1
5-EV-SA	EV Seat	1
18-018	EV Seat O Ring	1
18-023	O Ring 23mm	1
ASSJUMPER	EV Assembled Jumper	1
LVC-400	Pressure Control Valve Cartridge; 400kPa	1
ISTALINS	Installation Instructions	1
CAR-LVEV-IN	LVEV Inner Carton	1
4		
Code :	B-LVEV-400P;22C	Press. Contr. Val. with 2 x VRV22CXC
Manufactured Item :	LVEV-400P;22CXC	Press. Contr. Val. with 2 x VRV22CXC
Item	**Description**	**Quantity**
LVEV-400;22CXC	Pressure Control Valve; 22CXC; 400kPa	1
VRV-22;CX	Vacuum Control Valve; 22CXC	2
5		
Code :	B-LVEV-400P;15C	Press. Contr. Val. with 2 x VRV15CXC
Manufactured Item :	LVEV-400P;15CXC	Press. Contr. Val. with 2 x VRV15CXC
Item	**Description**	**Quantity**
LVEV-400;15CXC	Pressure Control Valve; 15CXC; 400kPa	1
VRV-15 CXC	Vacuum Control Valve; 15CXC	2

6		
Code :	B-LVEV-400P;3/4	Press. Contr. Val. with 2 x VRV3/4 BSP
Manufactured Item :	LVEV-400P;3/4	Pres. Cont. Val. with 2 x VRV3/4 BSP
Item	**Description**	**Quantity**
LVEV-400;3/4	Pressure Control Valve;3/4BSP 400kPa	1
VRV203/4	Vacuum Control Valve; 3/4;BSP	2

7		
Code :	B-LVEV-600;22CX	Pressure Contr. Valve; 22CXC; 600kPa
Manufactured Item :	LVEV-600;22CXC	Pressure Control Valve;22CXC;600kPa
Item	**Description**	**Quantity**
1-LVEV-C22	Pressure Control Valve Body; 22CXC	1
3-EV-SA	EV Spring Housing	1
12-EV-ADJ	EV Adjuster	1
11-EV-SA600	EV Spring; 600kPa	1
5-EV-SA	EV Seat	1
18-018	EV Seat O Ring	1
18-023	O Ring 23mm	1
ASSJUMPER	EV Assembled Jumper	1
LVC-600	Pressure Control Valve Cartridge; 600kPa	1
ISTALINS	Installation Instructions	1
CN22	Spare Cap Nut; 22mm	2
SR22	Spare Ring; 22mm	2
CN15	Spare Cap Nut; 15mm	1
SR15	Spare Ring; 15mm	1
CAR-LVEV-IN	LVEV Inner Carton	1

8		
Code :	B-MB-400 15CXC	Press. Contr. Val. with Shut Off & 2 VRV
Manufactured Item :	MB-400;15CXC	Press. Contr. Val. with Shutoff + 2x VRV
Item	**Description**	**Quantity**
S/OFF-15MM	Shut Off Valve; 15 CXC	1
VRV-15 CXC	Vacuum Control Valve; 15CXC	2
LVEV-400;15CXC	Pressure Control Valve; 15CXC; 400kPa	1
CAR-UNI-IN	Multi Block Inner Carton	1

9		
Code :	B-VRV-22;CXC	Vacuum Control Valve; 22CXC
Manufactured Item :	VRV-22;CX	Vacuum Control Valve; 22CXC
Item	**Description**	**Quantity**
5-VRV-RET	Vacuum Relief Valve Seal Retaining Ring	1
5-VRV-CAP	Vacuum Relef Valve Cap	1
18-017	VAcuum Control Valve O Ring	1
SR22	Spare Ring; 22mm	1
20VRVWASHER	VRV Seal washers	1
CN22	Spare Cap Nut; 22mm	1
1-VRV-C22	Vacuum Control Valve Body; 22CXC	1
5-VRV-SEAT-UDL	Vacuum Relief Valve Seat UDL	1
11-VRV-SPR	Vacuum Relief Valve Insert Spring	1

10		
Code :	B-VRV-15 CXC	Vacuum Control Valve; 15CXC
Manufactured Item :	VRV-15 CXC	Vacuum Control Valve; 15CXC
Item	**Description**	**Quantity**
SR15	Spare Ring; 15mm	1
18-017	VAcuum Control Valve O Ring	1
5-VRV-CAP	Vacuum Relef Valve Cap	1
CN15	Spare Cap Nut; 15mm	1
5-VRV-RET	Vacuum Relief Valve Seal Retaining Ring	1
20VRVWASHER	VRV Seal washers	1
1-VRV-C15	Vacuum Control Valve Body; 15CXC	1
5-VRV-SEAT-UDL	Vacuum Relief Valve Seat UDL	1
11-VRV-SPR	Vacuum Relief Valve Insert Spring	1

11		
Code :	B-VRV20;3/4	Vacuum Control Valve; 3/4;BSP
Manufactured Item :	VRV203/4	Vacuum Control Valve; 3/4;BSP
Item	**Description**	**Quantity**
5-VRV-RET	Vacuum Relief Valve Seal Retaining Ring	1
5-VRV-CAP	Vacuum Relef Valve Cap	1
20VRVWASHER	VRV Seal washers	1
1-SAVRV-20	Vacuum Control Valve Body; 3/4;BSP	1
18-017	VAcuum Control Valve O Ring	1
5-VRV-SEAT-UDL	Vacuum Relief Valve Seat UDL	1
12		
Code :	B-VRV-15'1/2	Vacuum Control Valve; 1/2 BSP
Manufactured Item :	VRV-15 1/2	Vacuum Control Valve; 1/2;BSP
Item	**Description**	**Quantity**
1-VRV-C15	Vacuum Control Valve Body; 15CXC	1
20VRVWASHER	VRV Seal washers	1
5-VRV-CAP	Vacuum Relef Valve Cap	1
5-VRV-RET	Vacuum Relief Valve Seal Retaining Ring	1
18-017	VAcuum Control Valve O Ring	1
5-VRV-SEAT-UDL	Vacuum Relief Valve Seat UDL	1
11-VRV-SPR	Vacuum Relief Valve Insert Spring	1
13		
Code :	B-GEYSERPAC	Geyser Valve Pack
Manufactured Item :	GEYSERPACK	TP Valve & Drain Cock Pack
Item	**Description**	**Quantity**
TP-400	Temp. & Press. Relief Valve; 400kPa	1
DRAINCOCK	Drain Cock 3/4 In/Out	1
14		
Code :	B-GEYSERP-600KP	Geyser Pack; Safety Valve & Drain 600kPa
Manufactured Item :	GEYSERP-600KPA	Geyer Pack; Safety Valve & Drain 600kPa
Item	**Description**	**Quantity**
TP-600	Temp. & Press. Relief Valve; 600kPa	1
DRAINCOCK	Drain Cock 3/4 In/Out	1
15		
Code :	B-DC-THER;15CXC	Drain Cock + Thermo Pocket; 15CxC
Manufactured Item :	DC-THER;15CXC	Drain Cock + Thermo Pocket; 15CxC
Item	**Description**	**Quantity**
DC-THER	Drain Cock with Thermocouple Pocket; 22	1
FIT-S;15CXC	Solar Adaptor; 15CXC	1
CN15	Spare Cap Nut; 15mm	1
SR15	Spare Ring; 15mm	1

