

Manufacturing Resource Planning:

Production Planning

Introduction

Production Planning is the function of an enterprise that must be operating *before* the manufacture of a product. According to Jensen & Wright in their book Manufacturing, production planning is concerned with:

1. The number of products to be built.
2. When and where to build them.
3. Maintaining production schedules.

The work of production planning contains three main areas that take a released production order and carry the order to the completion point. The three areas of production planning are:

1. **Routing**— is the planning of the path or flow the product will take in the production line.
2. **Scheduling**— is the time planning method as to when the product will be manufactured.
3. **Dispatching**— provides the orders to "go-ahead" to start production.

There is one area of Production Planning that is in charge of controlling the total sequence. The area of Production Planning that controls production is **Expediting**.

Flow Process Charting

The planning tool for the routing or path for a product to be manufactured is the Flow Process Chart. Usually before the flow process chart is developed a rough sketch process chart is made called the Operation Process Chart. The Operation Process Chart is a routing sheet comprised of Production Operations and Inspections. The Flow Process Chart is a more detailed Operations Chart in that it includes the Storage, Transportation, and Delay points that will occur in the manufacture of the product. Both the Flow Process Chart and the Operation Process Chart utilize symbols to graphically depict the routing of the product. Seen below are the flow symbols with an explanation of each as outlined by Dr. D. Stallsmith, Industrial Management Professor at UW-Stout:



Operation an object is intentionally changed in its characteristics.



Transportation an object is moved from one location to another.



Inspection occurs when an object is examined.



Storage object is kept and protected against unauthorized removal.



Delay object is temporarily waiting to enter next activity.



Combined Activity

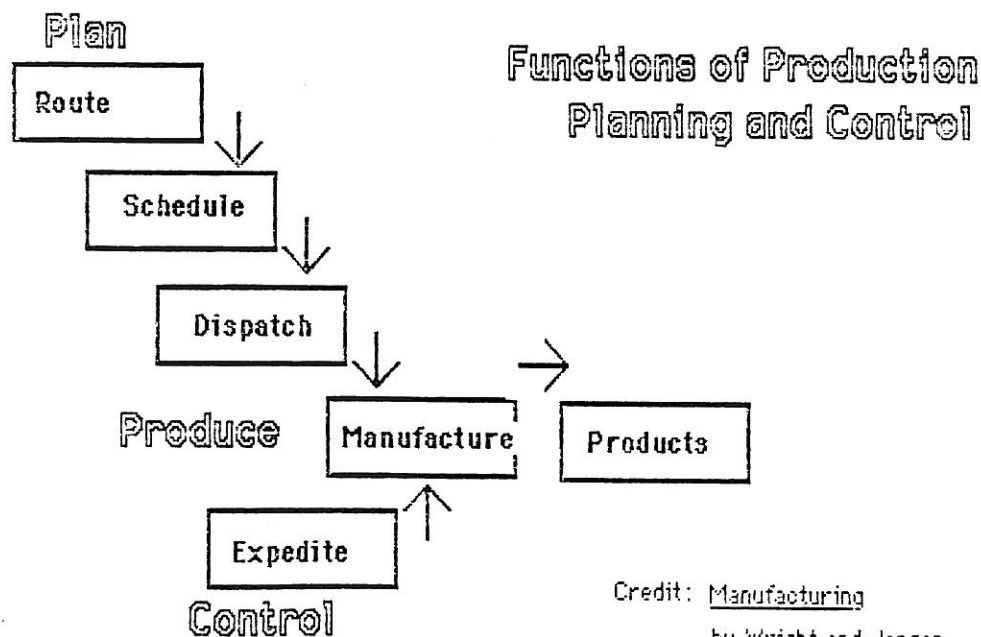
Two activities are performed concurrently at the same workstation; i.e., an operation and inspection combined, or an operation performed while in transit.



Flow Process Activity

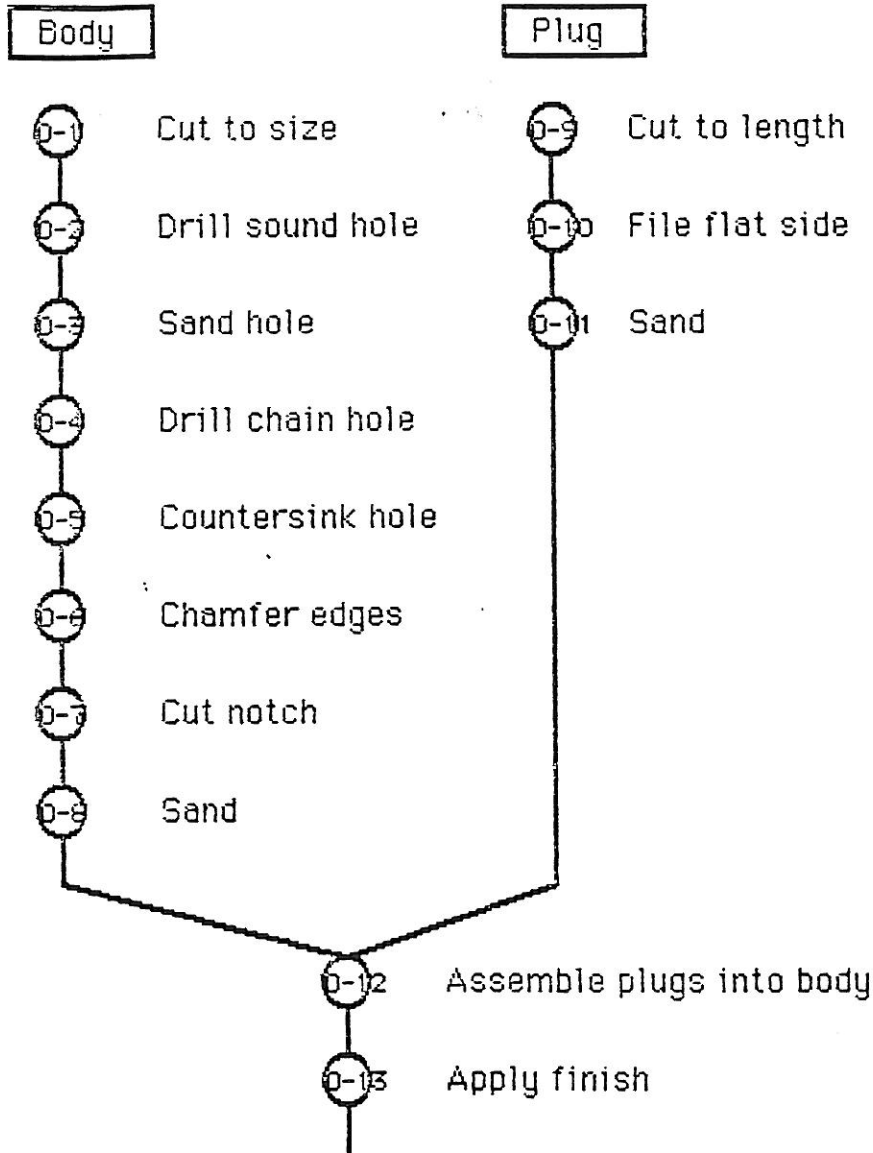
You will be able to plan your own production sequence by taking the routings of an Operation Process Chart and completing a Flow Process Chart. This may appear easy, but you will be making the decisions as to transportation, storage, delays, and combined activities. You will be using the **Flow Process** computer program to create your computerized chart. The software program contains all the information you need to run it. Follow these steps to get started:

