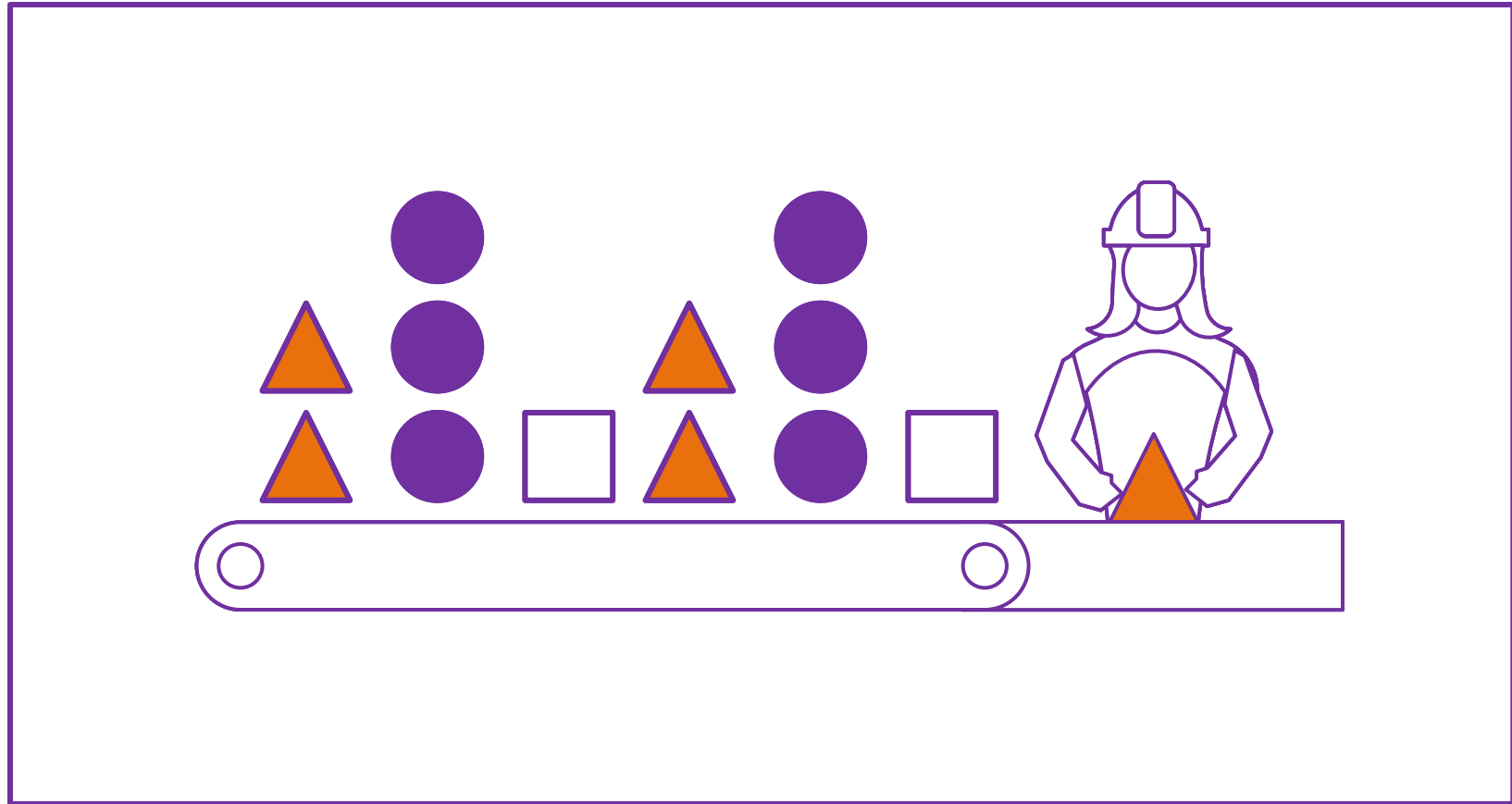


Mix Manufacturing VSM

Learn how to use eVSM for discrete manufacturing applications, allowing you to analyze capacity, lead time, and cost.



Course version: 019

Date Published: 8 March 2024

How to Use this File

This file contains the reading materials and the exercise pages from the course (title on previous page). While the course can only be taken on a computer, this booklet can be useful for note taking and later for refresher training.

This booklet is designed for on screen and print use. For on screen use, we recommend Acrobat Reader with the page display set to "Single Page View". If you are using this booklet on-screen while going through the exercises in eVSM, a second monitor is very helpful.

For hardcopy use, print the file on 8.5x11 or A4, and bind along the long edge.

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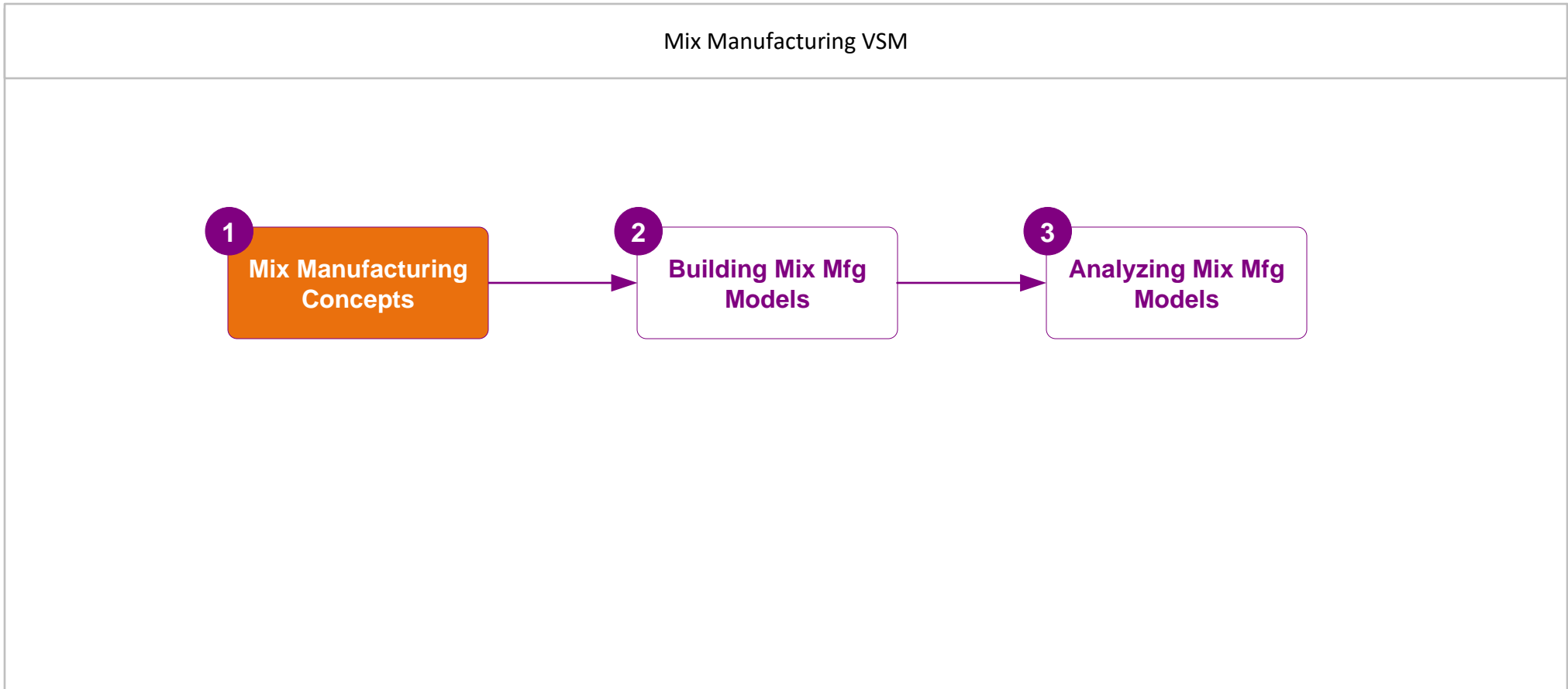
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Mix Manufacturing Concepts

The Mix Manufacturing VSM application focuses on plant value stream mapping for mixed model manufacturing of discrete parts and assemblies. This first lesson introduces the key concepts used in manufacturing value streams and mix modelling.

Before proceeding with this course, you **MUST** complete the Fast Draw and the Quick Mix Time courses.



Working with eLearner

The eLearner learning system includes a range of useful functions:

The screenshot shows the eLearner interface for a course titled "Time Maps: Lesson 1/7: Improvement Cycle". The user is logged in as "hr@evsm.com" and has a "Sign Out" button. The main content area displays "Ex 1 of 2: Configure the Sequence" with instructions: "Drag the purple shapes into the white boxes to sequence your improvement steps for the customer fulfillment value stream." Below the content is a toolbar with several icons: a question mark, an envelope, a starburst, a speech bubble, a document, a video camera, a list, a refresh, a left arrow, a right arrow, and a "Grade It!" button. A cartoon avatar of a woman with glasses is also visible.

Callouts provide the following information:

- Make sure YOU are signed in**: Points to the user's email address.
- You MUST click the Grade It button to check correct completion of each exercise and to record your score**: Points to the "Grade It!" button.
- Send feedback and questions to eVSM Support**: Points to the envelope icon.
- Check Hint if unclear about instructions**: Points to the starburst icon.
- Where reference documentation or video is available, these buttons will be active**: Points to the document and video camera icons.

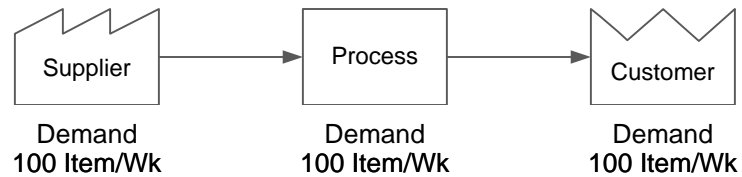
Important Notes

1. When you complete an exercise, you **MUST** click the "Grade It" button.
2. Points are deducted for incorrect attempts.
3. If you are stuck on an exercise, check the Hint. If that does not help, go back and review the preceding Readme pages. If you are still unsure, click the Feedback button and ask your question.

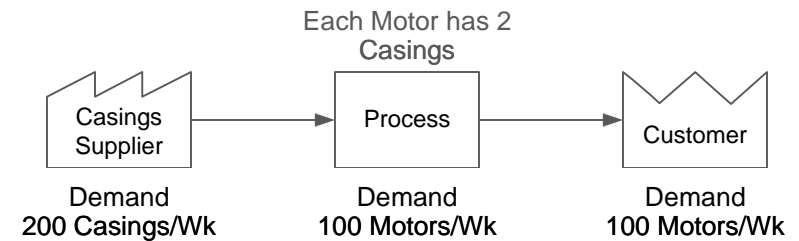
Value Stream Demand

Demand for the value stream is set by the customer and flows upstream through all the activities towards the suppliers. Generally, the demand at an activity is equal to the next downstream operation. Exceptions occur when activities are shared resources, have scrap, have parallel processing, etc. Here are some examples:

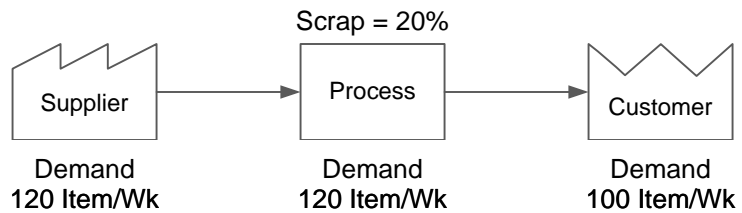
Simple straight flow



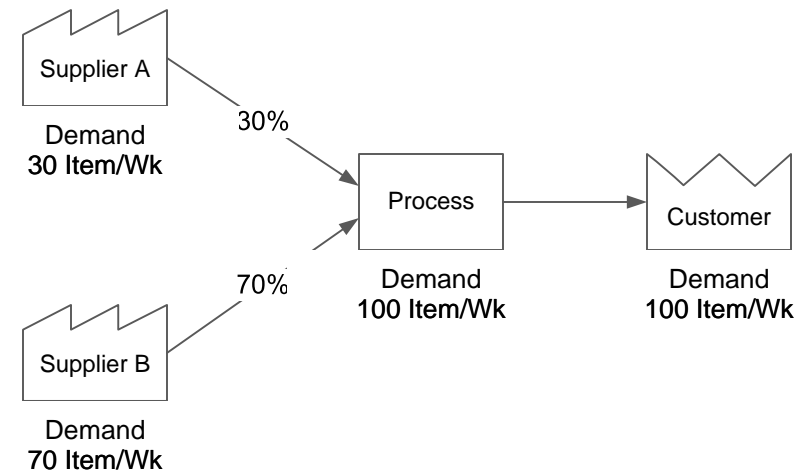
Components Demand



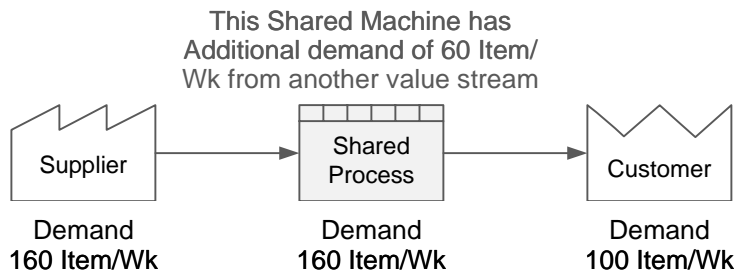
Scrap



Multiple Suppliers

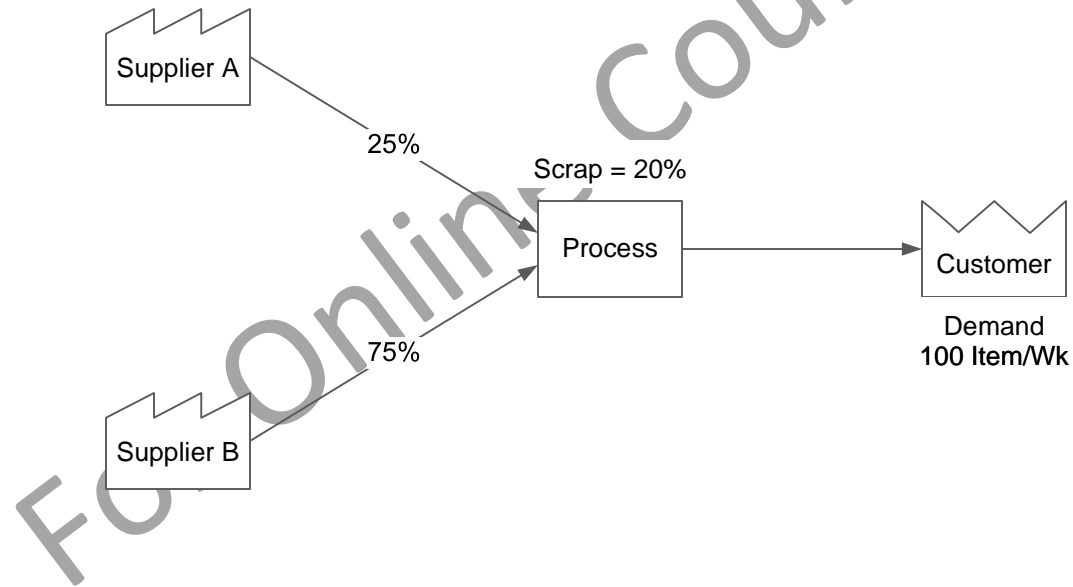


Shared Resources



Q. What is the weekly demand at Supplier B?

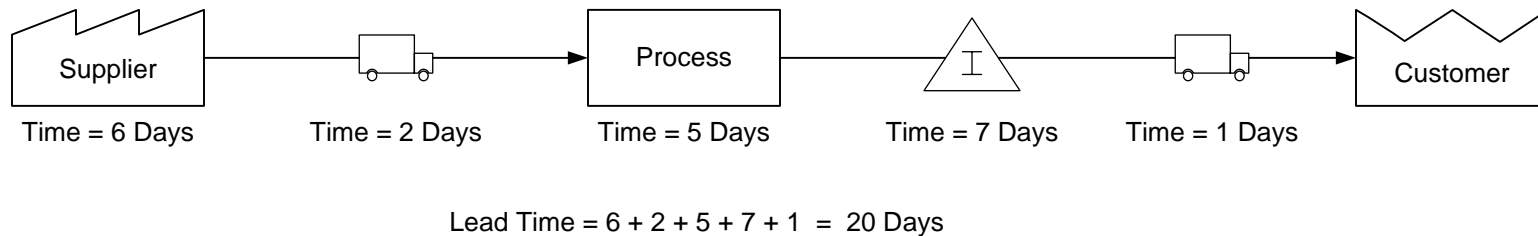
- 80 Item/Wk
- 100 Item/Wk
- 90 Item/Wk
- 75 Item/Wk