16		
Code :	B-DC-THER	Solar Drain Cock with Thermo Pocket - 22
Manufactured Item :	DC-THER	Drain Cock with Thermocouple Pocket; 22
Item	**Description**	**Quantity**
DC-THPOCKET	Thermo Pocket	1
DC-THER-BODY	Draincock Thermo Body	1
20-FIBREWAS-25	Fibre Washer; 25mm	1
FIT-S;22CXC	Solar Adaptor; 22CXC	1
CN22	Spare Cap Nut; 22mm	1
SR22	Spare Ring; 22mm	1

17		
Code :	B-TP-400	Temperature & Pressure Relief Valve; 400
Manufactured Item :	TP-400	Temp. & Press. Relief Valve; 400kPa
Item	**Description**	**Quantity**
TP-BOD CXC	Temp. & Press. Relief Valve Body; CXC	1
TP-CAP	Temp. & Press. Relief Valve Cap	1
TP-PROBE	Temp. & Press. Relief Valve Probe	1
TP-SEAL	Temp. & Press. Relief Valve Seal	1
TP-S;JUMP	Temp. & Press. Relief Valve Jumper	1
TP-S;JUMPRETAIN	Temp. & Press. Relief Valve Jumper Retai	1
TP-ADJNUT	Temp. & Press. Relief Valve Adj. Nut	1
TP-ADJSCREW	Temp. & Press. Relief Valve Adj. Screw	1
TP-SPR;400	Temp. & Press Relief Valve Spr.; 400 kPa	1
CN22	Spare Cap Nut; 22mm	1
SR22	Spare Ring; 22mm	1
TPCORES	TP Valve Probe Protectors	1
STICK-TP-400	Temp.& Press. Relief Valve Sticker; 400	1

18		
Code :	B-TP-600	Temp. & Press. Relief Valve; 600kPa
Manufactured Item :	TP-600	Temp. & Press. Relief Valve; 600kPa
Item	**Description**	**Quantity**
TP-BOD CXC	Temp. & Press. Relief Valve Body; CXC	1
TP-CAP	Temp. & Press. Relief Valve Cap	1
TP-PROBE	Temp. & Press. Relief Valve Probe	1
TP-SEAL	Temp. & Press. Relief Valve Seal	1
TP-S;JUMP	Temp. & Press. Relief Valve Jumper	1
TP-S;JUMPRETAIN	Temp. & Press. Relief Valve Jumper Retai	1
TP-ADJNUT	Temp. & Press. Relief Valve Adj. Nut	1
TP-ADJSCREW	Temp. & Press. Relief Valve Adj. Screw	1
11-TP-600	Safety Valve Spring; 600kPa	1
CN22	Spare Cap Nut; 22mm	1
SR22	Spare Ring; 22mm	1
TPCORES	TP Valve Probe Protectors	1
STICK-TP-600	Temp.& Press. Relief Valve Sticker; 600	1

19		
Code :	B-TP-400 LONG	TP-400 Long Probe; Pressure Relief Valve
Manufactured Item :	TP-400-LONG	TP-400; Long Probe; Pressure Relief Valv
Item	**Description**	**Quantity**
TP-BOD CXC	Temp. & Press. Relief Valve Body; CXC	1
TP-CAP	Temp. & Press. Relief Valve Cap	1
TP-PROBE-LONG	TP-400 Long Probe	1
TP-SEAL	Temp. & Press. Relief Valve Seal	1
TP-S;JUMP	Temp. & Press. Relief Valve Jumper	1
TP-S;JUMPRETAIN	Temp. & Press. Relief Valve Jumper Retai	1
TP-ADJNUT	Temp. & Press. Relief Valve Adj. Nut	1
TP-ADJSCREW	Temp. & Press. Relief Valve Adj. Screw	1
TP-SPR;400	Temp. & Press Relief Valve Spr.; 400 kPa	1
CN22	Spare Cap Nut; 22mm	1
SR22	Spare Ring; 22mm	1
TPCORES	TP Valve Probe Protectors	1
STICK-TP-400	Temp.& Press. Relief Valve Sticker; 400	1

20		
Code :	B-TP-600;SS	Solar Safety Valve; Std Probe; 600kPa
Manufactured Item :	TP-600;SS	Solar Safety Valve; Std. Probe
Item	**Description**	**Quantity**
TP-CAP	Temp. & Press. Relief Valve Cap	1
TP-PROBE	Temp. & Press. Relief Valve Probe	1
TP-SEAL	Temp. & Press. Relief Valve Seal	1
TP-S;JUMP	Temp. & Press. Relief Valve Jumper	1
TP-S;JUMPRETAIN	Temp. & Press. Relief Valve Jumper Retai	1
TP-ADJNUT	Temp. & Press. Relief Valve Adj. Nut	1
TP-ADJSCREW	Temp. & Press. Relief Valve Adj. Screw	1
11-TP-600	Safety Valve Spring; 600kPa	1
CN22	Spare Cap Nut; 22mm	1
SR22	Spare Ring; 22mm	1
TPCORES	TP Valve Probe Protectors	1
TP-BOD-S	Solar Temp. Press Relilef Body with Port	1