1. Place disk in drive and turn-on the computer.
2. From the menu select: **Flow Process**
3. Once you have the Flow Process main menu, select **Create**.
4. You now must provide a product name for filing purposes.
5. Review the Operation Process Chart and sketch-in where you think the transportation, storage, delays, and combined activities may fit in the sequence. A sample flow process chart is included for you to review.
6. Begin entering the *task#*, *description*, *machine required*, and *tooling required* for each process activity.
7. Upon completion of the computerized chart, return to the program main menu for options of **Edit** or **Look**. By selecting **Look**, you may reach the **print** option for a paper copy to hand-in to your instructor.



Credit: Manufacturing
by Wright and Jensen

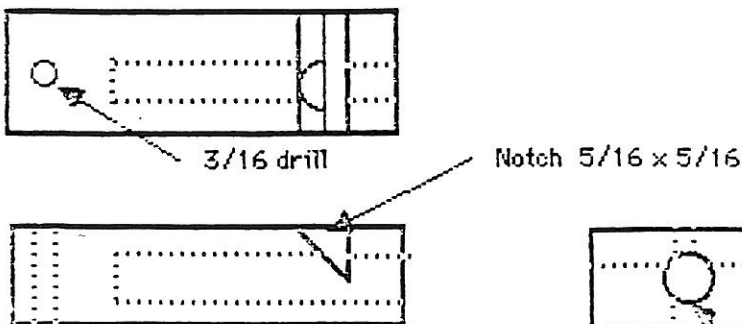
Wooden Whistle Operation Chart



Credit: Manufacturing- A Basic Text

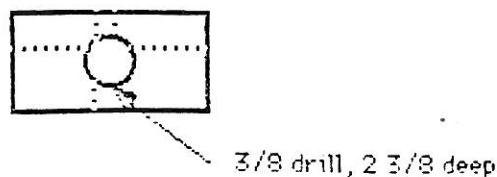
by Fales
Sheets
Mervich
Dinan
(modified slightly
from text)

Wooden Whistle Drawing and Parts List



Parts List:

- 1 Body 5/8" x 1" x 3" Birch
- 1 Plug 3/8" dia. x 3/4" Birch dowel



Note: chamfer all edges.

PRODUCT NAME---> CANDLE HOLDER

FLOW PROCESS CHART

S-STORAGE O-OPERATION D-DELAYS
T-TRANSPORTATION I-INSPECTION

<TYPE 'END' IF NO MORE TASK>

TASK NO.	DESCRIPTION OF TASK	MACHINE REQUIRED	TOOLING REQUIRED
S-1	STORE MATERIAL	NONE	NONE
T-1	TRANSPORT TO SURFACER	SURFACER	RULER
O-1	SURFACE TO 3/4"	SURFACER	RULER
T-2	TO RADIAL ARM SAW	CONVEYOR	NONE
O-2	CUT TO LENGTH 31"	RADIAL ARM SAW	STOP BLOCK
T-3	TO JOINTER	CONVEYOR	NONE
O-3	JOINT ONE EDGE	JOINTER	NONE
T-4	TO TABLE SAW	CONVEYOR	NONE
O-4 STICK	RIP TO 2" WIDTH	TABLE SAW	RULER/PUSH
T-5	TO TABLE SAW #2	CONVEYOR	NONE
O-5	CUT TO 6" LENGTH	TABLE SAW	JIG #1
I-1 UGE	INSPECT SIZE	NONE	GO NO-GO GA
T-6	TO BAND SAW	BOX	NONE
O-6	CUT CURVES TO SHAPE	BAND SAW	JIG #2
T-7	TO DRILL PRESS	BOX	NONE
O-7 JIG #3	DRILL 3/8" HOLE	DRILL PRESS	AUTO FEED/
T-8	TO SPINDLE SANDER	BOX	NONE
O-8	SAND CURVES ONLY	SPINDLE SANDER	NONE
T-9	TO BELT SANDER	BOX	NONE
O-9	SAND ENDS ONLY	BELT SANDER	MITER GAUGE
T-10	TO BENCH	AUTO CONVEYOR	NONE
O-10	SAND WITH ORBITAL SANDER	ORBITAL SANDER	NONE
I-2 FOR HOLES	INSPECT APPEARANCE	NONE	PLUG GAUGE