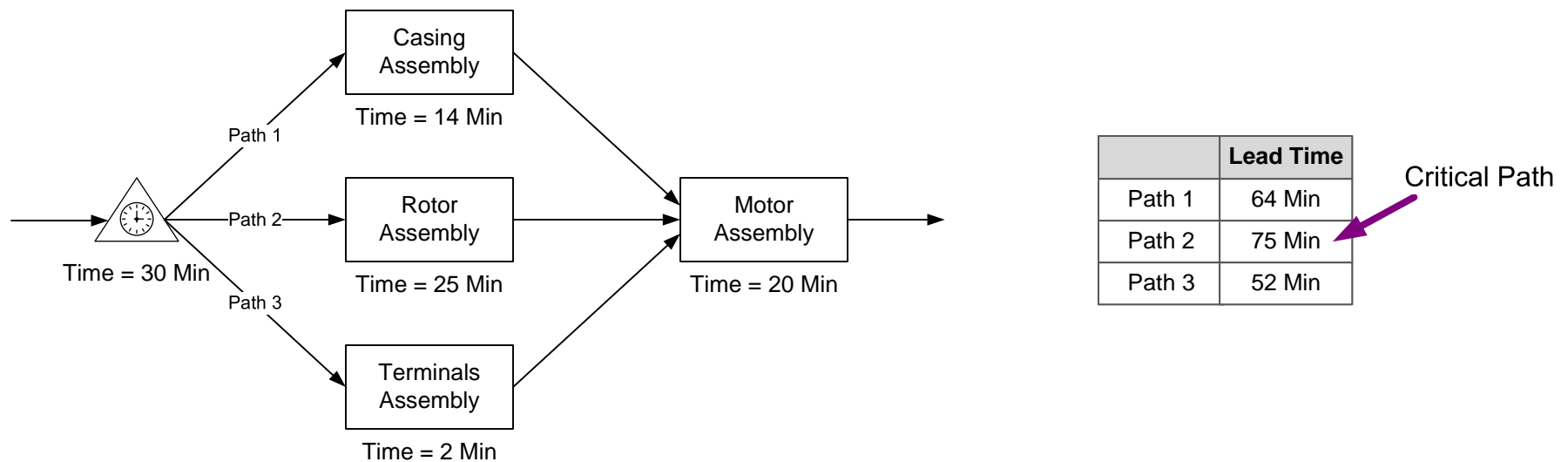
Lead Time

Lead time is the time it takes for an item of work to go through a process. It includes all of the time components such as work time, wait time, transport time, etc. The process may be an individual activity, a segment of a value stream, or the whole value stream. So it is important to clarify what part of the value stream the lead time is for.

Example 1 – Lead Time is the Sum of all times

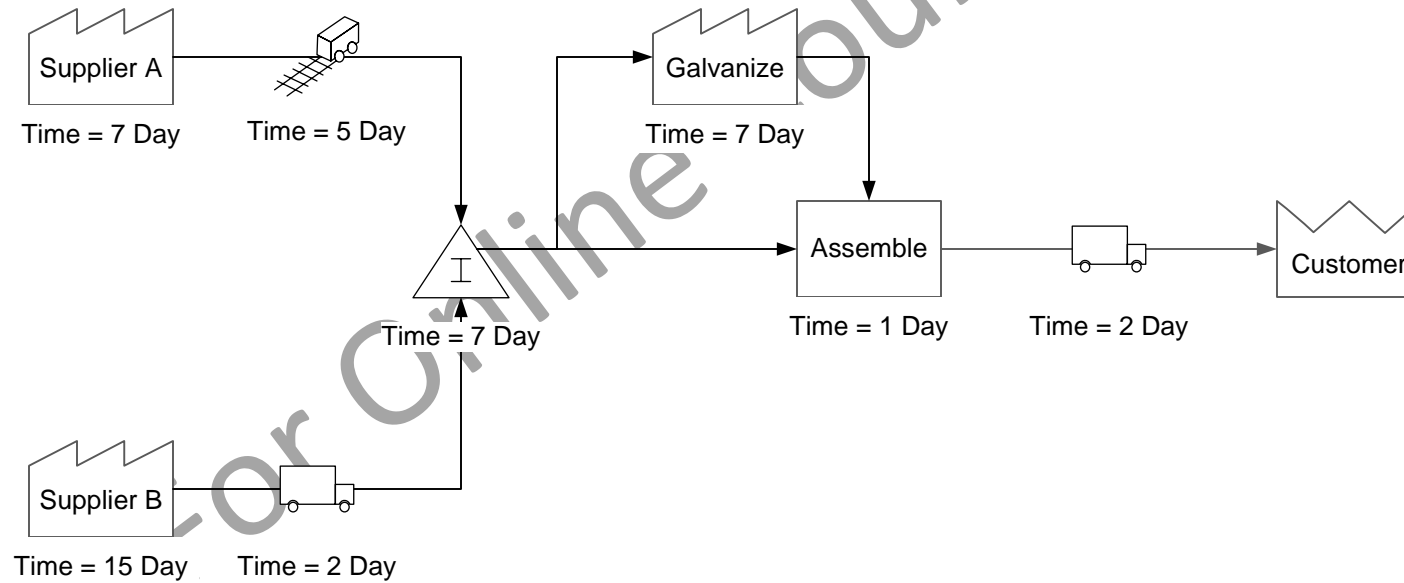


Example 2 – Critical Path is the Lead Time of the longest path



Q. What is the lead time for the critical path?

- 29 Days
- 38 Days
- 31 Days
- 34 Days



Capacity

A clear understanding of capacity allows you to see if you can meet the customer demand, identify excess resources, and select the best way to address any bottlenecks. The capacity of an activity is the maximum number of "good" products it can produce in a given time period.

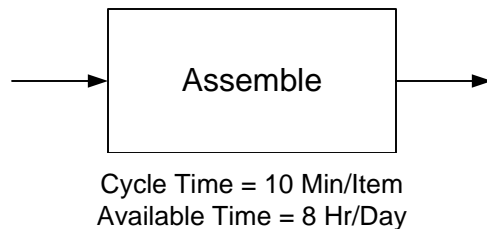
The simple calculation for capacity is:

$$\text{Capacity} = \frac{\text{Available Time}}{\text{Cycle Time}}$$

Typical value streams have losses such as downtime, setup time, changeovers, process inefficiencies, rework, scrap, etc. So, a more general calculation is:

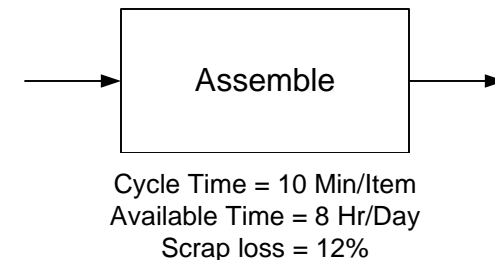
$$\text{Capacity} = \frac{\text{Available Time}}{\text{Cycle Time}} - \text{Losses}$$

Example 1 – No Capacity Losses



$$\text{Capacity} = \frac{8 * 60}{10} = 48 \text{ items/day}$$

Example 2 – Capacity with 12% Scrap

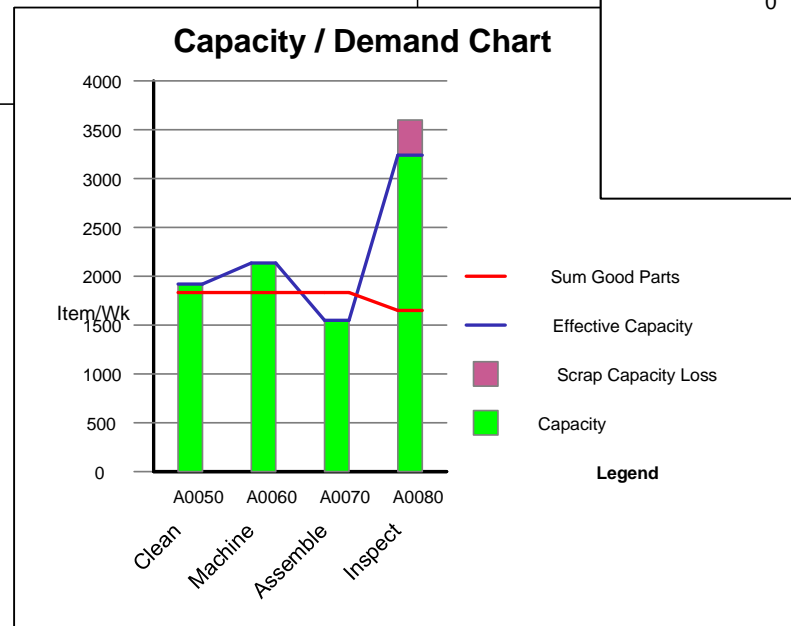
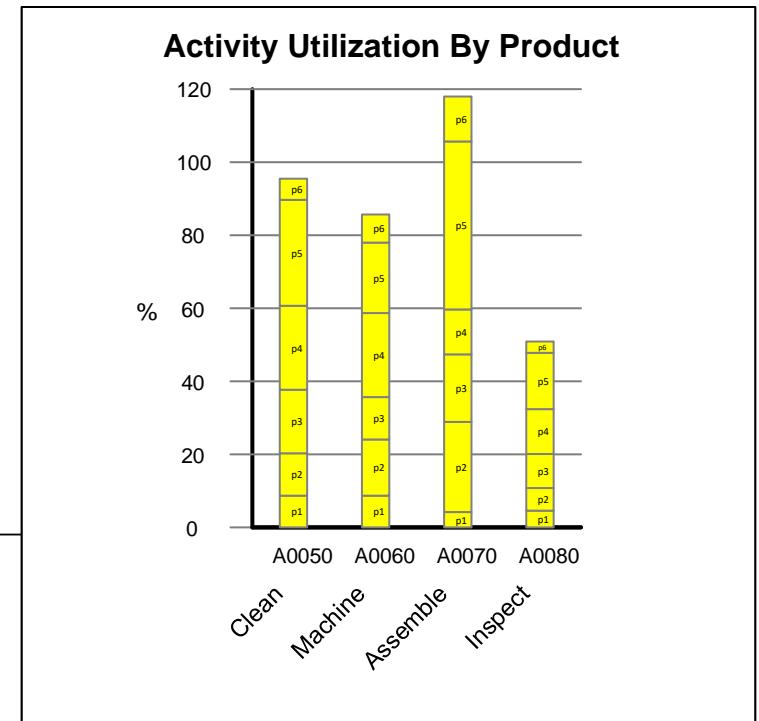
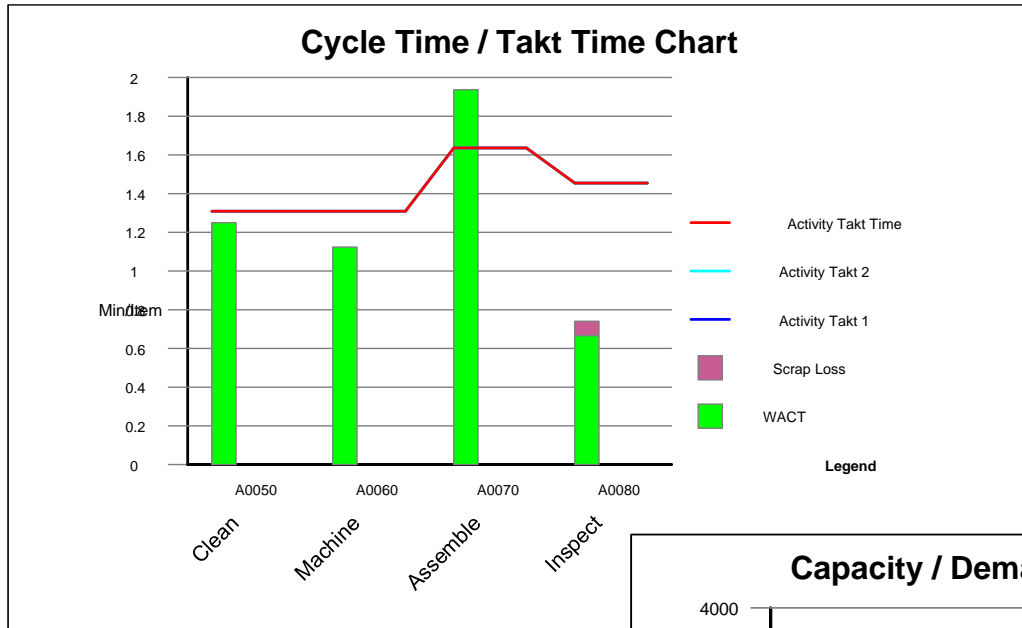


$$\text{Capacity} = \frac{8 * 60}{10} - 12\% = 43 \text{ items/day}$$

Capacity Analysis Charts

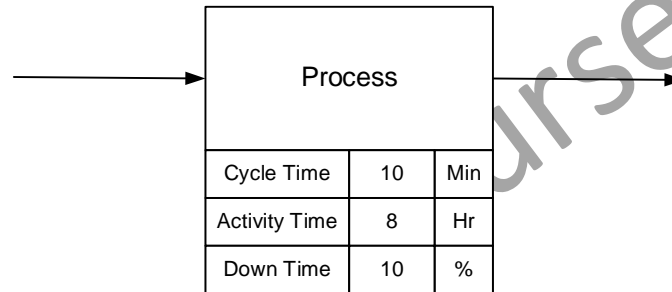
Charts are often used to visualize capacity across all activities in the value stream. These charts can help see where the bottle-neck process is, which activities have insufficient capacity, how well the line is balanced, and where there may be excess capacity. Here are some examples.

All three charts show that the Assemble activity is the bottle-neck and that the Inspect activity has excess capacity.



Q. What is the Daily Capacity of this Process?

- ~46 Item/Day
- ~28 Items/Day
- ~43 Items/Day
- ~48 Items/Day



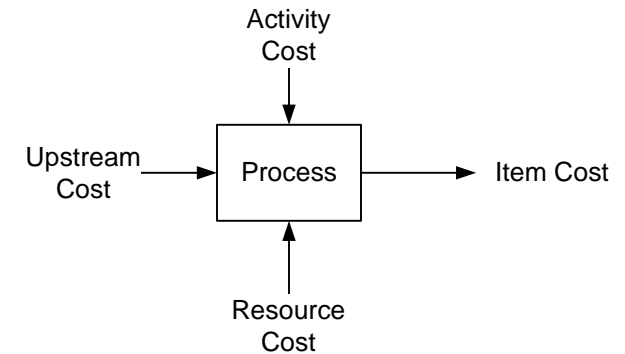
Cost Calculations

In a value stream map, if you know the cost of each activity for a given part, you can calculate the value of the part at any point in the value stream. This in-turn allows you to calculate the total value of inventory at any point, total value of all the inventory, holding costs, and period costs.