21		
Code :	B-TP-600 LONG	TP-600; L Safety Valve; 600kPa Long Prob
Manufactured Item :	TP-600;LONG	TP-600; L Saftey Valve 600kPa; Long Prob
Item	**Description**	**Quantity**
TP-BOD CXC	Temp. & Press. Relief Valve Body; CXC	1
TP-CAP	Temp. & Press. Relief Valve Cap	1
TP-PROBE-LONG	TP-400 Long Probe	1
TP-SEAL	Temp. & Press. Relief Valve Seal	1
TP-S;JUMP	Temp. & Press. Relief Valve Jumper	1
TP-S;JUMPRETAIN	Temp. & Press. Relief Valve Jumper Retai	1
TP-ADJNUT	Temp. & Press. Relief Valve Adj. Nut	1
TP-ADJSCREW	Temp. & Press. Relief Valve Adj. Screw	1
11-TP-600	Safety Valve Spring; 600kPa	1
CN22	Spare Cap Nut; 22mm	1
SR22	Spare Ring; 22mm	1
TPCORES	TP Valve Probe Protectors	1
22		
Code :	B-DRCOCK-S;15CX	Draincock Solar; 15CXC Port
Manufactured Item :	DRCOCK-S;15CXC	Draincock Solar; 15CXC Port
Item	**Description**	**Quantity**
DRCOCK-S	Solar Draincock with port	1
FIT-S;15CXC	Solar Adaptor; 15CXC	1
CN15	Spare Cap Nut; 15mm	1
SR15	Spare Ring; 15mm	1
23		
Code :	B-DRCOCK-S;22CX	Draincock Solar; 22CXC Port
Manufactured Item :	DRCOCK-S;22CXC	Draincock Solar; 22CXC Port
Item	**Description**	**Quantity**
DRCOCK-S	Solar Draincock with port	1
FIT-S;22CXC	Solar Adaptor; 22CXC	1
CN22	Spare Cap Nut; 22mm	1
SR22	Spare Ring; 22mm	1
24		
Code :	B-DC-½-¾FM	Drain Cock ½ BSP x ¾ FM
Manufactured Item :	DC-½-¾FM	Drain Cock ½ to ¾ FM
Item	**Description**	**Quantity**
DRCOCK15MM	Drain Cock 15mm	1
3/4X1/2BUSH	3/4 1/2 BSP Brass Bush FXF	1
25		
Code :	B-DC-THER;22CXC	Drain Cock + Thermo Pocket; 22CxC
Manufactured Item :	DC-THER;22CXC	Drain Cock + Thermo Pocket; 22CxC
Item	**Description**	**Quantity**
DC-THER	Drain Cock with Thermocouple Pocket; 22	1
FIT-S;22CXC	Solar Adaptor; 22CXC	1
CN22	Spare Cap Nut; 22mm	1
SR22	Spare Ring; 22mm	1

26		
Code :	B-TV-15;EL	Tempering Valve 15CXC; Equal Length
Manufactured Item :	TV-15	Tempering Valve -15CXC; Excl. Non-Return
Item	**Description**	**Quantity**
1-TVSA-15CXC;EL	Tempering Valve Body-15CXC; Equal Lenght	1
CN15	Spare Cap Nut; 15mm	3
SR15	Spare Ring; 15mm	3
CAR-TV	Carton Tempering Valve	1
23-TV-ELEM	Tempering Valve Element	1
18-023	O Ring 23mm	1
8-TV-BONNET	Tempering Valve Bonnet Sub Assembly	1
9-TV-SPIN	Tempering Valve Spindle Sub Assembly	1
11-TV-MSPR	Tempering Valve Main Spring	1
13-TV	Tempering Valve Control Piston	1
13-TV-D	Tempering Valve Diverter	1
15-TV-RET	Tempering Valve O Ring Retainer	1
5-TV-CAP	Tempering Valve Cap	1
18-127	Tempering Valve Bonnet O Ring 127mm	1
18-029	Tempering Valve Diverter O Ring 29mm	1
INSTAL-TV15CXC	Installation Instructions TV15CXC	1

27		
Code :	B-TV-22;EL	Tempering Valve 22CXC; Equal Length
Manufactured Item :	TV-22CXC;EL	Tempering Valve 22CXC; High Pressure
Item	**Description**	**Quantity**
CN22	Spare Cap Nut; 22mm	3
SR22	Spare Ring; 22mm	3
CAR-TV	Carton Tempering Valve	1
11-TV-MSPR	Tempering Valve Main Spring	1
13-TV	Tempering Valve Control Piston	1
13-TV-D	Tempering Valve Diverter	1
15-TV-RET	Tempering Valve O Ring Retainer	1
18-023	O Ring 23mm	1
23-TV-ELEM	Tempering Valve Element	1
5-TV-CAP	Tempering Valve Cap	1
8-TV-BONNET	Tempering Valve Bonnet Sub Assembly	1
9-TV-SPIN	Tempering Valve Spindle Sub Assembly	1
18-029	Tempering Valve Diverter O Ring 29mm	1
18-127	Tempering Valve Bonnet O Ring 127mm	1
22-OV-20	Tempering Valve 20mm Non-Return Cartridg	1
22-OV-20HT	High Temp 20mm Non Return	1
1-TVSA-22CXC;EL	Tempering Valve Body-22CXC; Incl	1
11-TV20-NR	Temp. Val. Non Return Cartridge Retainer	2

28		
Code :	B-TV-DIVER	Tempering Valve Diverter; 22CxC
Manufactured Item :	TV-DIVERTER	Tempering Valve Diverter; 22CxC
Item	**Description**	**Quantity**
CN22	Spare Cap Nut; 22mm	3
SR22	Spare Ring; 22mm	3
CAR-TV	Carton Tempering Valve	1
11-TV-MSPR	Tempering Valve Main Spring	1
13-TV	Tempering Valve Control Piston	1
13-TV-D	Tempering Valve Diverter	1
15-TV-RET	Tempering Valve O Ring Retainer	1
18-023	O Ring 23mm	1
5-TV-CAP	Tempering Valve Cap	1
8-TV-BONNET	Tempering Valve Bonnet Sub Assembly	1
9-TV-SPIN	Tempering Valve Spindle Sub Assembly	1
18-029	Tempering Valve Diverter O Ring 29mm	1
18-127	Tempering Valve Bonnet O Ring 127mm	1
1-TVSA-22CXC;EL	Tempering Valve Body-22CXC; Incl	1
23-TVA;DIVELEM	TV-Diverter Element	1