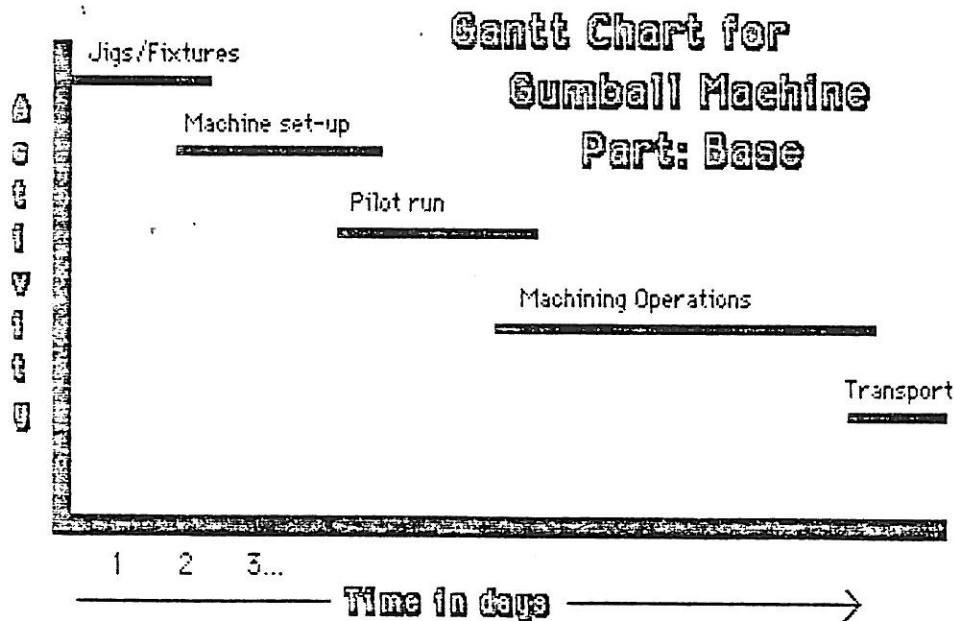
Manufacturing Resource Planning: Master Production Schedule

Introduction

In order to estimate the amount of material required for production, the Materials Manager must look to the Master Production Schedule to find the answer. This allows the Materials Manager to have **lead time** or have the correct amount of materials delivered in time for production. Avoiding shortages and eliminating excess inventory is the key to running a complete MRP system and the Master Production Schedule is the tool used to provide a timeline for ordering materials.

The Gantt Chart

Developed by Henry L. Gantt, an industrialist, to provide a timetable for the scheduling of materials and amounts, dates for ordering and receiving materials, dates for starting and completing parts, and dates for the sub-assemblies and final assembly of the product. The Gantt Chart is universal enough to accommodate any company needs in scheduling; for instance, a chart may be used to schedule the complete set-up of a company (as seen in the figure on the following page) over a number of weeks or it may be used to schedule one part for one week (as seen below).



Gathering Information to Create a Chart- Bill of Materials

To create a Gantt Chart, one must have the necessary production information to schedule and develop graphically. One of the best sources of information is the Bill of Materials, especially the Indented Bill of Materials. The Indented Bill shows the level of each product part so that you will know which level or part needs to be ordered/manufactured first, second, third, and so forth. Study the Indented Bill of Materials on the following page. Realize that the higher the level numbers have first priority, the lower level numbers have last priority. Here's a synopsis for the Gumball Machine BOM:

- Level 0 = #65256 inventory/item number
- Level 1 = #45234-45236 item numbers
- Level 2 = #25216-25224 item numbers

Gumball Machine- Indented Bill of Materials

Item#	Description	Quantity
65256	Gumball Machine Assembly	1
45234	Machine Base Sub-assembly	1
25216	Screws, wood, #8 x 1 1/4" FH	2
25217	Base, wood - Oak 1"	1
45235	Machine Body Sub-assembly	1
25218	Body, wood - Oak 2"	1
25219	Spindle, 1" Birch dowel	1
25220	Pin, 1/4" Birch dowel	1
45236	Jar Sub-assembly	1
25221	Mason Jar, pint size	1
25222	Lid, open top Mason type	1
25223	Screws, #4 x 1/2" RH	3
25224	Gumballs, 5/16" dia.	50

Gantt Chart Activity

You will be using a computer program with the Apple computer to develop a Gantt chart for use in the Master Production Scheduling of a product. Use the following steps to run the computer program GANTT CHART and the information provided to develop your own chart.

1. Place disk in the drive and turn-on the computer.
2. Select and run GANTT CHART PROGRAM.
3. When prompted type the name of the project, use:
Gumball Machine Production
4. The computer will ask for the numbers of items you wish to input. An item is the activity that needs to be scheduled and dated. There are: **5**
5. The computer will now ask for the item/activity, the start date (by week number), and finish date (by week number). Before you can tinue and input any information, take a look at the problem.

The Problem: A major customer has called your company, Gumball Enterprises, and ordered 5000 Gumball Machines. You have told the customer that there is no problem in meeting the 5000 machine order by week 14. Your main problem is how to schedule it.

Activity/Item	Time to Accomplish
ORDER parts #25216, 25221,25222,25223,25224	1 week
MFG parts #25220,25219,25218,25217	4 weeks
SUB assembly of parts # 45234, 45235,45236	2 weeks
ASSEMBly of part# 65256	2 weeks
PACK aging of products	1 week

Remember: delivery is week 14 !!!