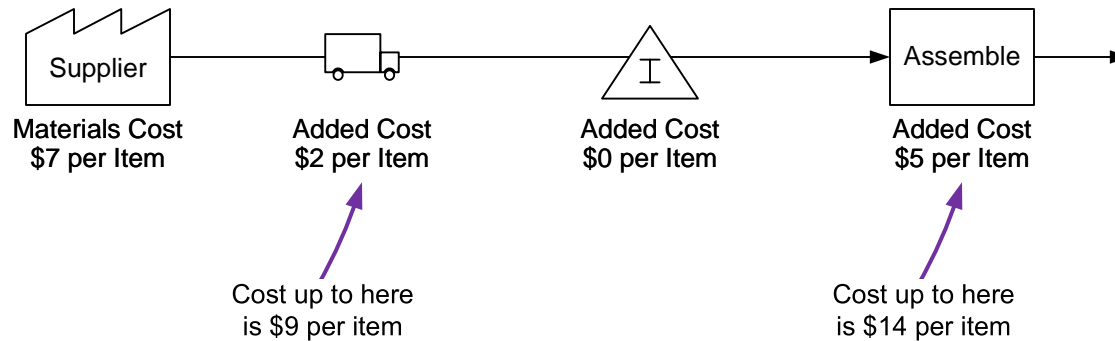
Cost of an Item

The cost of an item is the total expense to make that item. The cost of an item increases as it flows through the value stream. Each activity it goes through adds some cost. This activity cost can include machine time, energy usage, secondary materials, facility space, etc. It may also include human resource cost, if the resource cost is not being analyzed separately. So, the cost of an item at any point in the value stream is:

$$[\text{Sum of all upstream costs}] + [\text{Activity Cost}] + [\text{Resource Cost}]$$



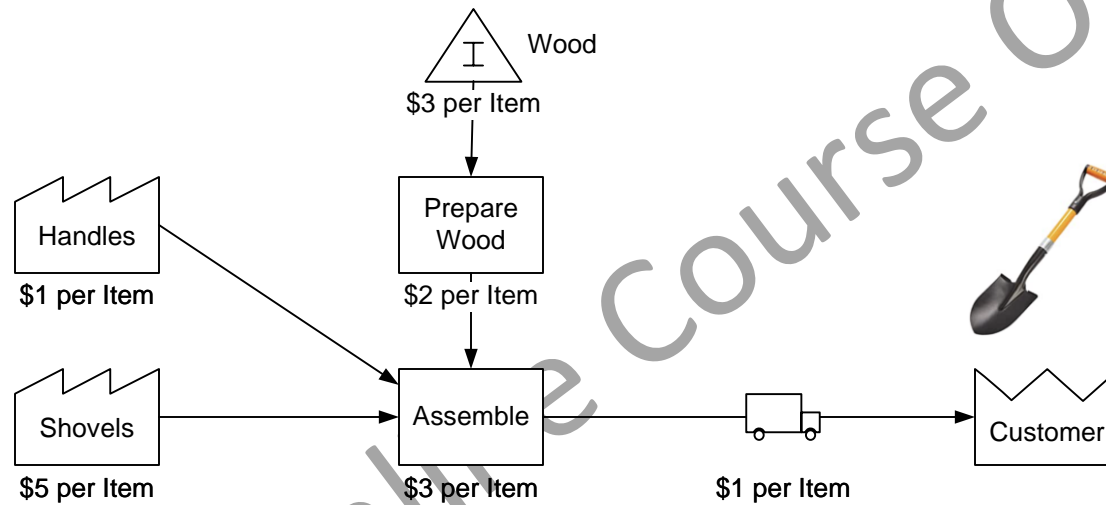
Example



Note: Cost is what you spend to make a product, price is what the customer pays.

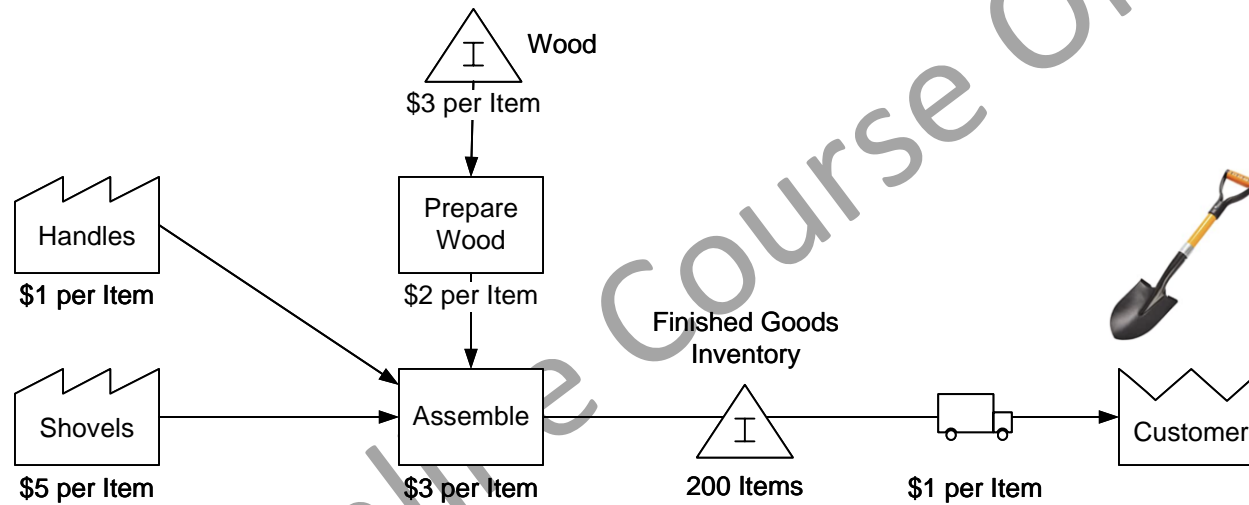
Q. What is the cost of 1 spade when it reaches the customer?

- \$17
- \$3
- \$21
- \$15



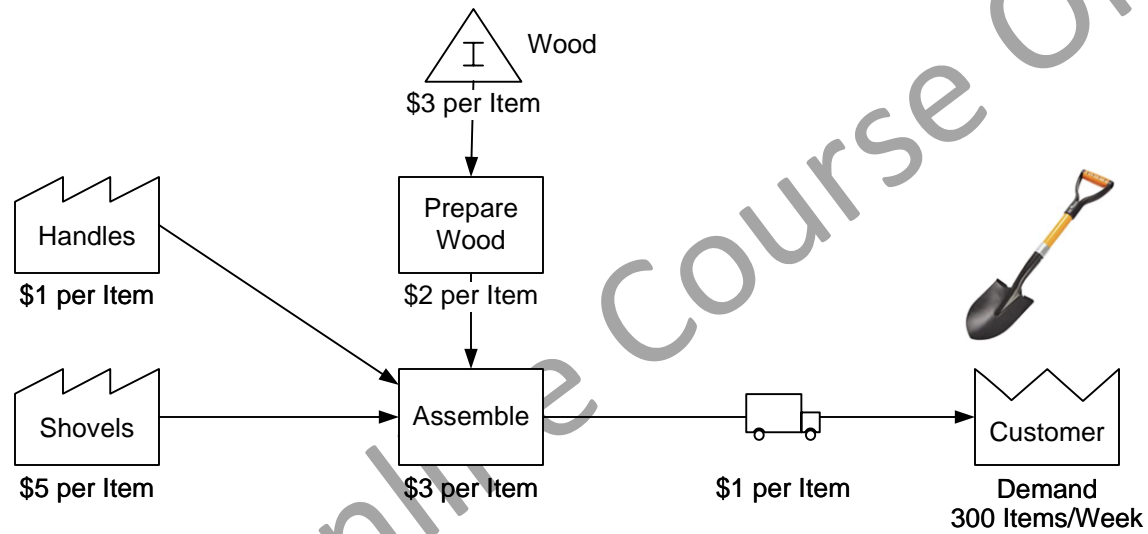
Q. What is the total value of the finished goods inventory?

- \$2800
- \$3200
- \$3400
- \$4100



Q. What is the annual cost of running this operation?

- ~K\$234
- ~K\$202
- ~K\$195
- ~K\$180

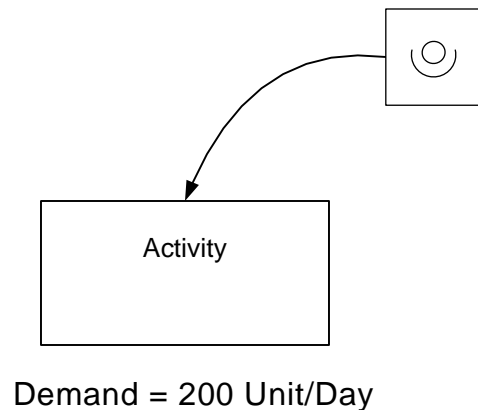


Resource Time

How much of the resource time is used each day?

$$\text{Resource Time} = \frac{\text{Demand} * \text{Resource Process Time}}{\text{Efficiency}}$$

Example



Staff

Available Time = 4 Hrs/Day

Resource Process Time = 6 Min/Unit

Cost = \$45/Hr

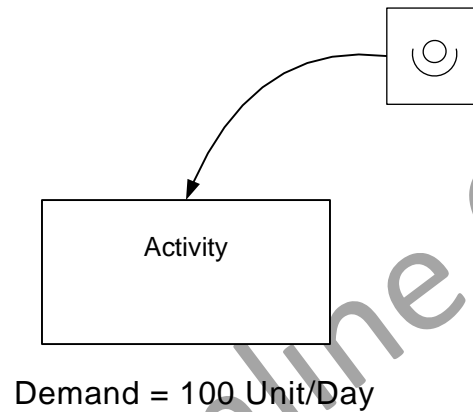
Efficiency = 90%

of staff = 4

$$\text{Resource Time} = \frac{200 * 6}{0.9} = \frac{1200}{0.9} = 1333.33 \text{ Mins/Day}$$

Q. How much of the resource time is used each day?

- 1000 Mins/Day
- 4 Hrs/Day
- 6.5 Hrs/Day
- 800 Mins/Day

**Staff**

Available Time = 4 Hrs/Day (per staff)

Resource Process Time = 8 Min/Unit

Cost = \$40/Hr

Efficiency = 80%

of staff = 4

Used Time & Available Time

What are the costs of the used time and the available time?

$$\text{Used Time} = \frac{\text{Demand} * \text{Resource Process Time}}{\text{Efficiency}}$$

$$\text{Cost of Used Time} = \frac{\text{Used Time}}{\text{Min per hour}} * \text{Cost}$$

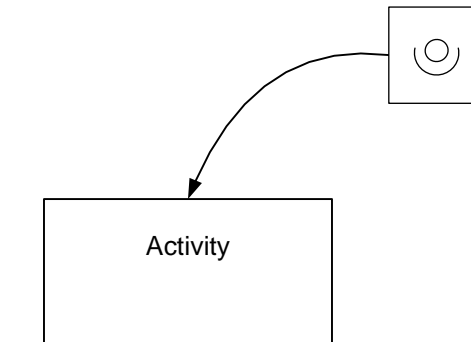
$$= \frac{(200 * 3) / 0.90}{60} * 45$$

$$= \$500 / \text{Day}$$

$$\text{Cost of Available Time} = \text{Available Time} * \# \text{ of staff} * \text{Cost}$$

$$= 4 * 4 * 45$$

$$= \$720 / \text{Day}$$



Demand = 200 Unit/Day

Resource

Available Time = 4 Hrs/Day

Resource Process Time = 3 Min/Unit

Cost = \$45/Hr

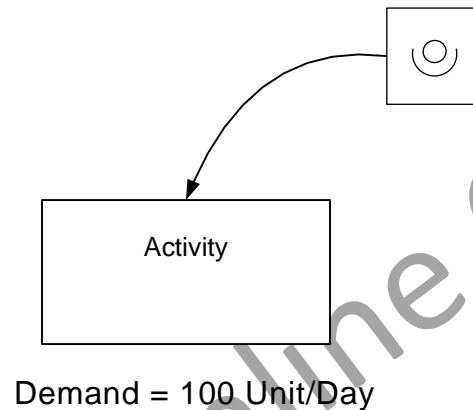
Efficiency = 90%

of staff = 4

Utilization

Q. What are the costs of the used time and the available time?

- Ⓐ Used Cost = \$700, Available Cost = \$650
- Ⓑ Used Cost = \$667, Available Cost = \$640
- Ⓒ Used Cost = \$640, Available Cost = \$667
- Ⓓ Used Cost = \$550, Available Cost = \$640

**Staff**

Available Time = 4 Hrs/Day (per staff)

Resource Process Time = 8 Min/Unit

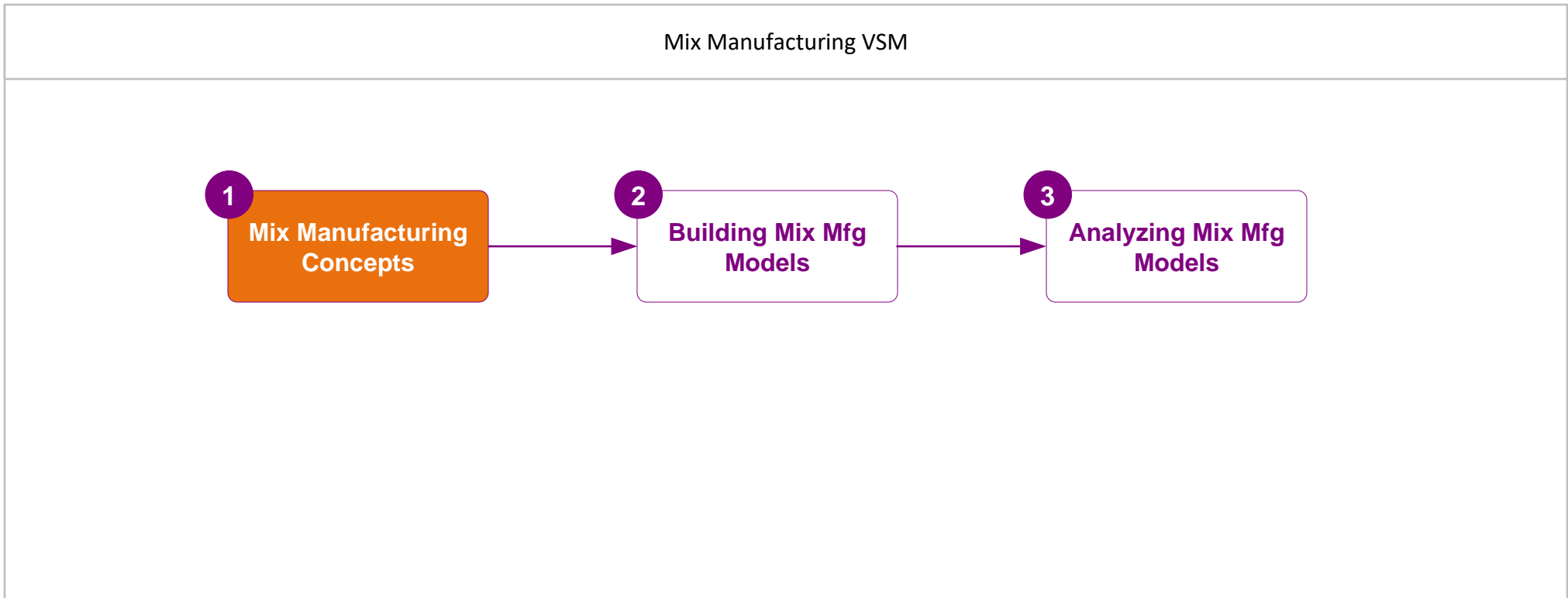
Cost = \$40/Hr

Efficiency = 80%

of staff = 4

You learned:

- Plant level discrete parts and assembly value stream mapping terminology such as activity time, inventory, scrap, activity cost, holding cost, and risk.
- How demand flows upstream from the customer.
- How some of the key metrics are calculated on plant level manufacturing maps.