29		
Code :	B-TV-DIVER;15CX	Tempering Valve Diverter;15CxC
Manufactured Item :	TV-DIVERT;15CXC	Tempering Valve Diverter; 15CxC
Item	**Description**	**Quantity**
CN15	Spare Cap Nut; 15mm	3
SR15	Spare Ring; 15mm	3
CAR-TV	Carton Tempering Valve	1
11-TV-MSPR	Tempering Valve Main Spring	1
13-TV	Tempering Valve Control Piston	1
13-TV-D	Tempering Valve Diverter	1
15-TV-RET	Tempering Valve O Ring Retainer	1
18-023	O Ring 23mm	1
5-TV-CAP	Tempering Valve Cap	1
8-TV-BONNET	Tempering Valve Bonnet Sub Assembly	1
9-TV-SPIN	Tempering Valve Spindle Sub Assembly	1
18-029	Tempering Valve Diverter O Ring 29mm	1
18-127	Tempering Valve Bonnet O Ring 127mm	1
1-TVSA-15CXC;EL	Tempering Valve Body-15CXC; Equal Lenght	1
23-TVA;DIVELEM	TV-Diverter Element	1

30		
Code :	B-ISOTEC	Isotec; 400kPa
Manufactured Item :	ISOTEC-400	Isotec Temperature Relief Valve; 400 kPa
Item	**Description**	**Quantity**
1-ISTC	Isotech Body	1
3-EV-SA	EV Spring Housing	1
5-EV-SA	EV Seat	1
9-ISTC	Isotech Adjusting Spindle	1
11-EV-SA400	EV Spring; 400kPa	1
11-ISTC-E	Isotech Element Spring	1
11-ISTC-LP	Low Pressure Spring; Isotech	1
12-EV-ADJ	EV Adjuster	1
12-ISTC	Isotech Spring Disc	1
18-018	EV Seat O Ring	1
18-023	O Ring 23mm	1
20-EV-SA	EV Seal	1
CN22	Spare Cap Nut; 22mm	3
SR22	Spare Ring; 22mm	3
CAR-TV	Carton Tempering Valve	1
10-EVRSA-P	Isotech Polysulfone	1
10-EVSA-P	Isotech Polysulfone Jumper	1
11-ISTC	Isotech Spindle Spring Clip	1
13-ISTC	Isotech Polysulfone Plunger	1
18-120	Isotech Spindle 'O' Ring	1
23-ISTC	Isotech Element	1
15-ISTCNUT	Isotech Valve end nut	1

31		
Code :	B-MB-400;22CX-L	Press Contr Val with Shut Off & 2 x VRV
Manufactured Item :	MB-400;22CXC-L	MB-400; 22CXC PCV Set Loose
Item	**Description**	**Quantity**
LVEV-400;22CXC	Pressure Control Valve; 22CXC; 400kPa	1
S/OFF-22CXC	Shut Off Valve; 22 CXC	1
VRV-22;CX	Vacuum Control Valve; 22CXC	2
CAR-UNI-IN	Multi Block Inner Carton	1

32		
Code :	B-LVC-400	Pressure Control Valve Cartridge; 400kPa
Manufactured Item :	LVC-400	Pressure Control Valve Cartridge; 400kPa
Item	**Description**	**Quantity**
LVC-10-LVP	Cartridge Jumper	1
LVC-12-LV	Cartridge Adjuster	1
LVC-13-LVP	Cartridge Piston	1
LVC-15-LVP-M4	Cartridge Stainless Cap Screw	1
18-007	Cartridge O Ring; 7mm	1
18-023	O Ring 23mm	1
18-113	Cartridge O Ring; 113mm	1
18-121	Cartridge O Ring; 121mm	1
18-124	Cartridge O Ring; 124mm	1
18-130	LV Cartridges O Ring	1
LVC-20-LVP	Cartridge Washer	1
LVC-3-LVP	Cartridge Spring Housing	1
LVC-3-LVP-R	Cartrdige Lock Ring	1
LVC-4-LVP	Cartridge Pressure Plate	1
LVC-5-LVP	Cartridge Seat	1
LVC-7-LVP	Cartridge Filter	1
LVCSPR	Cartridge Spring	1
5-LV-RED	LV-400 Adjuster Screw Cap	1

33		
Code :	B-LVC-600	Pressure Control Valve Cartridge; 600kPa
Manufactured Item :	LVC-600	Pressure Control Valve Cartridge; 600kPa
Item	**Description**	**Quantity**
LVC-10-LVP	Cartridge Jumper	1
LVC-12-LV	Cartridge Adjuster	1
LVC-13-LVP	Cartridge Piston	1
LVC-15-LVP-M4	Cartridge Stainless Cap Screw	1
18-007	Cartridge O Ring; 7mm	1
18-023	O Ring 23mm	1
18-113	Cartridge O Ring; 113mm	1
18-121	Cartridge O Ring; 121mm	1
18-124	Cartridge O Ring; 124mm	1
18-130	LV Cartridges O Ring	1
LVC-20-LVP	Cartridge Washer	1
LVC-3-LVP	Cartridge Spring Housing	1
LVC-3-LVP-R	Cartrdige Lock Ring	1
LVC-4-LVP	Cartridge Pressure Plate	1
LVC-5-LVP	Cartridge Seat	1
LVC-7-LVP	Cartridge Filter	1
LVCSPR	Cartridge Spring	1
5-LV-GREEN	LV-600 Adjuster Screw Cap	1
STICK-LV-600	LV-600 Sticker	1

34		
Code :	BASSJUMPER	EV Assembled Jumper
Manufactured Item :	ASSJUMPER	EV Assembled Jumper
Item	**Description**	**Quantity**
20-EV-SA	EV Seal	1
10-EV-SA	EV Jumper	1
10-EVR-SA	EV Jumper Retainer	1