6. Input the activities/items and dates.
7. At the end of inputting the information, ask for a print-out
8. Hand-in your Gantt Chart print-out for evaluation to your instructor.

Company Set-up Gantt Chart

A
c
t
i
v
i
t
y

Product Development

Company Organization

Financial Organization

Production System Development

Personnel Provisions

Product Manufacture

Marketing Operations

Cash Flow to manage

Union Activities

Company Dissolution

1 2 3...

Time
in weeks



Manufacturing Resource Planning:

Shop Floor Control

Introduction

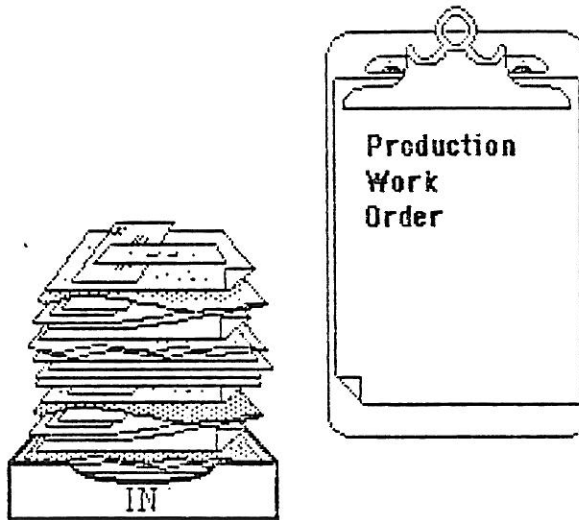
The Production Work Order is developed by management in order to control the production line itself as to what should be produced and the quantities. This technique is called Shop Floor Control and the Production Work Order is the document that carries all the information required to run the production line.

Activity/Software

It is your turn to complete a Production Work Order in order to provide the production system foreman and his shift with the necessary information to mass produce a product. The following steps of procedure will help you develop your Production Work Order as part of Shop Floor Control:

1. Place the disk in the drive and turn-on the computer.
2. Run the program Production Work Order.
3. Once you reach the "Production Work Order" main menu, select "E".
4. You now have the Production Work Order Form displayed.
5. Select "H" which will provide you with the necessary instructions and edit commands to complete the work order.
6. After reading the Help commands, you should now have the Work Order Form displayed again.
7. Select "P", and input the name of your product. The product name will now be found on all work order pages. This name also becomes the file name!
8. Before getting under way, understand that a production work order is the detailed instructions for a work station in the production system. Usually a production work order is derived from a single task/operation of the Flow Process Chart. Included in this packet is a sample of a Production Work Order Form, so you can see how one is completed; and, a sample of a Flow Process Chart, so you may select a task/operation to get started with this activity.
9. Now that you are aware of the materials included in this packet, begin by selecting "C" to change a line of the work order form. Try the following example:
 - a. Push "C" [you type]
 - b. Change What [computer responds]
 - c. Type "MB" <return> [you type]
 - d. Machine/Bench: [computer responds]
 - e. Push "H" [you type]
 - f. ? _____ [computer responds]
 - g. Type "Table Saw" <return> [you type]
 - h. Does it appear on the work order form? [you look for]
If yes, continue to complete the work order. [continue]
If no, try again. [try again]
10. Complete the work order.
11. Ask your instructor to check your work.
{steps continued on next page}

12. Once you have completed all work order forms (do not exceed 50 forms) you may select "E" to return to the main menu.
13. Select "P" to see the print menu.
14. Push "A" to turn on the printer port.
15. Be sure to have the printer turned on too!
16. Push "B" and follow the instructions.
17. Upon completion of the printed copies of the production work order forms, be sure to write brief statements for the "Detailed Operational Procedures:" and the "Detailed Quality Control Procedures:" on each form.
18. Review all your work order forms and check for mistakes.
19. Hand-in the Production Work Order Forms for evaluation.



**Please Hand-in your work
upon completion!**

PRODUCTION WORK ORDER FORM

PART: CANDLEHOLDER

PAGE NO. 1

Machine/Bench:TABLE SAW

Operation No:0-5

Part Name:CANDLE HOLDER BASE

Part No:1-357

Drwg.No:98-45-678

No. of Pcs:200

Jig/Fixture :

Tool to be Used:NONE

PrWork Station:0-4

NxtWork Station:I-1

Material Specification:

Finished Dimension:

#2 COMMON BUTTERNUT

3/4 X 2 X 6

Detailed Operational Procedures:

USING A STOP BLOCK
AND MITER GAUGE,
CROSSCUT $\frac{3}{4}$ X 2 X LENGTH
PIECES OF BUTTERNUT
INTO 6" LENGTHS

Detailed Quality Control Procedures

CHECK EVERY
10TH PIECE FOR 6"
LENGTH $\pm \frac{1}{32}$ "

Operat. Date #Produced #Rejected

Operat. Date #Produced #Rejected

1.

6.

2.

7.

3.

8.

4.

9.

5.

10.