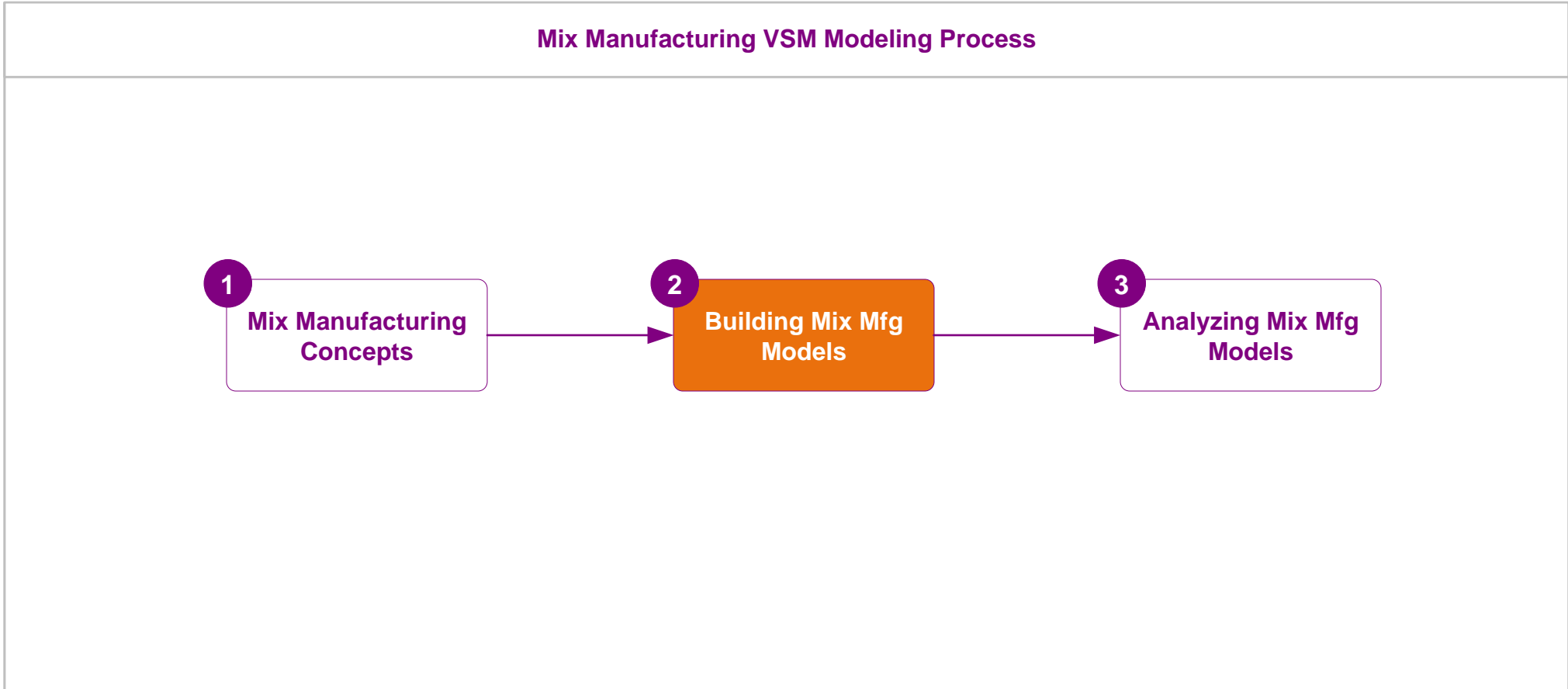


What's next:

You will learn how to build a plant level manufacturing value stream model from scratch.

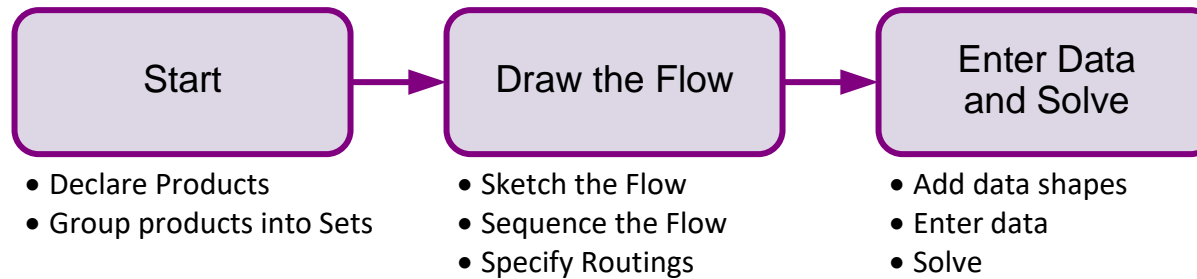
Building a Value Stream Model

This lesson teaches how to build an eVSM Mix model with the Mix Manufacturing application from scratch. A brief overview is followed by descriptions and hands-on exercises to declare a mix of products, draw the flow, specify routings, enter data, check, and solve the model.



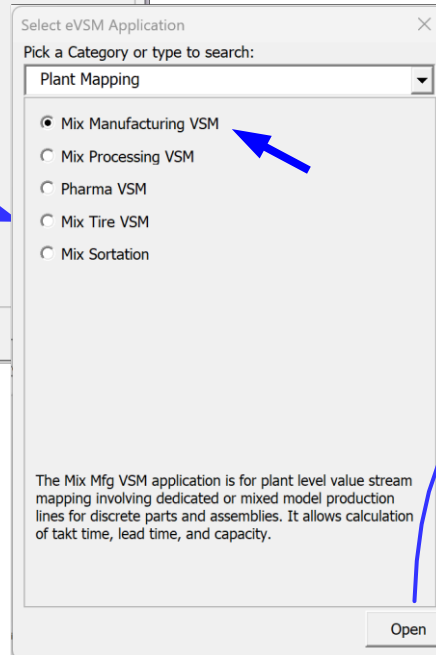
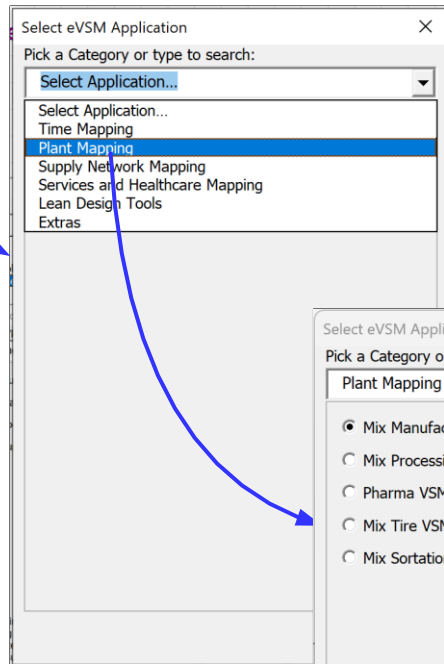
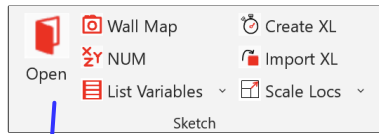
eVSM Mix Modeling Process

You learned how to build an eVSM Mix value stream model in the Mix Time course. If unsure of the process, you should review the notes for lessons 3, 4, and 5. In summary, the process is as follows:

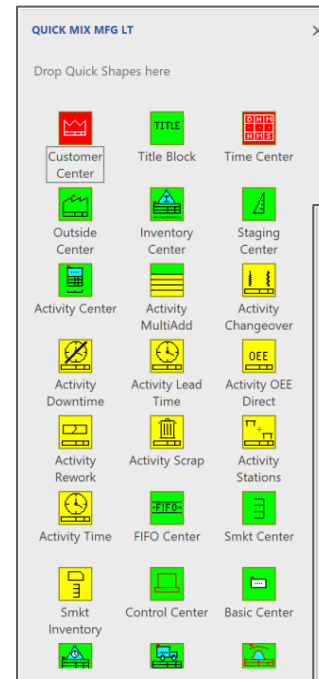


In this lesson, you will practice the above steps to build Mix Manufacturing models. Details of building eVSM Mix models were covered in the Mix Time course. Use the Mix Time course notes PDF file as a refresher if you need. You can download a fresh copy from <https://evsm.com/MixTimeV12>

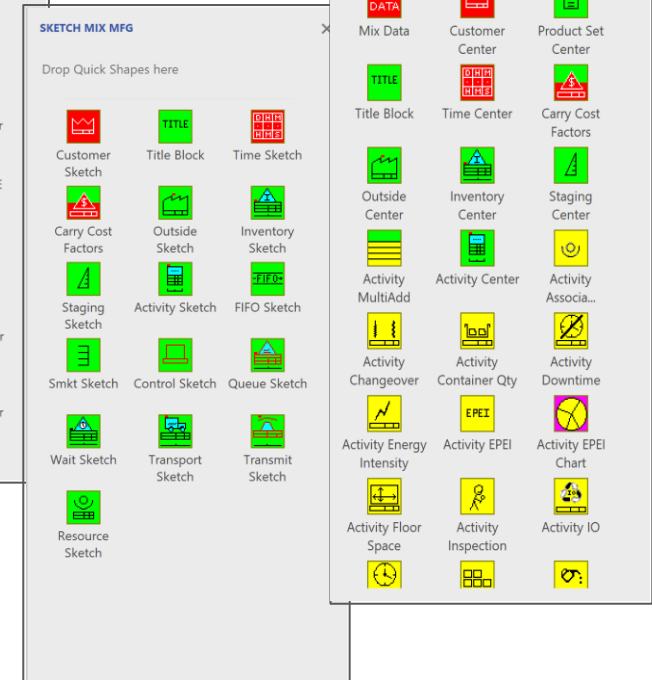
Mix Manufacturing VSM Stencils



This is a subset of the main stencil.
Useful for new users and for quicker access to the icons used most frequently

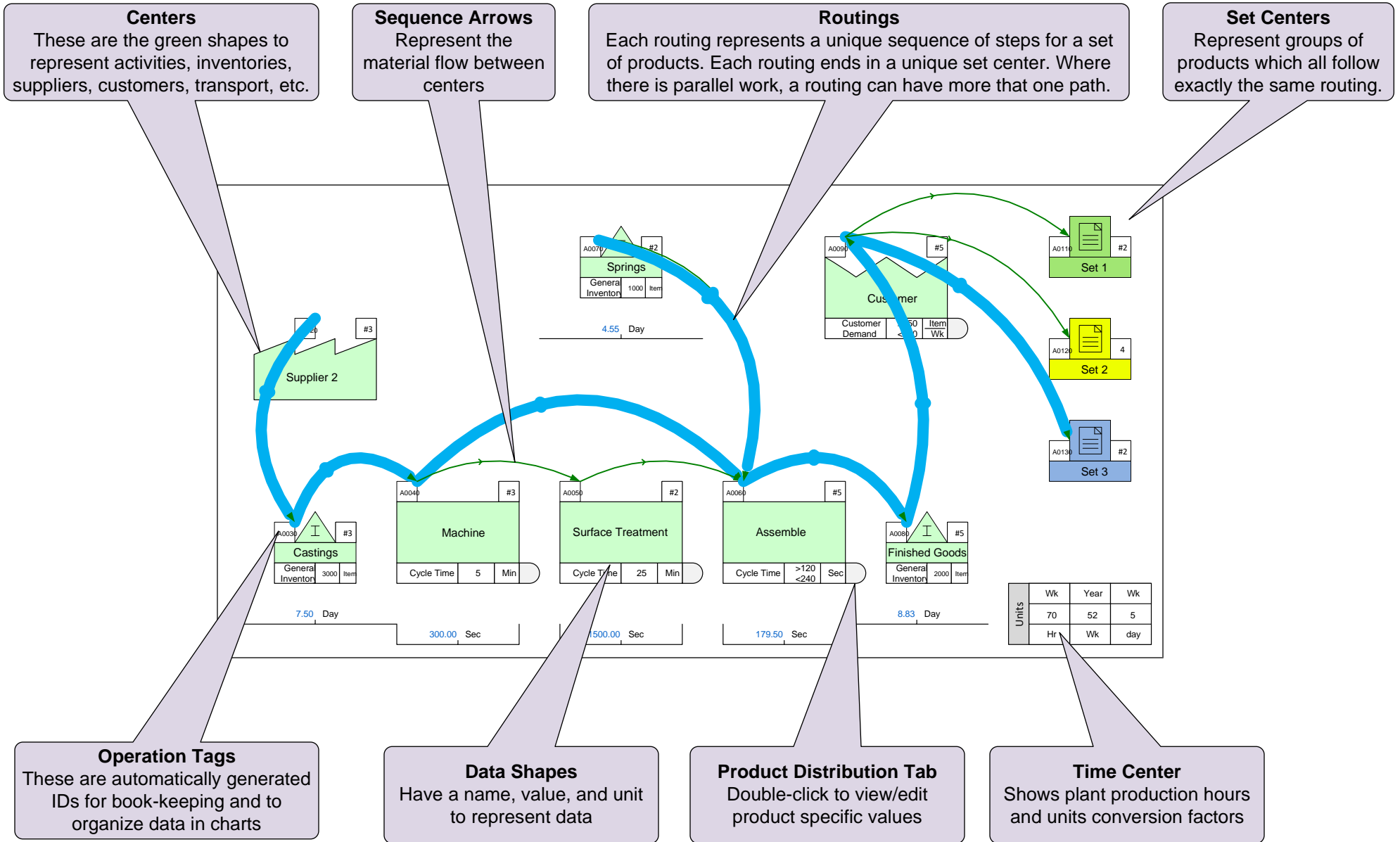


This is the main stencil and contains all icons for this application



The sketch stencil contains only the shapes required to create a flowchart (no data fields) of the value stream. Used to capture the flow. Once the flow is established, a single click will add all the default datashapes to the page.

Recap: Essential Terminology



Start a Mix Manufacturing Map

Initiate this page for a Mix Manufacturing map

For Online Course Only

Declare Products and Sets with the Mix Manager

1. Initiate this page for a Mix Manufacturing map.
2. Use the Mix Manager dialog (not Excel) to enter the following products and sets.
3. Exit the Mix Manager dialog and click the “Draw Sets” button in the toolbar.
4. Click Grade It.

Note: These are the exact steps you learnt in the Mix Time course.

Set Names	
Adult Bike	C01-City Bike C02-Mountain Bike C03-Hybrid Bike
Kids Bike	C04-Super Bike

For Online Course Only

Edit Products and Sets

In the Mix Manager dialog, make the changes shown below. After editing, click the “Draw Sets” button in the toolbar. Then Grade It!