35		
Code :	B-LVC-400;COBRA	Cartrige; 400kPa COBRA
Manufactured Item :	LVC-400;COBRA	Replacement Cartridge; 400kPa COBRA
Item	**Description**	**Quantity**
LVC-10-LVP	Cartridge Jumper	1
LVC-12-LV	Cartridge Adjuster	1
LVC-13-LVP	Cartridge Piston	1
LVC-15-LVP-M4	Cartridge Stainless Cap Screw	1
LVC-20-LVP	Cartridge Washer	1
LVC-3-LVP	Cartridge Spring Housing	1
LVC-3-LVP-R	Cartrdige Lock Ring	1
LVC-4-LVP	Cartridge Pressure Plate	1
LVC-5-LVP	Cartridge Seat	1
LVC-7-LVP	Cartridge Filter	1
LVCSPR	Cartridge Spring	1
18-007	Cartridge O Ring; 7mm	1
18-023	O Ring 23mm	1
18-113	Cartridge O Ring; 113mm	1
18-121	Cartridge O Ring; 121mm	1
18-124	Cartridge O Ring; 124mm	1
18-130	LV Cartridges O Ring	1
5-LV-RED;COBRA	LV-400 Adjuster Screw Cap; COBRA	1
STICK-LVC400;CO	Cartridge Sticker; 400kPa COBRA	1

5.7 Appendix C : Output interfaces –Inventory records of 3 more products to see the variation between them

Output interface of LVEV-400P,22CxC

OUTPUTS of MRP system	
Product	LVEV400P,22CxC
	Product
	Component with 2nd level

			12-Nov				12-Dec				13-Jan			
Item	Week	0	1	2	3	4	5	6	7	8	9	10	11	12
LVEV400P,22CxC	Gross requirements		0	0	0	3072	0	0	0	2105	0	0	0	2001
	Scheduled receipt													
	Projected Available Balance	138			138	-2934			0	-2105			0	-2001
	Net requirement					2934				2105				2001
	Planned order receipt					2934				2105				2001
0	Planned order release					2934				2105				2001
5-EV-SA	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	2809			2809	-125			0	-2105			0	-2001
	Net requirement					125				2105				2001
	Planned order receipt					125				2105				2001
4	Planned order release	125				2105				2001				
SR22	Gross requirements					5868				4210				4002
	Scheduled receipt													
	Projected Available Balance	2553			2553	-3315			0	-4210			0	-4002
	Net requirement					3315				4210				4002
	Planned order receipt					3315				4210				4002
3	Planned order release		3315				4210				4002			
CN15	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	5072			5072	2138			2138	33			33	-1968
	Net requirement					0				0				1968
	Planned order receipt													1968
3	Planned order release										1968			
SR15	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	13633			13633	10699			10699	8594			8594	6593
	Net requirement					0				0				0
	Planned order receipt													
3	Planned order release													
11-EV-SA400	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	3761			3761	827			827	-1278			0	-2001
	Net requirement					0				1278				2001
	Planned order receipt									1278				2001
2	Planned order release							1278				2001		
12-EV-ADJ	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	5602			5602	2668			2668	563			563	-1438
	Net requirement					0				0				1438
	Planned order receipt													1438
3	Planned order release										1438			
3-EV-SA	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	6735			6735	3801			3801	1696			1696	-305
	Net requirement					0				0				305
	Planned order receipt													305
3	Planned order release										305			
1-LVEV-C22	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	1690			1690	-1244			0	-2105			0	-2001
	Net requirement					1244				2105				2001
	Planned order receipt					1244				2105				2001
3	Planned order release		1244				2105				2001			
18-018	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	4495			4495	1561			1561	-544			0	-2001
	Net requirement					0				544				2001
	Planned order receipt									544				2001
4	Planned order release					544				2001				
18-023	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	6588			6588	3654			3654	1549			1549	-452
	Net requirement					0				0				452
	Planned order receipt													452
4	Planned order release									452				
ISTALINS	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	9734			9734	6800			6800	4695			4695	2694
	Net requirement					0				0				0
	Planned order receipt													
1	Planned order release													

CN22	Gross requirements					5868				4210				4002
	Scheduled receipt													
	Projected Available Balance	2947			2947	-2921			0	-4210			0	-4002
	Net requirement					2921				4210				4002
	Planned order receipt					2921				4210				4002
3	Planned order release		2921				4210				4002			
CAR-LVEV-IN	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	1878			1878	-1056			0	-2105			0	-2001
	Net requirement					1056				2105				2001
	Planned order receipt					1056				2105				2001
2	Planned order release			1056				2105				2001		
ASSJUMPER	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	0			0	-2934			0	-2105			0	-2001
	Net requirement					2934				2105				2001
	Planned order receipt					2934				2105				2001
0	Planned order release					2934				2105				2001
20-EV-SA	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	5383			5383	2449			2449	344			344	-1657
	Net requirement					0				0				1657
	Planned order receipt													1657
1	Planned order release												1657	
10-EV-SA	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	2429			2429	-505			0	-2105			0	-2001
	Net requirement					505				2105				2001
	Planned order receipt					505				2105				2001
4	Planned order release	505				2105				2001				
10-EVR-SA	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	3444			3444	510			510	-1595			0	-2001
	Net requirement					0				1595				2001
	Planned order receipt									1595				2001
4	Planned order release					1595				2001				
LVC-400	Gross requirements					2934				2105				2001
	Scheduled receipt													
	Projected Available Balance	1147			1147	-1787			0	-2105			0	-2001
	Net requirement					1787				2105				2001
	Planned order receipt					1787				2105				2001
0	Planned order release					1787				2105				2001
LVC-10-LVP	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	1348			1348	-439			0	-2105			0	-2001
	Net requirement					439				2105				2001
	Planned order receipt					439				2105				2001
4	Planned order release	439				2105				2001				
LVC-12-LV	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	1157			1157	-630			0	-2105			0	-2001
	Net requirement					630				2105				2001
	Planned order receipt					630				2105				2001
4	Planned order release	630				2105				2001				
LVC-13-LVP	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	1498			1498	-289			0	-2105			0	-2001
	Net requirement					289				2105				2001
	Planned order receipt					289				2105				2001
4	Planned order release	289				2105				2001				
LVC-15-LVP-M4	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	1006			1006	-781			0	-2105			0	-2001
	Net requirement					781				2105				2001
	Planned order receipt					781				2105				2001
4	Planned order release	781				2105				2001				
18-007	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	1586			1586	-201			0	-2105			0	-2001
	Net requirement					201				2105				2001
	Planned order receipt					201				2105				2001
4	Planned order release	201				2105				2001				
18-023	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	6588			6588	4801			4801	2696			2696	695
	Net requirement					0				0				0
	Planned order receipt													
4	Planned order release													