DEVELOPED BY _____
PRODUCTION CONTROL

APPROVED BY _____
PRODUCTION MANAGER

QUALITY CONTROL

FLOW PROCESS CHART

S-STORAGE O-OPERATION D-DELAYS
T-TRANSPORTATION I-INSPECTION

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O-10	SAND WITH ORBITAL SANDER	ORBITAL SANDER	NONE
I-2 FOR HOLES	INSPECT APPEARANCE	NONE	PLUG GAUGE
O-11	CHECK SANDING	NONE	SANDPAPER

Manufacturing Resource Planning: Resource Requirements Planning

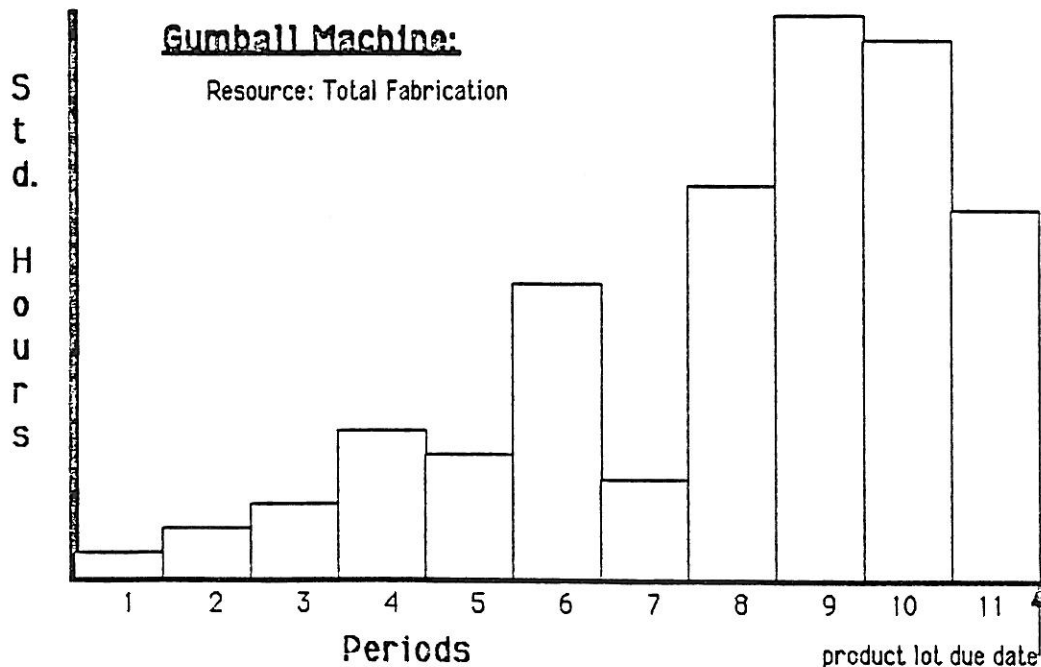
Introduction

The Resource Requirements Plan is determined as a part of the Master Production Schedule. In effect the Resource Plan considers the relation of load, space, materials and working capital in the Master Production Schedule. The Resource Plan eliminates the problems of production-line "bottlenecks", increased production costs, lack of warehouse space, and the inability to deliver the product to the customer on time.

Resource Requirement Technique

According to Joseph Orlicky, author of the foremost book on MRP titled: Material Requirements Planning, There are five steps which comprise the technique of Resource Requirements Planning:

1. Defining the resources to be considered.
2. Computing a load profile for each product that indicates what load is imposed on what resources by a single unit of the product. (*see example below*)
3. Extending these profiles by the quantities called for by a proposed master production schedule and thus determining the total load, or resource requirement, on each of the resources in question.
4. Simulating the effect of alternative master production schedules.
5. Selecting a realistic schedule that makes best use of (existing or planned) resources.



Resource Requirements Activity Simulation: Robot Production Line

The following activity is a simulation of a company situation whereby, product demand has been forecasted to increase at alarming rates to exceed company limits. It is your job to find a solution by reviewing the Resource Plan, reading the problem statement, and following the directions to solve the problem. Before continuing, please realize that there is not just one solution to the problem, there are many diverse solutions. Please ready to justify your solution at the end.

Resources

Definition

- a. load capacity of the plant to manufacture: *exceeds capacity*
- b. space requirements: *enough space for an extra production line, but no warehouse space*
- c. materials are shipped on Just-In-Time basis: *unloading of materials occurs upon production line demand*
- d. working capital provision: *growth has allowed for the building and set-up of a new automated line in existing warehouse space*

Load Profile

- a. indicates that redevelopment of a master schedule will not work. All indicators point to beyond plant capacity.
- b. all resources have been exceeded, except space.

Problem Statement and Directions-

You are responsible for establishing a new production line which will construct the Assembly Line Robots that the old production line could not handle. Everything is ready to go and now you must design the assembly process and assign plant personnel. Your goal is to design the most efficient process possible, in order to stay within the limits of working capital. The efficiency will be measured by the company's profit, and the profit will be determined by the number of completed robots shipped-out every hour.

In this production line, you will have the following work stations:

U1-Unloading of the motor/power pack assemblies.

U2-Unloading of the robot monitoring systems.

U3-Unloading of the mechanical assemblies.

A1-Assembly of the motor/power pack to the mechanical assembly.

A2-Assembly of the monitoring system to the power pack/motor/mechanical assembly.

F-Finishing of the completed robot by applying paint.

T-Testing of the completed robot assembly.

P-Packaging of the robot assembly for shipping.

S-Shipping of the completed assembly.

Exactly 12 employees must be used and any employee can perform any work task, but the maximum work rate per employee is as follows:

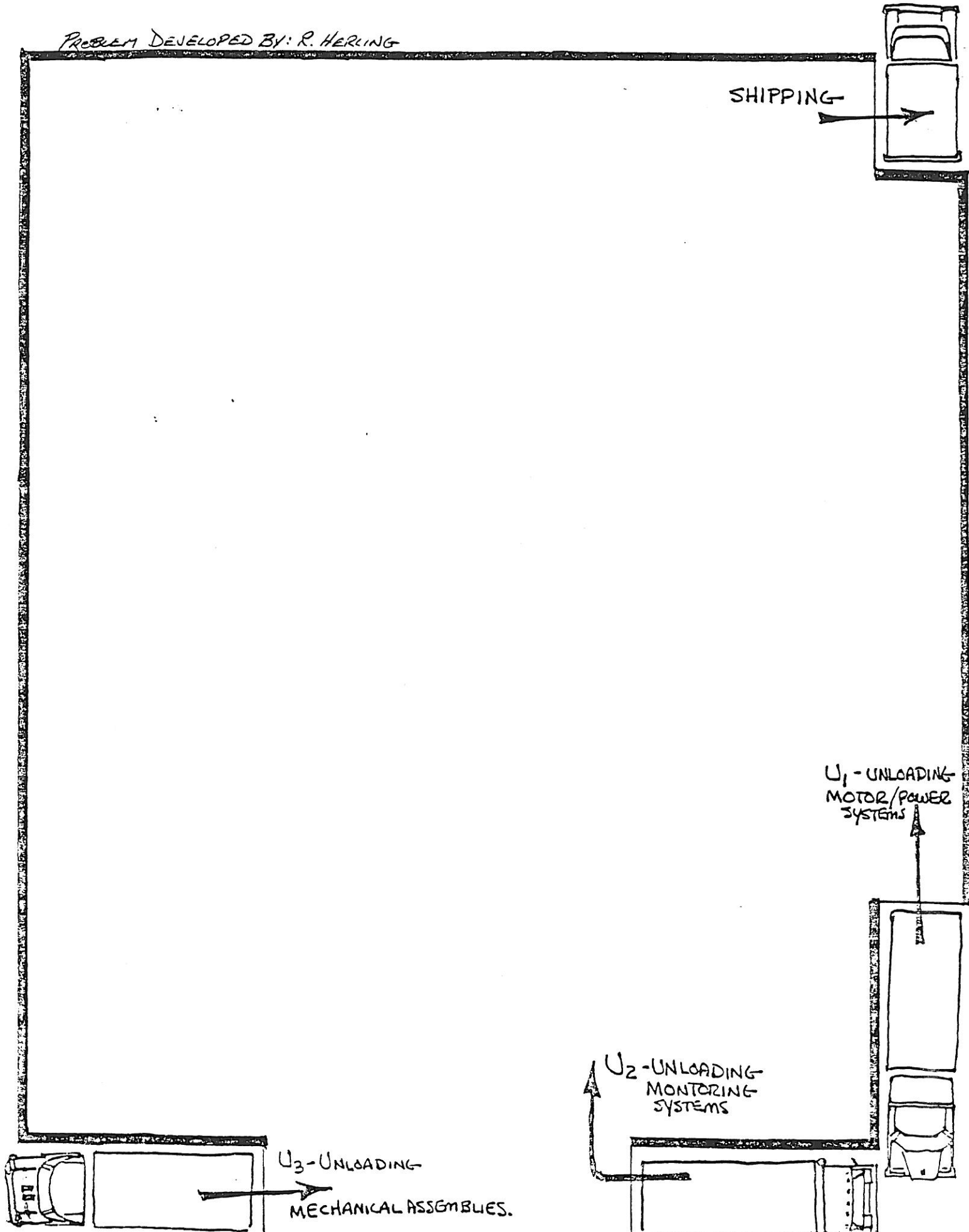
Unloading	30 parts/hour
Assembly	10 units/hour
Finishing	5 units/hour
Testing	20 units/hour
Packaging	5 units/hour
Shipping	10 units/hour

Remember, your goal is to ship as many completed robots per hour as possible. You are limited only in that you must use exactly 12 employees, all work stations must be used, and work can be completed no faster than is listed for each task.

On the attached floor plan show: 1. the location of each work station, 2. the location of each employee, and 3. the method or means of moving the parts or completed assemblies from one work station to the next! Be ready to justify your work to your instructor!