Current:

Set Names	Product Names
Set 1	Product 1 Product 2
Set 2	Product 3 Product 4

Change to:

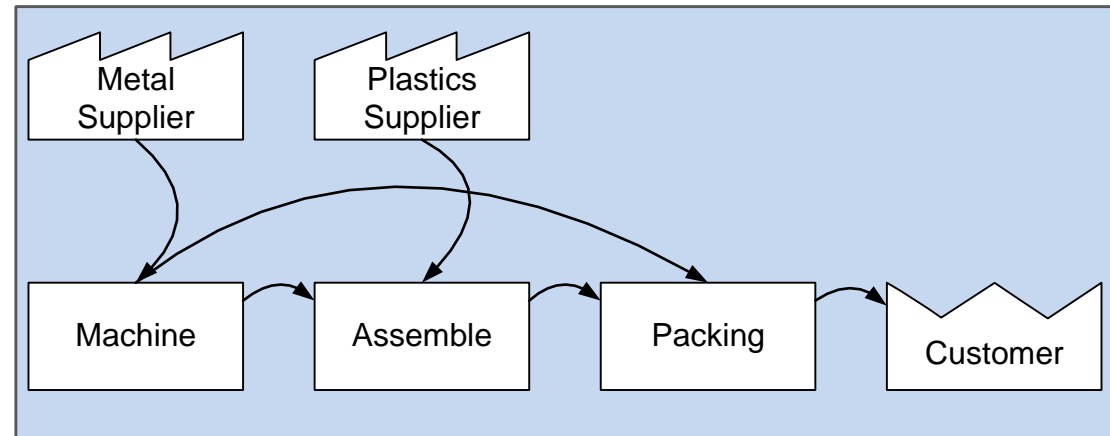
Set Names	Product Names
Set 1	Product 1
Set 2	Product 5 Product 4
Set 3	Product 2 Product 3

For Online Co

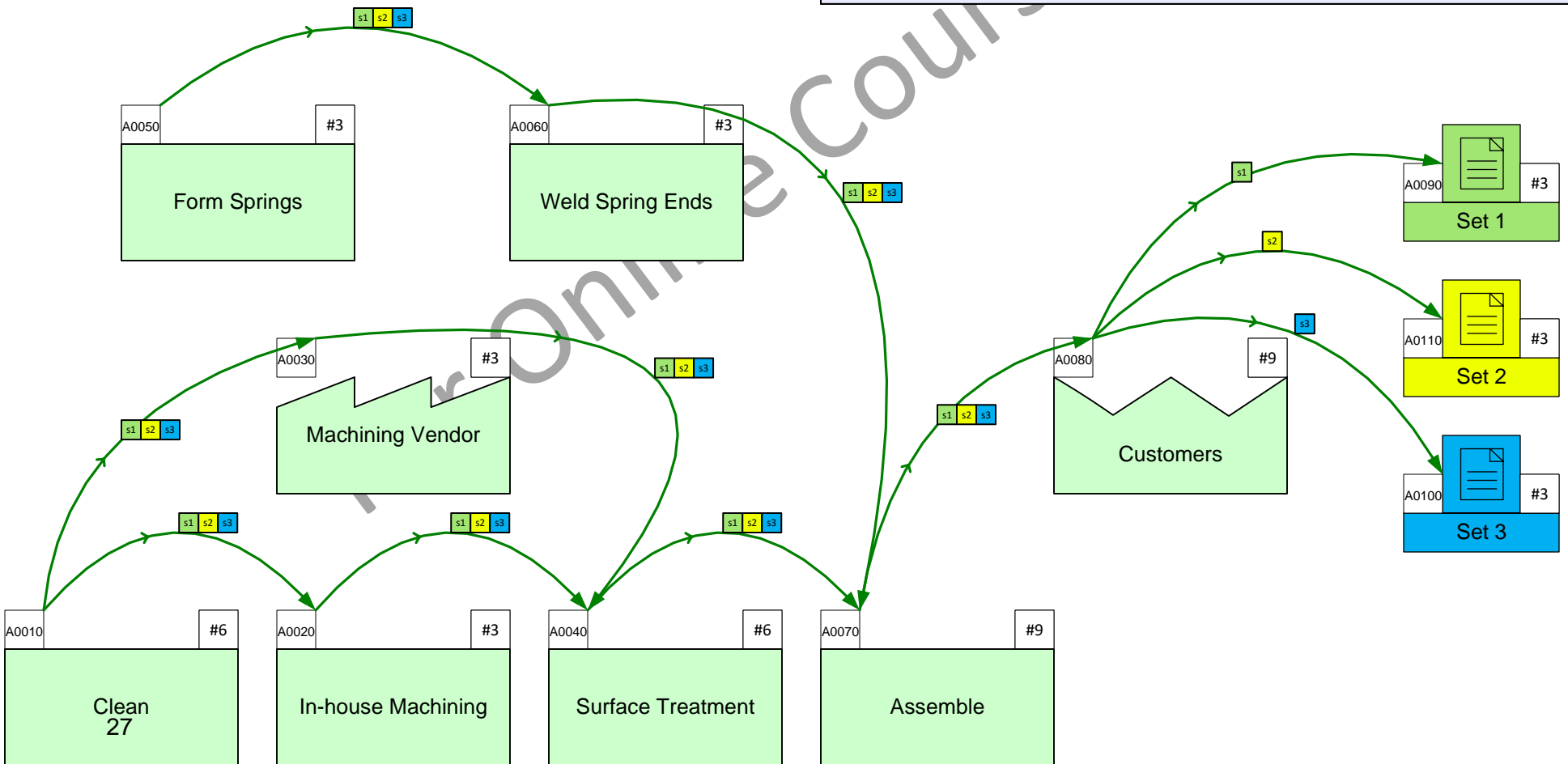
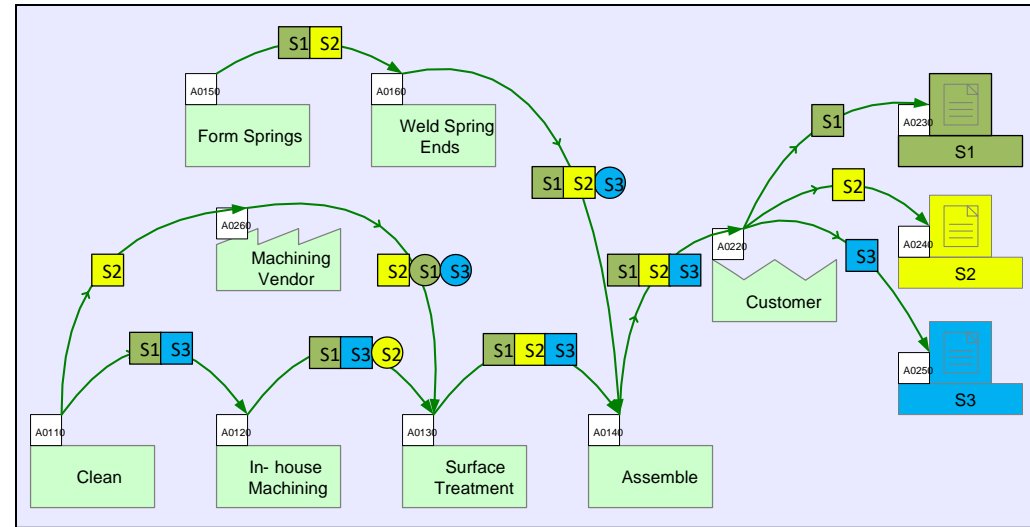
Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

Draw and Sequence

1. Initiate the page for a Mix Manufacturing VSM
2. Draw this flow with the Sketch Mix Manufacturing stencil. No need to draw the Set centers.
3. Add Sequence arrows to show the flow of materials.
4. Grade It !



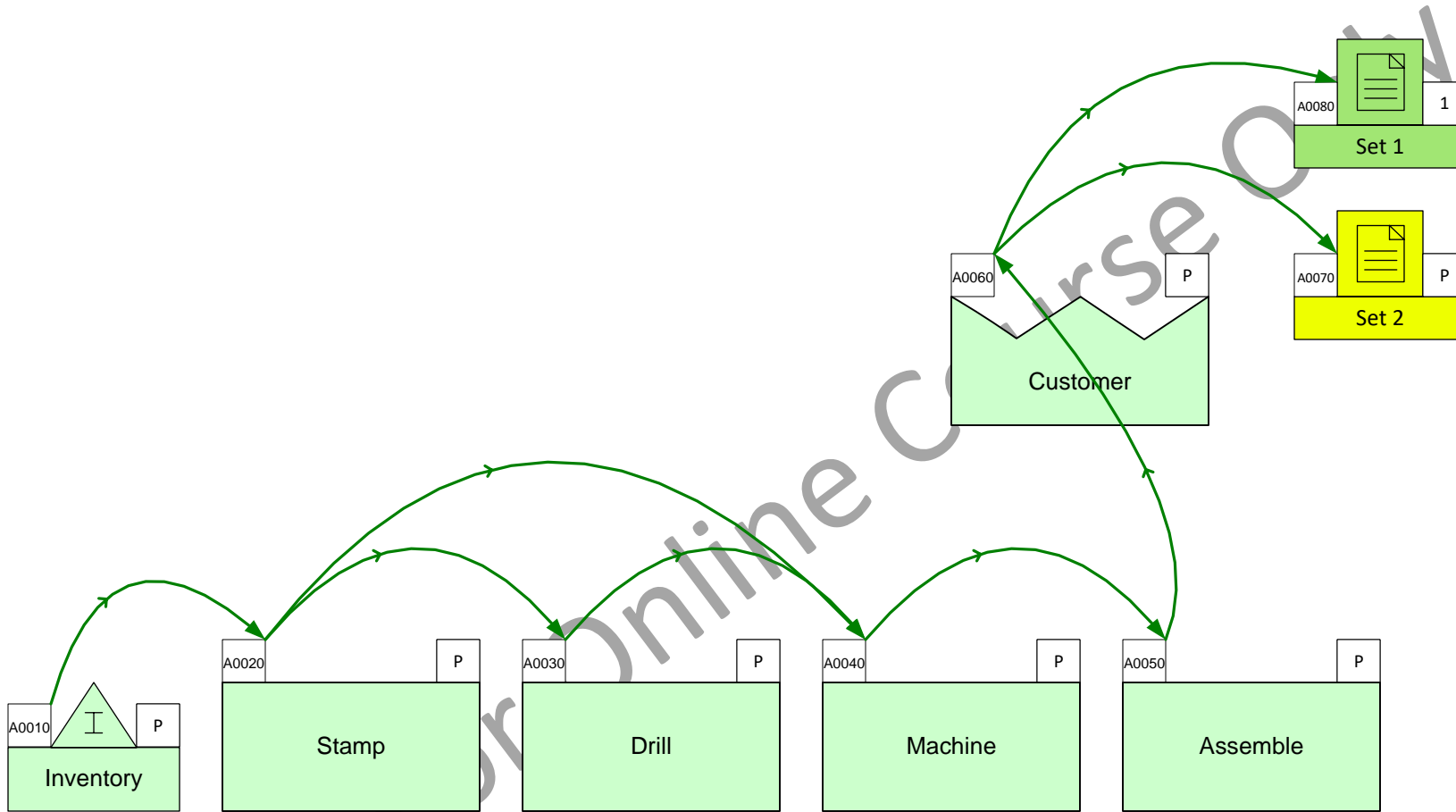
Routings Exercise 1



Routings Exercise 2

Use Set Gates to set up the routings on the map below as shown in the product matrix.

Set ID	Set Name	Product ID	Product Name	Raw material	Stamping	Drilling	Machining	Assembly	Finished Goods	Customer
S1	Set 1	P1	Product 1	x	x	x	x	x	x	x
S1	Set 1	P2	Product 2	x	x	x	x	x	x	x
S2	Set 2	P3	Product 3	x	x		x	x	x	x



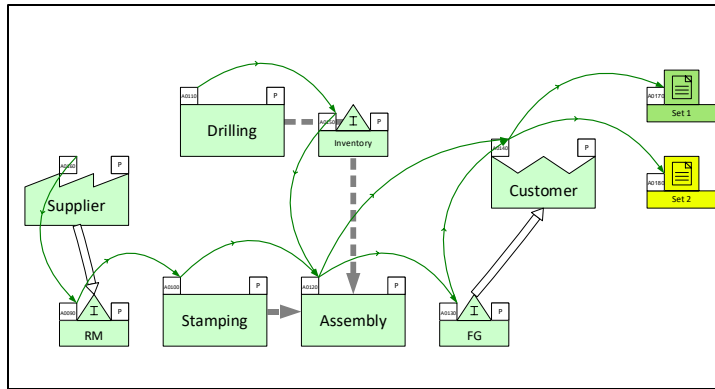
- s1 - Set 1
- p1 - Product 1 (Qty 0)
- p2 - Product 2 (Qty 0)

- s2 - Set 2
- p3 - Product 3 (Qty 0)

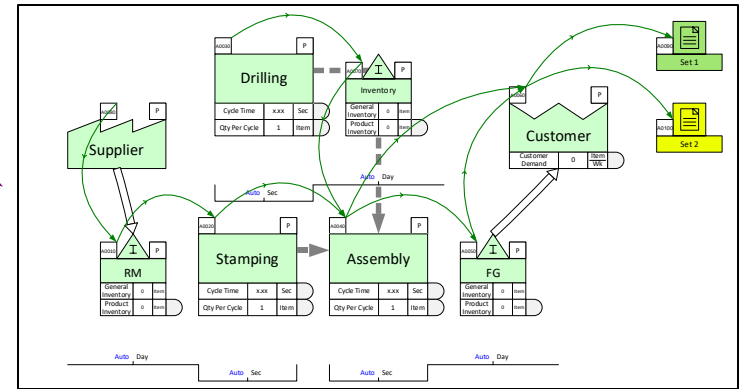
Data on Sketch Centers

If the flow has been drawn with a Sketch stencil, then you can automatically turn the flowchart into a data based value stream map model. Just right-mouse click on any Sketch Mix Manufacturing shape on the page and use the “Add all data (page)” command.