18-113	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	2316			2316	529			529	-1576			0	-2001
	Net requirement					0				1576				2001
	Planned order receipt									1576				2001
4	Planned order release					1576				2001				
18-121	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	2655			2655	868			868	-1237			0	-2001
	Net requirement					0				1237				2001
	Planned order receipt									1237				2001
4	Planned order release					1237				2001				
18-124	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	1526			1526	-261			0	-2105			0	-2001
	Net requirement					261				2105				2001
	Planned order receipt					261				2105				2001
4	Planned order release	261				2105				2001				
18-130	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	1515			1515	-272			0	-2105			0	-2001
	Net requirement					272				2105				2001
	Planned order receipt					272				2105				2001
4	Planned order release	272				2105				2001				
LVC-20-LVP	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	2250			2250	463			463	-1642			0	-2001
	Net requirement					0				1642				2001
	Planned order receipt									1642				2001
4	Planned order release					1642				2001				
LVC-3-LVP	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	7058			7058	5271			5271	3166			3166	1165
	Net requirement					0				0				0
	Planned order receipt													
4	Planned order release													
LVC-3-LVP-R	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	2289			2289	502			502	-1603			0	-2001
	Net requirement					0				1603				2001
	Planned order receipt									1603				2001
4	Planned order release					1603				2001				
LVC-4-LVP	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	1321			1321	-466			0	-2105			0	-2001
	Net requirement					466				2105				2001
	Planned order receipt					466				2105				2001
4	Planned order release	466				2105				2001				
LVC-5-LVP	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	1442			1442	-345			0	-2105			0	-2001
	Net requirement					345				2105				2001
	Planned order receipt					345				2105				2001
4	Planned order release	345				2105				2001				
LVC-7-LVP	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	1150			1150	-637			0	-2105			0	-2001
	Net requirement					637				2105				2001
	Planned order receipt					637				2105				2001
4	Planned order release	637				2105				2001				
LVCSPR	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	1886			1886	99			99	-2006			0	-2001
	Net requirement					0				2006				2001
	Planned order receipt									2006				2001
4	Planned order release					2006				2001				
5-LV-RED	Gross requirements					1787				2105				2001
	Scheduled receipt													
	Projected Available Balance	5165			5165	3378			3378	1273			1273	-728
	Net requirement					0				0				728
	Planned order receipt													728
4	Planned order release									728				

VRV-22;CX	Gross requirements					5868				4210				4002
	Scheduled receipt													
	Projected Available Balance	38			38	-5830			0	-4210			0	-4002
	Net requirement					5830				4210				4002
	Planned order receipt					5830				4210				4002
0	Planned order release					5830				4210				4002
5-VRV-RET	Gross requirements					5830				4210				4002
	Scheduled receipt													
	Projected Available Balance	11835			11835	6005			6005	1795			1795	-2207
	Net requirement					0				0				2207
	Planned order receipt													2207
1	Planned order release												2207	
5-VRV-CAP	Gross requirements					5830				4210				4002
	Scheduled receipt													
	Projected Available Balance	10082			10082	4252			4252	42			42	-3960
	Net requirement					0				0				3960
	Planned order receipt													3960
1	Planned order release												3960	
18-017	Gross requirements					5830				4210				4002
	Scheduled receipt													
	Projected Available Balance	7240			7240	1410			1410	-2800			0	-4002
	Net requirement					0				2800				4002
	Planned order receipt									2800				4002
0.14/0	Planned order release									2800				4002
SR22	Gross requirements					5830				4210				4002
	Scheduled receipt													
	Projected Available Balance	2553			2553	-3277			0	-4210			0	-4002
	Net requirement					3277				4210				4002
	Planned order receipt					3277				4210				4002
3	Planned order release		3277				4210				4002			
20VRVWASHER	Gross requirements					5830				4210				4002
	Scheduled receipt													
	Projected Available Balance	3958			3958	-1872			0	-4210			0	-4002
	Net requirement					1872				4210				4002
	Planned order receipt					1872				4210				4002
1	Planned order release				1872				4210				4002	
CN22	Gross requirements					5830				4210				4002
	Scheduled receipt													
	Projected Available Balance	2947			2947	-2883			0	-4210			0	-4002
	Net requirement					2883				4210				4002
	Planned order receipt					2883				4210				4002
3	Planned order release		2883				4210				4002			
1-VRV-C22	Gross requirements					5830				4210				4002
	Scheduled receipt													
	Projected Available Balance	3520			3520	-2310			0	-4210			0	-4002
	Net requirement					2310				4210				4002
	Planned order receipt					2310				4210				4002
3	Planned order release		2310				4210				4002			
5-VRV-SEAT-UDL	Gross requirements					5830				4210				4002
	Scheduled receipt													
	Projected Available Balance	9649			9649	3819			3819	-391			0	-4002
	Net requirement					0				391				4002
	Planned order receipt									391				4002
1	Planned order release								391				4002	
11-VRV-SPR	Gross requirements					5830				4210				4002
	Scheduled receipt													
	Projected Available Balance	16000			16000	10170			10170	5960			5960	1958
	Net requirement					0				0				0
	Planned order receipt													
2	Planned order release													