NAME : _____

PROBLEM DEVELOPED BY: R. HERLING



Manufacturing Resource Planning: Resource Requirements Planning

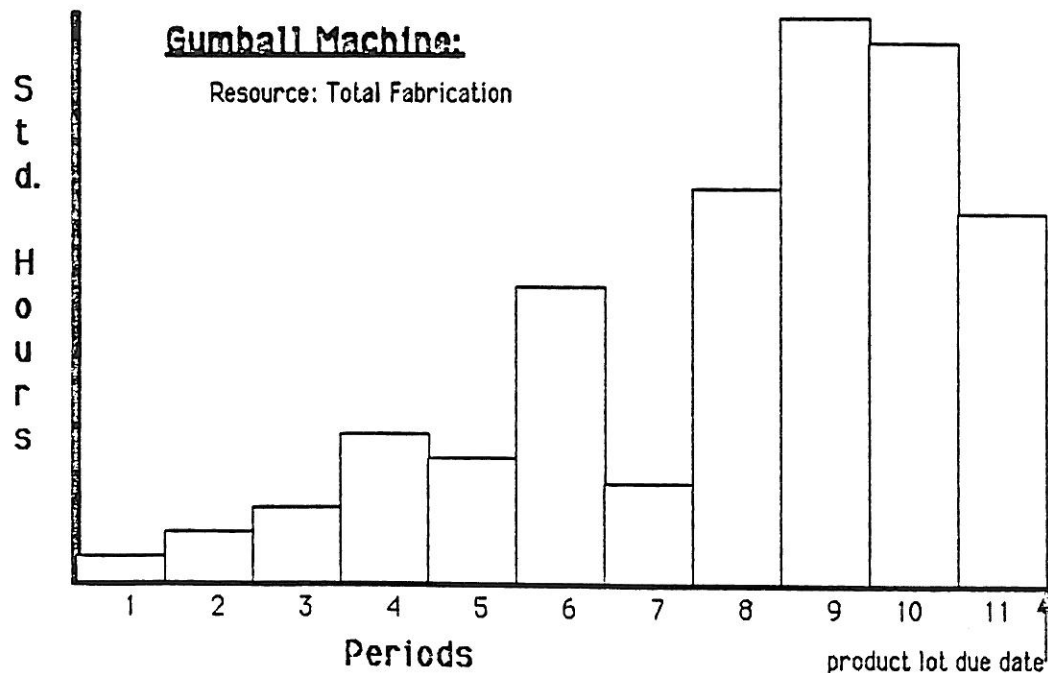
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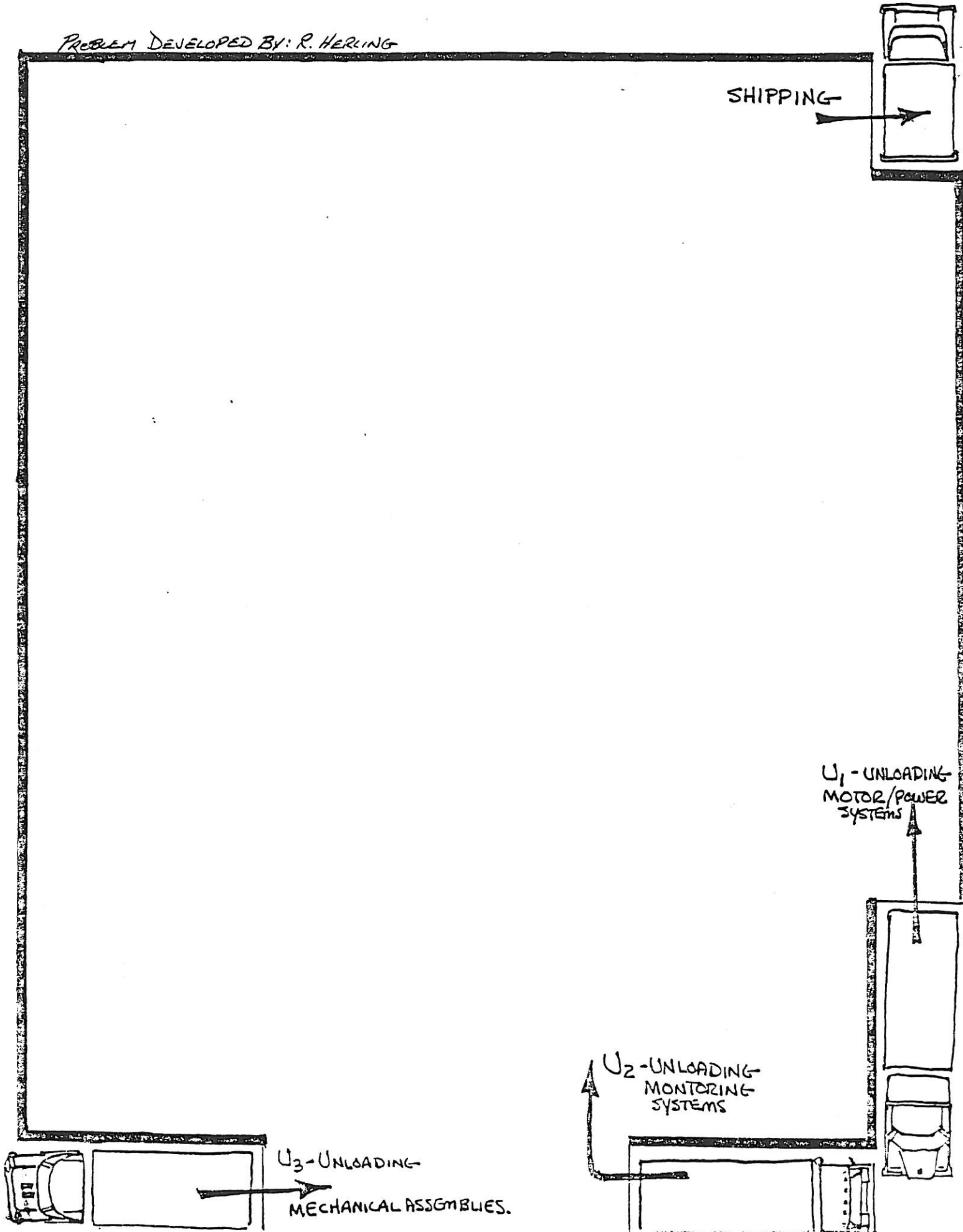
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NAME : _____

PROBLEM DEVELOPED BY: R. HERLING



Manufacturing Resource Planning:

Inventory Control

Introduction

Inventory control in Manufacturing Resource Planning allows for the utmost management of materials. The most common questions of inventory control are:

What do we have?

What do we need?

What do we do?

To answer these questions one must be given accurate information as to quantities available to production. To answer the above questions, the inventory control person would need to know the quantity on hand, quantity on order, quantity required, and quantity available. Notice that the questions we are asking are for what has already happened. What we need to do is anticipate the number of products required later on so that we have enough in stock to satisfy the customer. All of this can be made simple through the proper set-up of inventory into a processing system called material requirements planning. Let's give it a try.....

How to Use the Inventory Software

Computer Inventory is a computerized inventory program that keeps track of a stock number, a description, a supplier number (for filing information on each supplier), a unit price and the quantity on hand. You will use this program to determine quantities on hand of products produced in the Enterprise class and help project consumer demand.

----- COMPUTER INVENTORY -----

- | | |
|---------------------------|--------------------------|
| A. View Inventory File | B. Search Inventory File |
| C. Change Inventory | D. Create Inventory File |
| E. Exit | F. Open Supplier File |
| G. Add to Supplier File | H. Search Supplier File |
| I. Print Supplier Numbers | |

----- *Create Inventory*

To create an inventory file press 'D'. No return is needed at the main menu level. The computer will ask you for a file name or department name. The department name is used to keep track of different inventories. When you create a new file, type in the information the computer asks for, but each category has certain restrictions:

Stock numbers 1-9 digits
Descriptions 1-12 letters
Supplier numbers 1-3 digits
Unit Price 0-4 digits (2 decimal places)
Quantity 0-5 digits

To avoid problems, please follow these computer restrictions. If you do exceed the limits the computer will ignore your response and ask again.