Sketch Map



After “Add all data”



Right-mouse menu, available on all the center’s parent shapes (green shapes)

- -
 -
 -
-
- Add all data (shape)
 - Add all data (page)
-
- Remove all data (shape)
 - Remove all data (page)

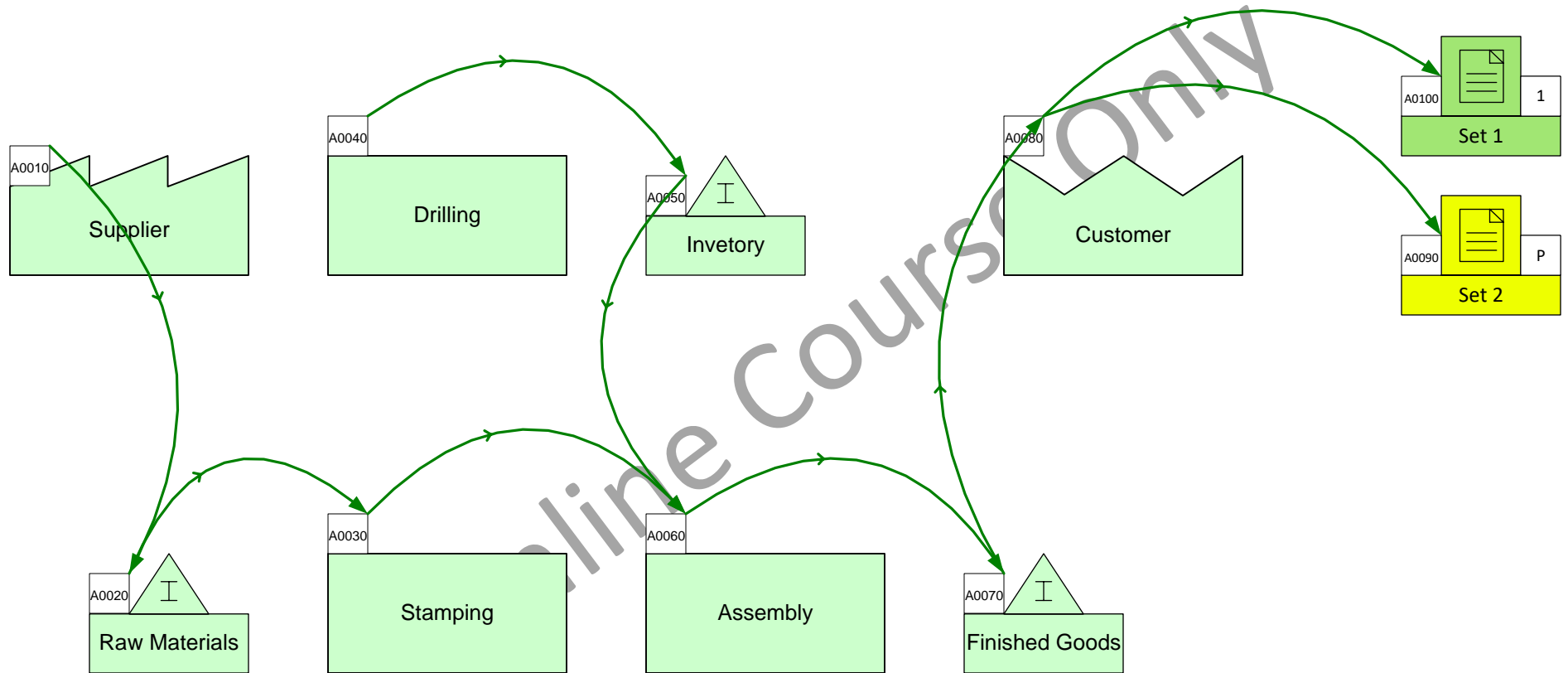
Click this command to automatically add data shapes to all centers on the page.

Data shapes can be removed too. Note that this will delete any entered and calculated values.

Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

Add Data Shapes to Sketch

Use the right-mouse menus on the centers to add default data shapes to this sketch.



Enter Data

Enter the Cycle Time and Customer Demand values as shown.

Assemble - Cycle Time	
Product	Value
Default	0
1 - Product 1	4.00
2 - Product 2	3.00
3 - Product 3	2.00
4 - Product 4	5.00
5 - Product 5	6.00

Customer - Customer Demand	
Product	Value
Default	0
p1 - Product 1	200
p2 - Product 2	150
p3 - Product 3	70
p4 - Product 4	160
p5 - Product 5	45

A0010	#2
Assemble	
Cycle Time	0 Min
Qty Per Cycle	1 Item

A0020	#2
Customer	
Customer Demand	0 Item Day

A0050	1
Set 1	

A0060	2
Set 2	

s1 - Set 1

p1 - Product 1 (Qty 0.0)

p2 - Product 2 (Qty 0.0)

s2 - Set 2

p3 - Product 3 (Qty 0.0)

p4 - Product 4 (Qty 0.0)

p5 - Product 5 (Qty 0.0)

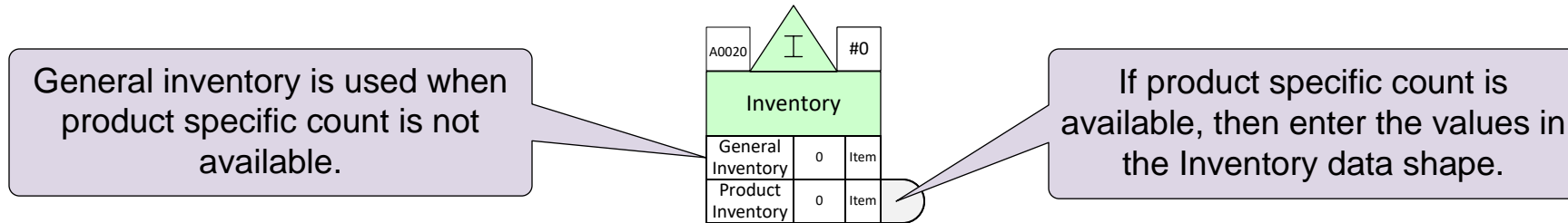
Auto	Sec
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Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day



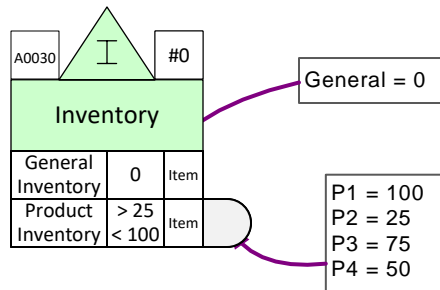
General vs Product Specific Inventory

The inventory center allows input of general (total) inventory and product specific inventory.

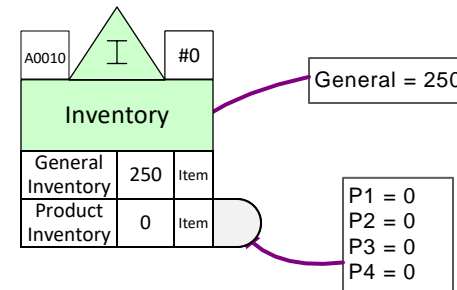


The two inventory types get added together. So at each inventory center, enter either the general or the product inventory. Never both.

Product-specific Inventory Example



General Inventory Example

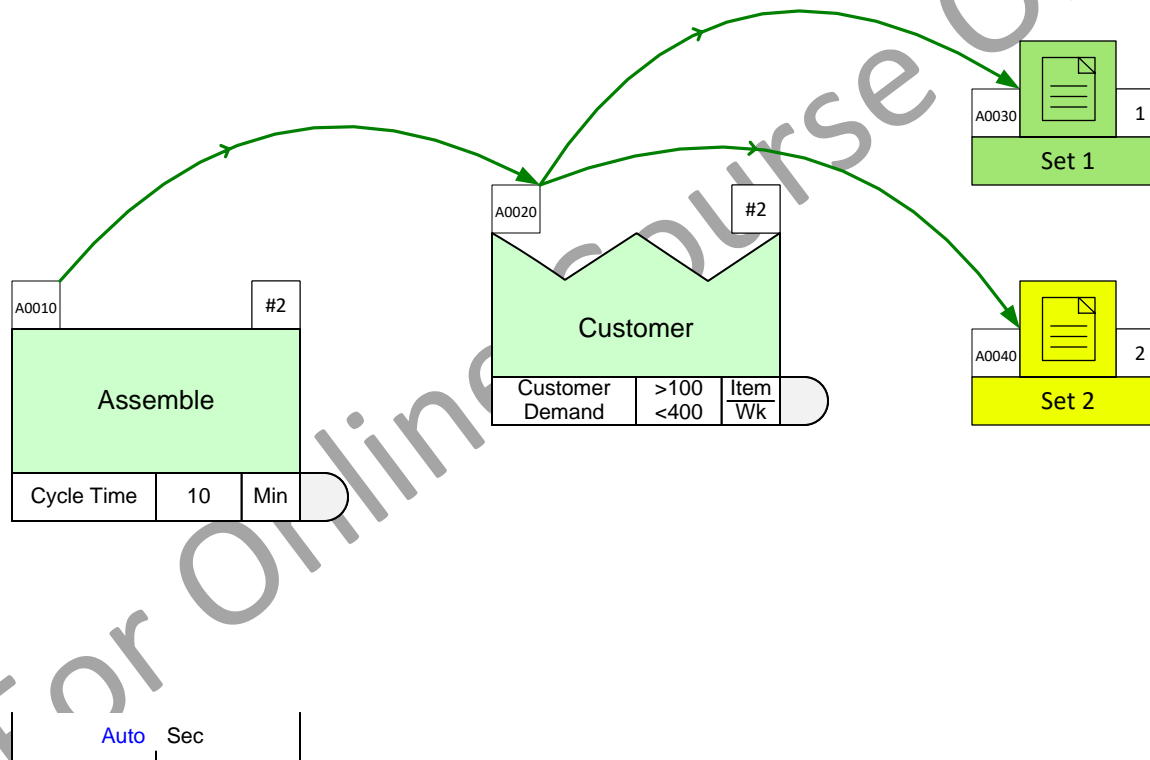


Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

Enter Data Values with the List Variables dialog

Through the List Variables dialog, change the “Qty Per Cycle” values at the Assemble operation to:

- P1 = 2 Item
- P2 = 4 Item
- P3 = 4 Item

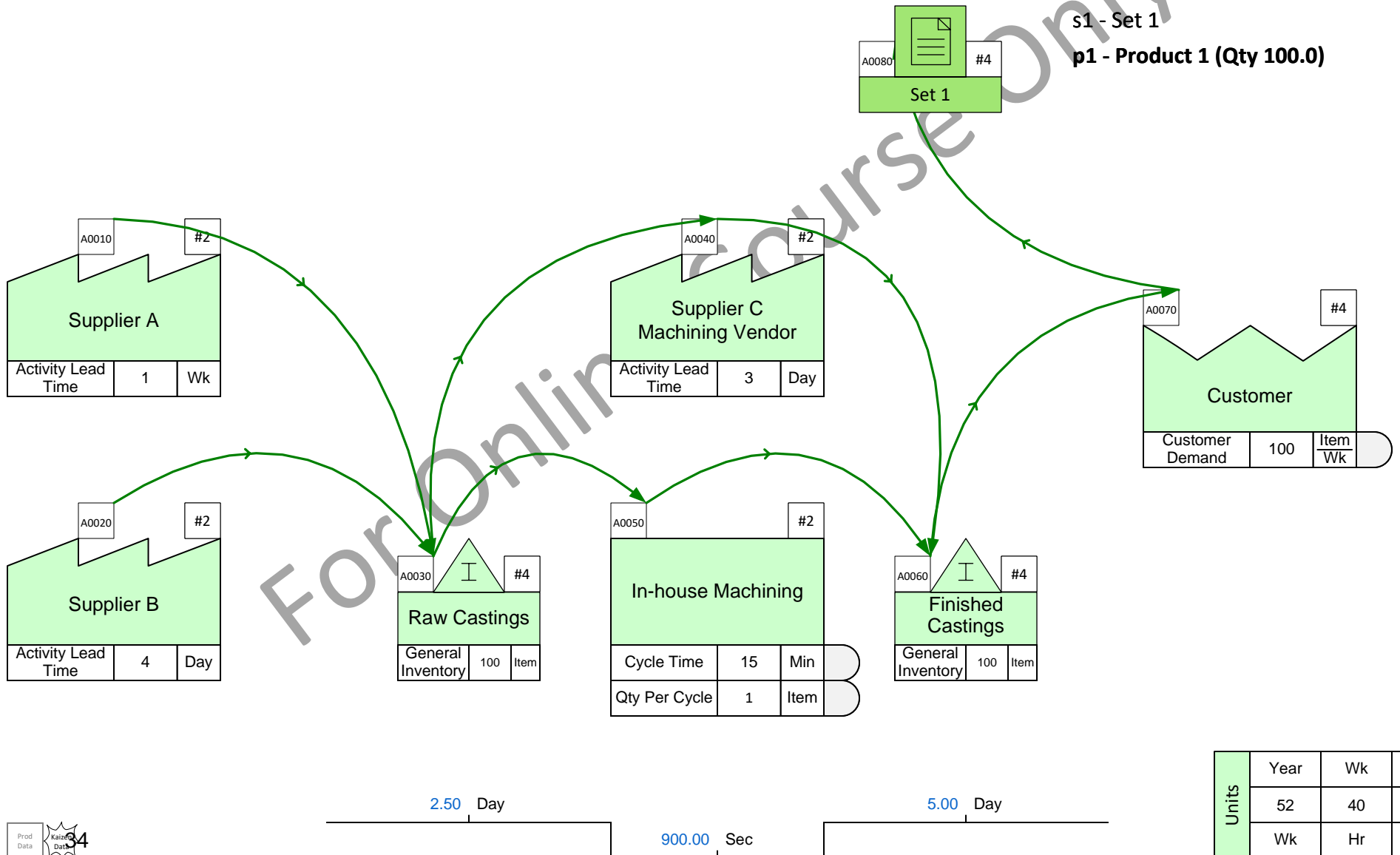


Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

Adjust Product Flow

Adjust the map to show:

- Supplier A provides 30% Raw Castings
- Supplier B provides 70% Raw Castings
- Supplier C does 50% of the machining

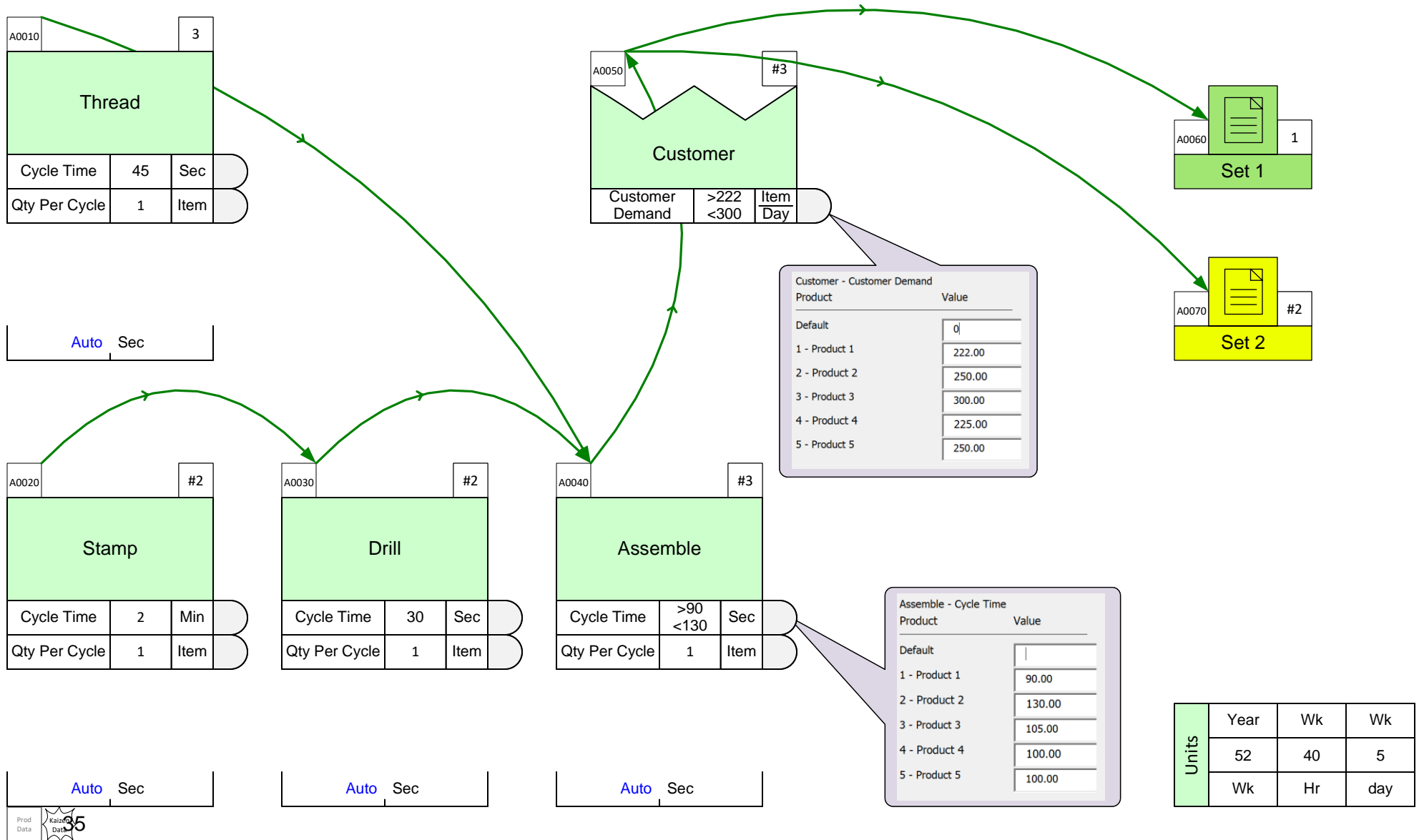


Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

Example Map 1

In the next exercise, you will draw the map below from scratch. A printed copy of this page will be helpful.