Output interface of LVEV-400,15CxC

OUTPUTS of MRP system

Product	LVEV400;15CxC
	Product
	Component with 2nd level

			12-Nov				12-Dec				13-Jan			
Item	Week	0	1	2	3	4	5	6	7	8	9	10	11	12
LVEV400;15CxC	Gross requirements		0	0	0	3072	0	0	0	2105	0	0	0	2001
	Scheduled receipt													
	Projected Available Balance	29			29	-3043			0	-2105			0	-2001
	Net requirement					3043				2105				2001
	Planned order receipt					3043				2105				2001
0	Planned order release					3043				2105				2001
5-EV-SA	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	2809			2809	-234			0	-2105			0	-2001
	Net requirement					234				2105				2001
	Planned order receipt					234				2105				2001
4	Planned order release	234				2105				2001				
CN15	Gross requirements					9129				6315				6003
	Scheduled receipt													
	Projected Available Balance	5072			5072	-4057			0	-6315			0	-6003
	Net requirement					4057				6315				6003
	Planned order receipt					4057				6315				6003
3	Planned order release		4057				6315				6003			
SR15	Gross requirements					9129				6315				6003
	Scheduled receipt													
	Projected Available Balance	13633			13633	4504			4504	-1811			0	-6003
	Net requirement					0				1811				6003
	Planned order receipt									1811				6003
3	Planned order release						1811				6003			
11-EV-SA400	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	3761			3761	718			718	-1387			0	-2001
	Net requirement					0				1387				2001
	Planned order receipt									1387				2001
2	Planned order release							1387				2001		
12-EV-ADJ	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	5602			5602	2559			2559	454			454	-1547
	Net requirement					0				0				1547
	Planned order receipt													1547
3	Planned order release										1547			
3-EV-SA	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	6735			6735	3692			3692	1587			1587	-414
	Net requirement					0				0				414
	Planned order receipt													414
3	Planned order release										414			
1-LVEV-C22	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	1690			1690	-1353			0	-2105			0	-2001
	Net requirement					1353				2105				2001
	Planned order receipt					1353				2105				2001
3	Planned order release		1353				2105				2001			
18-018	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	4495			4495	1452			1452	-653			0	-2001
	Net requirement					0				653				2001
	Planned order receipt									653				2001
4	Planned order release					653				2001				
18-023	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	6588			6588	3545			3545	1440			1440	-561
	Net requirement					0				0				561
	Planned order receipt													561
4	Planned order release									561				
ISTALINS	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	9734			9734	6691			6691	4586			4586	2585
	Net requirement					0				0				0
	Planned order receipt													
1	Planned order release													
CAR-LVEV-IN	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	1878			1878	-1165			0	-2105			0	-2001
	Net requirement					1165				2105				2001
	Planned order receipt					1165				2105				2001
2	Planned order release			1165				2105				2001		

ASSJUMPER	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	0			0	-3043			0	-2105			0	-2001
	Net requirement					3043				2105				2001
	Planned order receipt					3043				2105				2001
0	Planned order release					3043				2105				2001
20-EV-SA	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	5383			5383	2340			2340	235			235	-1766
	Net requirement					0				0				1766
	Planned order receipt													1766
1	Planned order release												1766	
10-EV-SA	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	2429			2429	-614			0	-2105			0	-2001
	Net requirement					614				2105				2001
	Planned order receipt					614				2105				2001
4	Planned order release	614				2105				2001				
10-EVR-SA	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	3444			3444	401			401	-1704			0	-2001
	Net requirement					0				1704				2001
	Planned order receipt									1704				2001
4	Planned order release					1704				2001				
LVC-400	Gross requirements					3043				2105				2001
	Scheduled receipt													
	Projected Available Balance	1147			1147	-1896			0	-2105			0	-2001
	Net requirement					1896				2105				2001
	Planned order receipt					1896				2105				2001
0	Planned order release					1896				2105				2001
LVC-10-LVP	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	1348			1348	-548			0	-2105			0	-2001
	Net requirement					548				2105				2001
	Planned order receipt					548				2105				2001
4	Planned order release	548				2105				2001				
LVC-12-LV	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	1157			1157	-739			0	-2105			0	-2001
	Net requirement					739				2105				2001
	Planned order receipt					739				2105				2001
4	Planned order release	739				2105				2001				
LVC-13-LVP	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	1498			1498	-398			0	-2105			0	-2001
	Net requirement					398				2105				2001
	Planned order receipt					398				2105				2001
4	Planned order release	398				2105				2001				
LVC-15-LVP-M4	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	1006			1006	-890			0	-2105			0	-2001
	Net requirement					890				2105				2001
	Planned order receipt					890				2105				2001
4	Planned order release	890				2105				2001				
18-007	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	1586			1586	-310			0	-2105			0	-2001
	Net requirement					310				2105				2001
	Planned order receipt					310				2105				2001
4	Planned order release	310				2105				2001				
18-023	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	6588			6588	4692			4692	2587			2587	586
	Net requirement					0				0				0
	Planned order receipt													
4	Planned order release													
18-113	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	2316			2316	420			420	-1685			0	-2001
	Net requirement					0				1685				2001
	Planned order receipt									1685				2001
4	Planned order release					1685				2001				
18-121	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	2655			2655	759			759	-1346			0	-2001
	Net requirement					0				1346				2001
	Planned order receipt									1346				2001
4	Planned order release					1346				2001				

18-124	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	1526			1526	-370			0	-2105			0	-2001
	Net requirement					370				2105				2001
	Planned order receipt					370				2105				2001
4	Planned order release	370				2105				2001				
18-130	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	1515			1515	-381			0	-2105			0	-2001
	Net requirement					381				2105				2001
	Planned order receipt					381				2105				2001
4	Planned order release	381				2105				2001				
LVC-20-LVP	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	2250			2250	354			354	-1751			0	-2001
	Net requirement					0				1751				2001
	Planned order receipt									1751				2001
4	Planned order release					1751				2001				
LVC-3-LVP	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	7058			7058	5162			5162	3057			3057	1056
	Net requirement					0				0				0
	Planned order receipt													
4	Planned order release													
LVC-3-LVP-R	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	2289			2289	393			393	-1712			0	-2001
	Net requirement					0				1712				2001
	Planned order receipt									1712				2001
4	Planned order release					1712				2001				
LVC-4-LVP	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	1321			1321	-575			0	-2105			0	-2001
	Net requirement					575				2105				2001
	Planned order receipt					575				2105				2001
4	Planned order release	575				2105				2001				
LVC-5-LVP	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	1442			1442	-454			0	-2105			0	-2001
	Net requirement					454				2105				2001
	Planned order receipt					454				2105				2001
4	Planned order release	454				2105				2001				
LVC-7-LVP	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	1150			1150	-746			0	-2105			0	-2001
	Net requirement					746				2105				2001
	Planned order receipt					746				2105				2001
4	Planned order release	746				2105				2001				
LVCSPR	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	1886			1886	-10			0	-2105			0	-2001
	Net requirement					10				2105				2001
	Planned order receipt					10				2105				2001
4	Planned order release	10				2105				2001				
5-LV-RED	Gross requirements					1896				2105				2001
	Scheduled receipt													
	Projected Available Balance	5165			5165	3269			3269	1164			1164	-837
	Net requirement					0				0				837
	Planned order receipt													837
4	Planned order release									837				