Change Inventory

To change inventory information, press 'C'. Type the department and press return. The computer will show you the requested inventory file and number each line. A prompt will ask 'what line # do you want to change?' Type the number and hit return. At this time you may add an item to the file, alter incorrect information, and change quantities as inventory levels fluctuate. Follow the prompt as to what you need to change and type the appropriate letter/symbol. After changes are complete, the prompt will ask if there are more changes. Answering Y or N and return will update the file and return to the main menu.

View Inventory

To view an inventory press 'A'. Type the department and press return. The computer will ask you if you want the printer on; this is optional, the program will place all information to the screen if you do not request the printer. Therefore, you may view a 'hardcopy' from the printer, or check information from the screen.

Search for Inventory

To search for an inventory file, or for a certain item, press 'B'. Type the department and press return. The computer will ask if you would like to search by <D/*>. The 'D' stands for description and the '*' stands for stock number. The computer searches for your information and prints it out, or will respond that there is no item with that stock number or description.

Supplier Files

In order to keep track of the suppliers for your inventory items, you can keep a separate file of their numbers for ordering purposes. To open a supplier file press 'F'. The computer will ask for some information on the supplier and about the suppliers representative. Follow the prompt and answer the questions; you should not have any problems. Please note that there is only one supplier file, therefore, you should "OPEN" once only to begin your files. (Open Once, Add Thereafter)

To add to suppliers file press 'G'. You may, at any time, add to the suppliers file. All the same questions will be asked with the same prompting as when you started the file.

To search a supplier file press 'H'. Type the number you are looking for and press return. This will find all the information about the supplier and print it on the screen.

To printout the suppliers file press 'I'. The computer will ask you if you want <A/O>, A is all of the suppliers and O is just one supplier. The program will again ask if you want to print, this is just an option to select Y or N.

Exit

To exit from the program press 'E'. Take the diskette out and power down.

MRP: Inventory Control Activity

Input Inventory Levels

Study the following diagram which is called a TIME BUCKET. The time bucket provides you all the information you need to control your inventory levels without carrying too many products. Remember, carrying products in inventory costs the company dollars.

1st week inventory
(in warehouse now)

shipped orders

Inventory for each week

Totals for each category

	Period (week)											Total
	1	2	3	4	5	6	7	8	9	10	11	
Customer Orders		20		25		15	12					72
In-Production			30			19						49
On-Hand	23	23	3	33	8	8	12					0
Future Orders												0

guaranteed future orders

In-process on the production line

1st weeks inventory:

The first weeks inventory should be inputted to the program software from the above Time Bucket as follows:

Stock #	Description	Supplier #	\$Unit price	Quantity
1009	Gumball Machine	156	5.99	23

As soon as you have properly inputted this information to the computer, have a printout made to show your instructor.

2nd weeks inventory:

The second weeks inventory should be inputted to the program software as follows:

Stock #	Description	Supplier #	\$Unit price	Quantity
1009	Gumball Machine	156	5.99	3

How many gumball machines were shipped ? _____

As soon as you have properly inputted this information to the computer, have a printout made to show your instructor.

Updated Time Bucket

		Period (week)										Total	
		1	2	3	4	5	6	7	8	9	10		11
Customer Orders			20		25		15	12			8		84
In-Production				30			19						49
On-Hand	23	23	3	33	8	8	12				?		?
Future Orders									12				12

3rd weeks inventory:

The third weeks inventory should be filled-in below before inputting to the program software:

Stock #	Description	Supplier #	\$Unit price	Quantity
---------	-------------	------------	--------------	----------

_____	_____	_____	5.99	_____
-------	-------	-------	------	-------

How many gumball machines were shipped ? _____

How many gumball machines are in-production ? _____

As soon as you have properly inputted this information to the computer, have a printout made to show your instructor.

4th weeks inventory:

The fourth weeks inventory should be filled-in below before inputting to the program software : *(be sure to use the updated time bucket)*

Stock #	Description	Supplier #	\$Unit price	Quantity
---------	-------------	------------	--------------	----------

_____	_____	_____	5.99	_____
-------	-------	-------	------	-------

How many gumball machines were shipped ? _____

As soon as you have properly inputted this information to the computer, have a printout made to show your instructor.

5th weeks inventory:

The fifth weeks inventory should be filled-in below before inputting to the program software:

Stock #	Description	Supplier #	\$Unit price	Quantity
---------	-------------	------------	--------------	----------

_____	_____	_____	5.99	_____
-------	-------	-------	------	-------

How many gumball machines were shipped ? _____

As soon as you have properly inputted this information to the computer, have a printout made to show your instructor.

6th weeks inventory:

The sixth weeks inventory should be filled-in before inputting to the program software: *(complete the questions before continuing to week 7)*

Stock #	Description	Supplier #	\$Unit price	Quantity
---------	-------------	------------	--------------	----------

_____	_____	_____	5.99	_____
-------	-------	-------	------	-------

How many gumball machines were shipped ? _____

How many gumball machines are in-production? _____

How many gumball machines are on-hand ? _____

As soon as you have properly inputted this information to the computer, have a printout made to show your instructor.

7th weeks inventory:

The seventh weeks inventory should be filled-in below before inputting to the program software:

Stock #	Description	Supplier #	\$Unit price	Quantity
---------	-------------	------------	--------------	----------

_____	_____	_____	5.99	_____
-------	-------	-------	------	-------

How many gumball machines are being shipped ? _____

How many gumball machines are on-hand ? _____

What is the cost to carry the inventory ? _____

As soon as you have properly inputted this information to the computer, have a printout made to show your instructor.