ID	Name	ID	Name	Stamp	Drill	Assemble	Thread	Customer
S1	Set 1	P1	Product 1	X	X	X	X	X
S2	Set 2	P2	Product 2	X	X	X		X
S2	Set 2	P3	Product 3	X	X	X		X
S2	Set 2	P4	Product 4	X	X	X		X
S1	Set 1	P5	Product 5	X	X	X	X	X



Draw the map shown on the previous page below.

Initialize the page for Quick Mix Mfg, create the products and sets shown in the matrix, draw the Set centers, draw the map with the Sequence arrows, specify the routings, and enter the data values. No need to Solve the map.

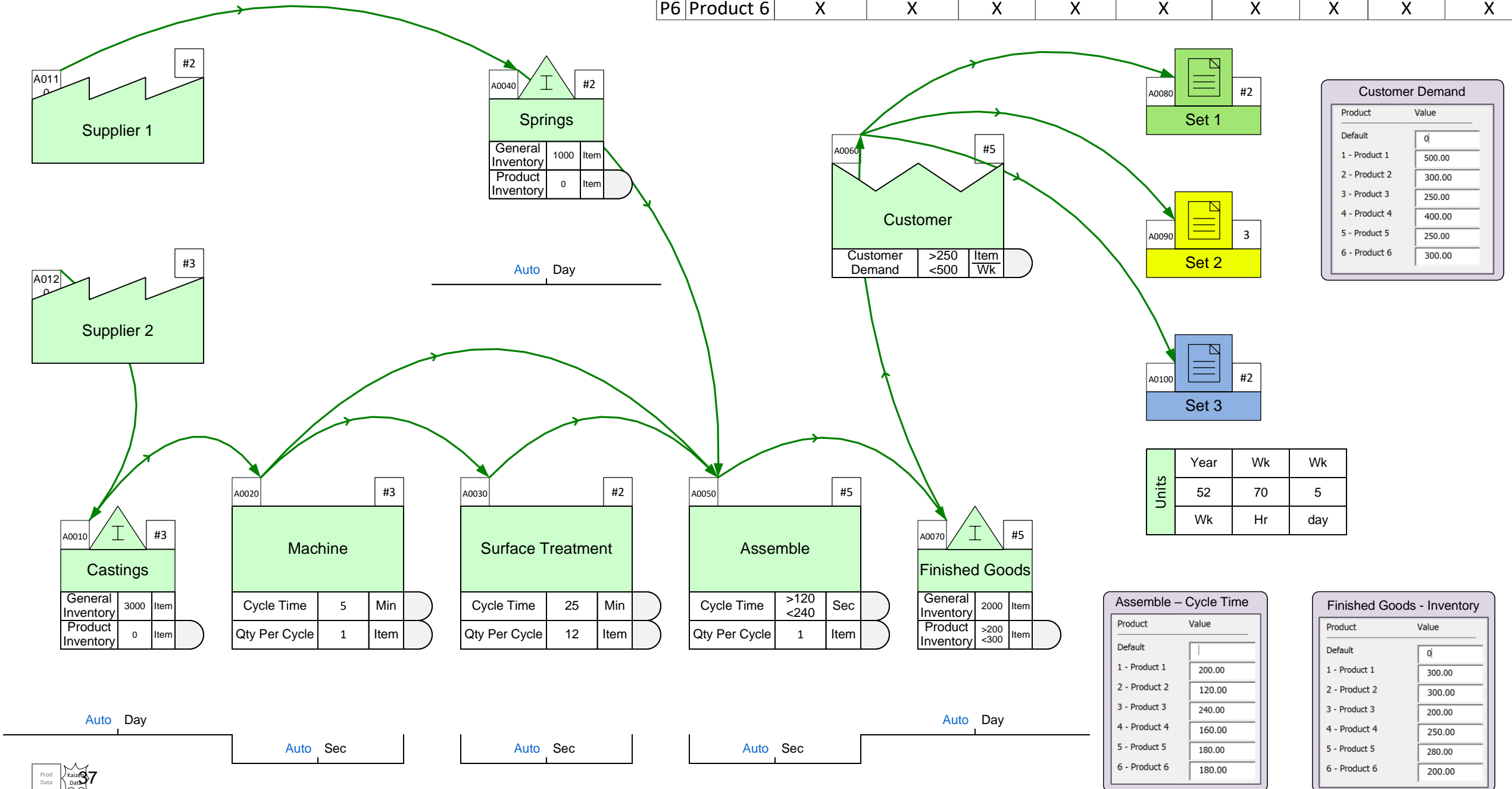
ID	Name	ID	Name	Stamp	Drill	Assemble	Thread	Customer
S1	Set 1	P1	Product 1	X	X	X	X	X
S2	Set 2	P2	Product 2	X	X	X		X
S2	Set 2	P3	Product 3	X	X	X		X
S2	Set 2	P4	Product 4	X	X	X		X
S1	Set 1	P5	Product 5	X	X	X	X	X

For Online Course Only

Example Map 2

In the next exercise, you will draw the map below from scratch. A printed copy of this page will be helpful.

ID	Name	Supplier 1	Supplier 2	Castings	Machine	Surface Treatment	Assemble	Springs	Finished Goods	Customer
P1	Product 1	X	X	X	X	X	X	X	X	X
P2	Product 2	X	X	X	X		X	X	X	X
P3	Product 3		X	X	X	X	X		X	X
P4	Product 4		X	X	X	X	X		X	X
P5	Product 5		X	X	X	X	X		X	X
P6	Product 6	X	X	X	X	X	X	X	X	X



Draw the map shown on the previous page below.

Follow the instructions in the last example map exercise. You will need to figure out what Sets are needed and which products will be in each Set. Complete the exercise by Solving the map.

Image of map and matrix available here

For Online Course Only

**You Practiced:**

- How to declare products and group them into sets.
- How to draw the material flow and specify routings.
- How to add data and solve the map.

Mix Manufacturing VSM Modeling Process**What's next:**

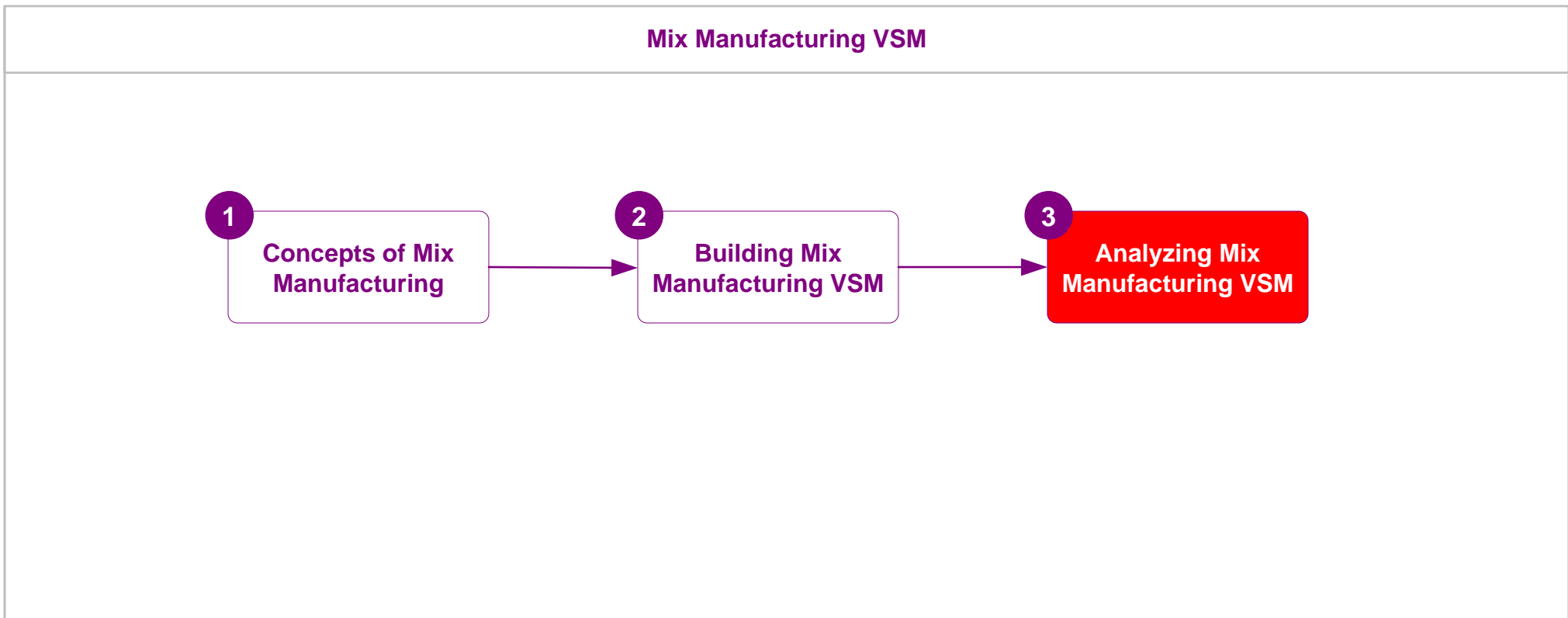
In the next lesson, you will learn how to visualize the analyses results on the map, and how to extend the map to address common what-if scenarios.

Analyze the Value Stream Model

In the last lesson you practiced building full working value stream models with the Quick Mix Manufacturing application.

In this lesson, you will learn how to analyze the model for key metrics such as demand, capacity, lead time, and cost. You will also see how to extend the model to explore “What-If” scenarios.

Note: This lesson provides practice exercises for many of the topics covered in the Mix Time course. It would be wise to keep a copy of the Mix Time course notes handy. You can download a fresh copy from: <https://evsm.com/MixTimeV12>



Topics Covered in this Lesson

1. Mix Manufacturing Standard Charts
2. Mix Manufacturing Add-on Calculations
3. What-If Scenario Examples

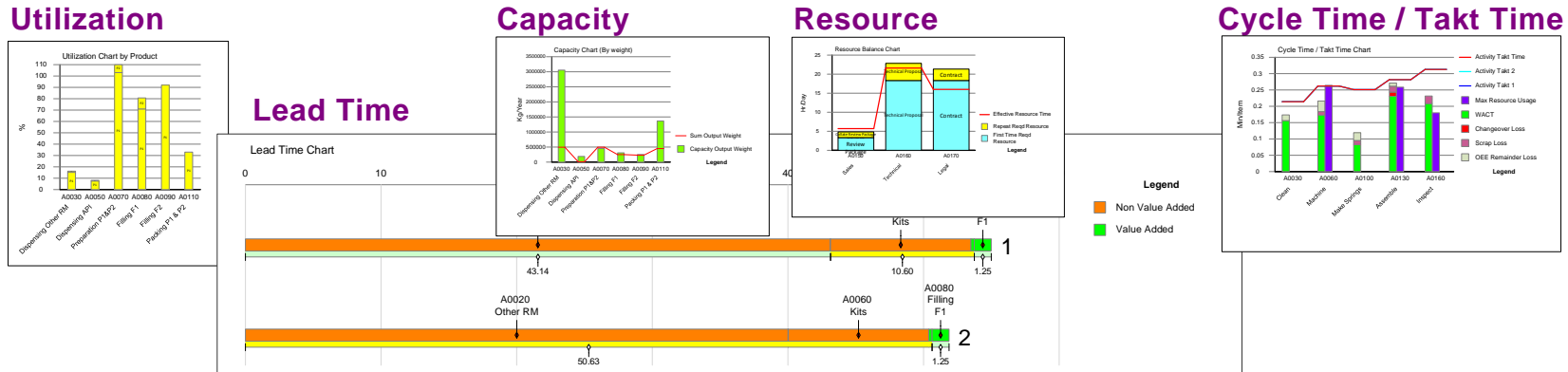
Additional Mix Manufacturing Functions

There are a number of other general functions available in Mix Manufacturing which are very useful but are not covered in this course. These are covered in the Quick Mix Time course. Download PDF copy at <https://evsm.com/MixTimeCourse12>

- Category Function
- Gadgets
- Resource Analyses
- Input data through Excel
- Edit charts

Mix Manufacturing Charts

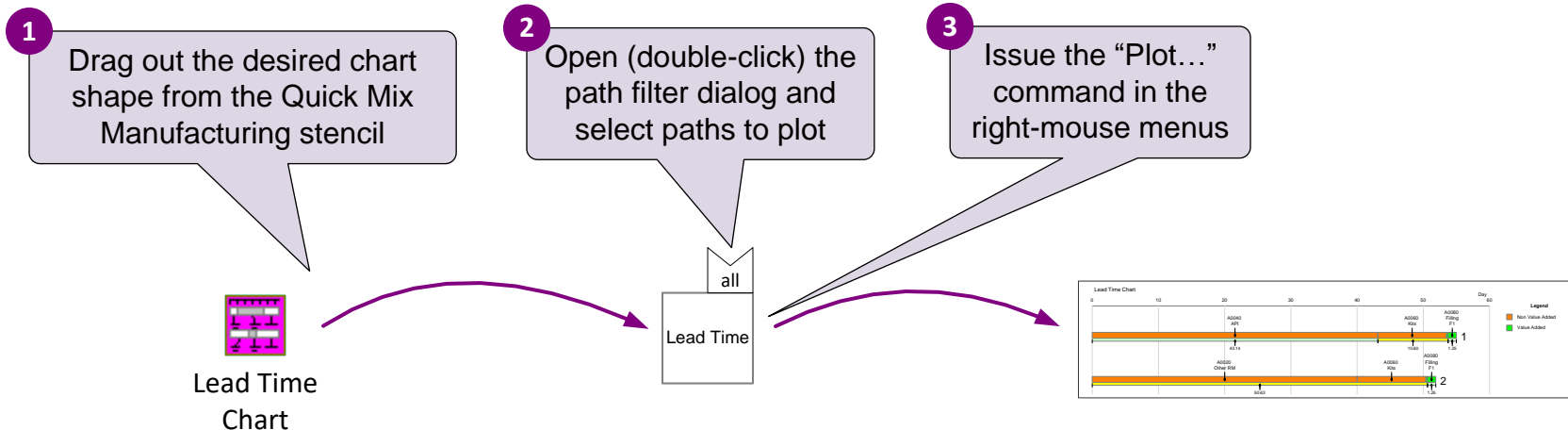
Mix Manufacturing includes several built in charts.