Output interface of LVEV-400,3/4

OUTPUTS of MRP system	
Product	LVEV400;3/4"
	Product
	Component with 2nd level

			12-Nov				12-Dec				13-Jan			
Item	Week	0	1	2	3	4	5	6	7	8	9	10	11	12
LVEV400;3/4"	Gross requirements		0	0	0	3072	0	0	0	2105	0	0	0	2001
	Scheduled receipt													
	Projected Available Balance	133			133	-2939			0	-2105			0	-2001
	Net requirement					2939				2105				2001
	Planned order receipt					2939				2105				2001
0	Planned order release					2939				2105				2001
5-EV-SA	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	2809			2809	-130			0	-2105			0	-2001
	Net requirement					130				2105				2001
	Planned order receipt					130				2105				2001
4	Planned order release	130				2105				2001				
11-EV-SA400	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	3761			3761	822			822	-1283			0	-2001
	Net requirement					0				1283				2001
	Planned order receipt									1283				2001
2	Planned order release							1283				2001		
12-EV-ADJ	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	5602			5602	2663			2663	558			558	-1443
	Net requirement					0				0				1443
	Planned order receipt													1443
3	Planned order release										1443			
3-EV-SA	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	6735			6735	3796			3796	1691			1691	-310
	Net requirement					0				0				310
	Planned order receipt													310
3	Planned order release										310			
1-LVEV-C22	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	1690			1690	-1249			0	-2105			0	-2001
	Net requirement					1249				2105				2001
	Planned order receipt					1249				2105				2001
3	Planned order release		1249				2105				2001			
18-018	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	4495			4495	1556			1556	-549			0	-2001
	Net requirement					0				549				2001
	Planned order receipt									549				2001
4	Planned order release					549				2001				
18-023	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	6588			6588	3649			3649	1544			1544	-457
	Net requirement					0				0				457
	Planned order receipt													457
4	Planned order release									457				
ISTALINS	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	9734			9734	6795			6795	4690			4690	2689
	Net requirement					0				0				0
	Planned order receipt													
1	Planned order release													
CAR-LVEV-IN	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	1878			1878	-1061			0	-2105			0	-2001
	Net requirement					1061				2105				2001
	Planned order receipt					1061				2105				2001
2	Planned order release			1061				2105				2001		
ASSJUMPER	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	0			0	-2939			0	-2105			0	-2001
	Net requirement					2939				2105				2001
	Planned order receipt					2939				2105				2001
0	Planned order release					2939				2105				2001
20-EV-SA	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	5383			5383	2444			2444	339			339	-1662
	Net requirement					0				0				1662
	Planned order receipt													1662
1	Planned order release												1662	

10-EV-SA	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	2429			2429	-510			0	-2105			0	-2001
	Net requirement					510				2105				2001
	Planned order receipt					510				2105				2001
4	Planned order release	510				2105				2001				
10-EVR-SA	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	3444			3444	505			505	-1600			0	-2001
	Net requirement					0				1600				2001
	Planned order receipt									1600				2001
4	Planned order release					1600				2001				
LVC-400	Gross requirements					2939				2105				2001
	Scheduled receipt													
	Projected Available Balance	1147			1147	-1792			0	-2105			0	-2001
	Net requirement					1792				2105				2001
	Planned order receipt					1792				2105				2001
0	Planned order release					1792				2105				2001
LVC-10-LVP	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	1348			1348	-444			0	-2105			0	-2001
	Net requirement					444				2105				2001
	Planned order receipt					444				2105				2001
4	Planned order release	444				2105				2001				
LVC-12-LV	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	1157			1157	-635			0	-2105			0	-2001
	Net requirement					635				2105				2001
	Planned order receipt					635				2105				2001
4	Planned order release	635				2105				2001				
LVC-13-LVP	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	1498			1498	-294			0	-2105			0	-2001
	Net requirement					294				2105				2001
	Planned order receipt					294				2105				2001
4	Planned order release	294				2105				2001				
LVC-15-LVP-M4	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	1006			1006	-786			0	-2105			0	-2001
	Net requirement					786				2105				2001
	Planned order receipt					786				2105				2001
4	Planned order release	786				2105				2001				
18-007	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	1586			1586	-206			0	-2105			0	-2001
	Net requirement					206				2105				2001
	Planned order receipt					206				2105				2001
4	Planned order release	206				2105				2001				
18-023	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	6588			6588	4796			4796	2691			2691	690
	Net requirement					0				0				0
	Planned order receipt													
4	Planned order release													
18-113	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	2316			2316	524			524	-1581			0	-2001
	Net requirement					0				1581				2001
	Planned order receipt									1581				2001
4	Planned order release					1581				2001				
18-121	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	2655			2655	863			863	-1242			0	-2001
	Net requirement					0				1242				2001
	Planned order receipt									1242				2001
4	Planned order release					1242				2001				
18-124	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	1526			1526	-266			0	-2105			0	-2001
	Net requirement					266				2105				2001
	Planned order receipt					266				2105				2001
4	Planned order release	266				2105				2001				
18-130	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	1515			1515	-277			0	-2105			0	-2001
	Net requirement					277				2105				2001
	Planned order receipt					277				2105				2001
4	Planned order release	277				2105				2001				

LVC-20-LVP	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	2250			2250	458			458	-1647			0	-2001
	Net requirement					0				1647				2001
	Planned order receipt									1647				2001
4	Planned order release					1647				2001				
LVC-3-LVP	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	7058			7058	5266			5266	3161			3161	1160
	Net requirement					0				0				0
	Planned order receipt													
4	Planned order release													
LVC-3-LVP-R	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	2289			2289	497			497	-1608			0	-2001
	Net requirement					0				1608				2001
	Planned order receipt									1608				2001
4	Planned order release					1608				2001				
LVC-4-LVP	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	1321			1321	-471			0	-2105			0	-2001
	Net requirement					471				2105				2001
	Planned order receipt					471				2105				2001
4	Planned order release	471				2105				2001				
LVC-5-LVP	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	1442			1442	-350			0	-2105			0	-2001
	Net requirement					350				2105				2001
	Planned order receipt					350				2105				2001
4	Planned order release	350				2105				2001				
LVC-7-LVP	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	1150			1150	-642			0	-2105			0	-2001
	Net requirement					642				2105				2001
	Planned order receipt					642				2105				2001
4	Planned order release	642				2105				2001				
LVCSPR	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	1886			1886	94			94	-2011			0	-2001
	Net requirement					0				2011				2001
	Planned order receipt									2011				2001
4	Planned order release					2011				2001				
5-LV-RED	Gross requirements					1792				2105				2001
	Scheduled receipt													
	Projected Available Balance	5165			5165	3373			3373	1268			1268	-733
	Net requirement					0				0				733
	Planned order receipt													733
4	Planned order release									733				