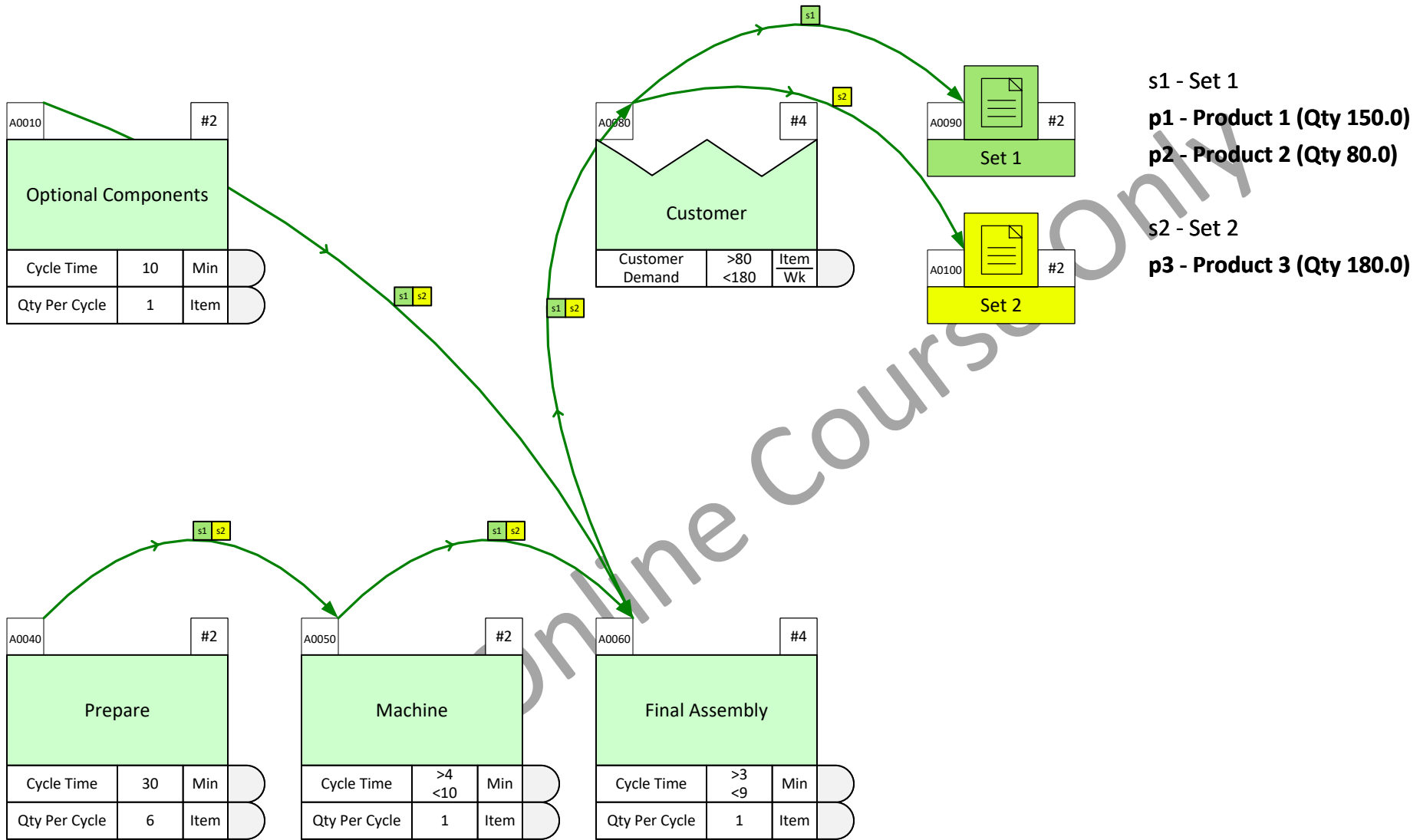
Plotting Charts...

These charts can only be plotted if the required data is available on the map and after the model has solved successfully.

To plot a chart, simply drop the chart icon on the drawing page, and use the plot command in the right mouse menus of the chart shape. Some charts (e.g. Lead time chart) include a filter to remove unwanted paths from the chart.



Capacity/Demand Chart

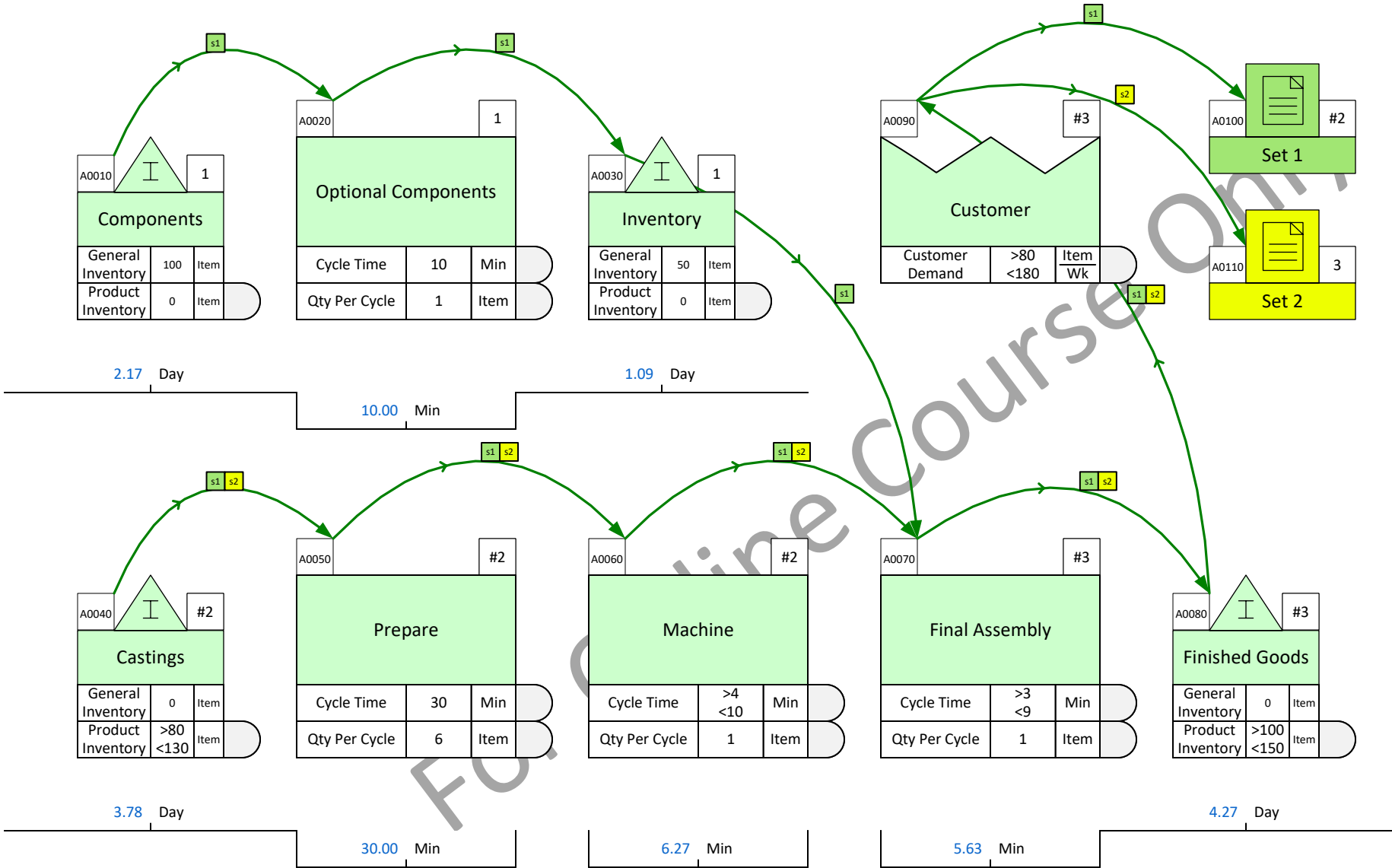


Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

Prod Data 43

Plot the Lead time Chart For Path 2

Drop the Lead Time Chart shape from the Quick Mix Mfg stencil. Set it's Path Filter to path 2. Then plot the chart.

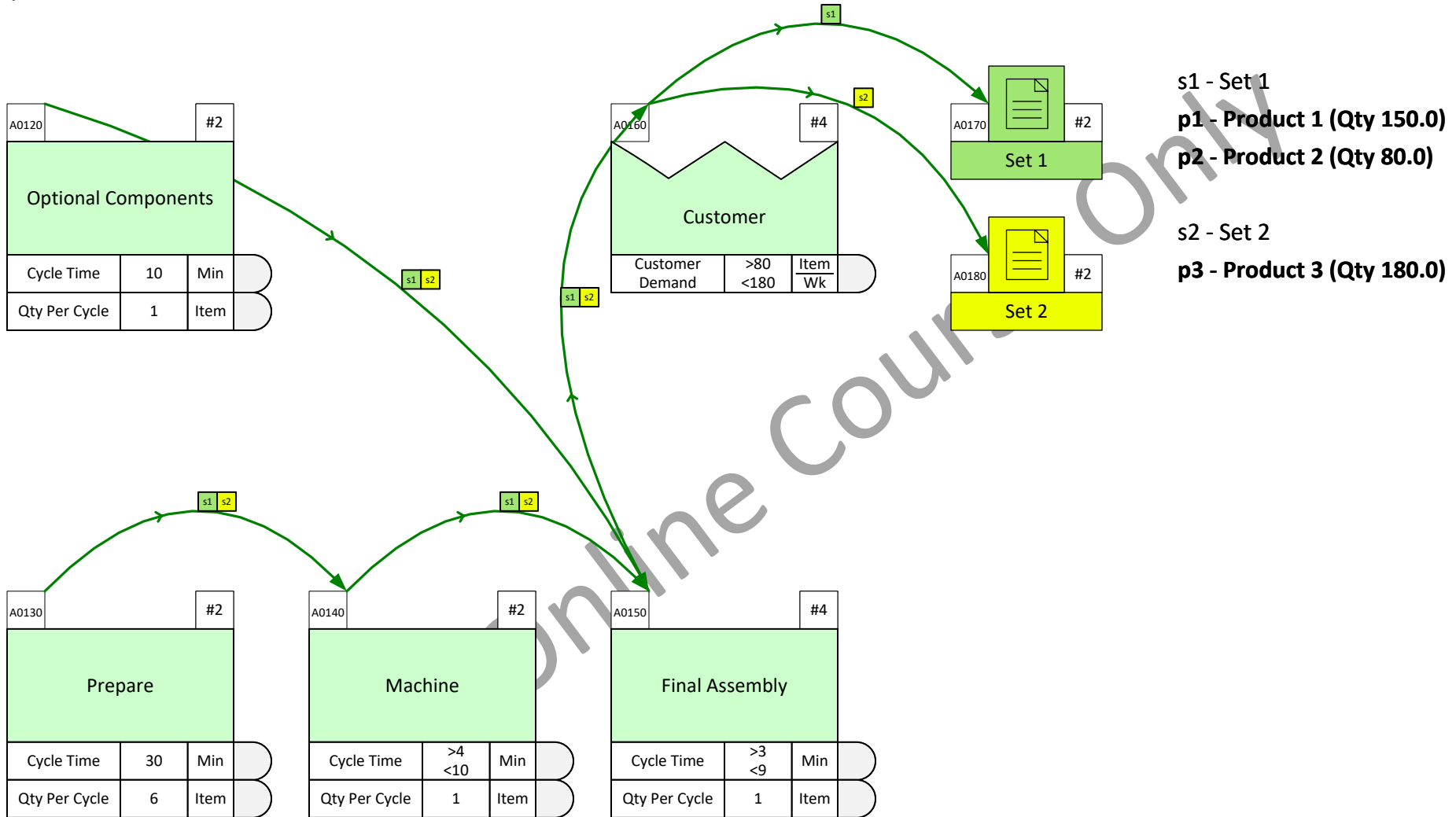


- s1 - Set 1
- p1 - Product 1 (Qty 150.0)
- p2 - Product 2 (Qty 80.0)
- s2 - Set 2
- p3 - Product 3 (Qty 180.0)

Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day
	44		

Product Utilization Chart

Plot the Product Utilization chart to identify the highest utilization products. Review the chart and click Grade It!



Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

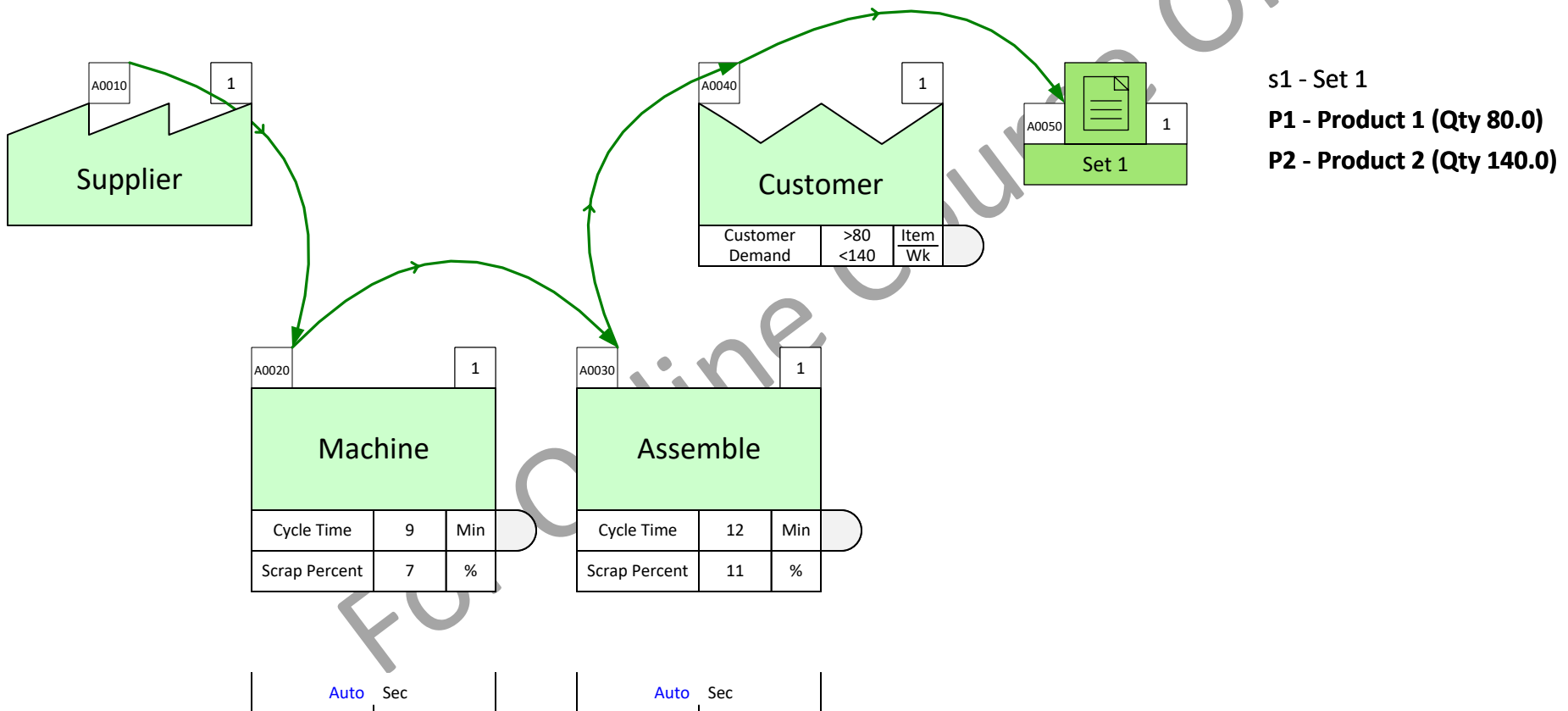
Prod Data Kaizen Data 45

Supplier Demand Exercise 1

What is the weekly demand at the Supplier for raw materials for products P1 and P2?

Follow these steps:

1. Make the "Demand" variable visible at the Supplier via the Views dialog.
2. Solve the model and see the result.



Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

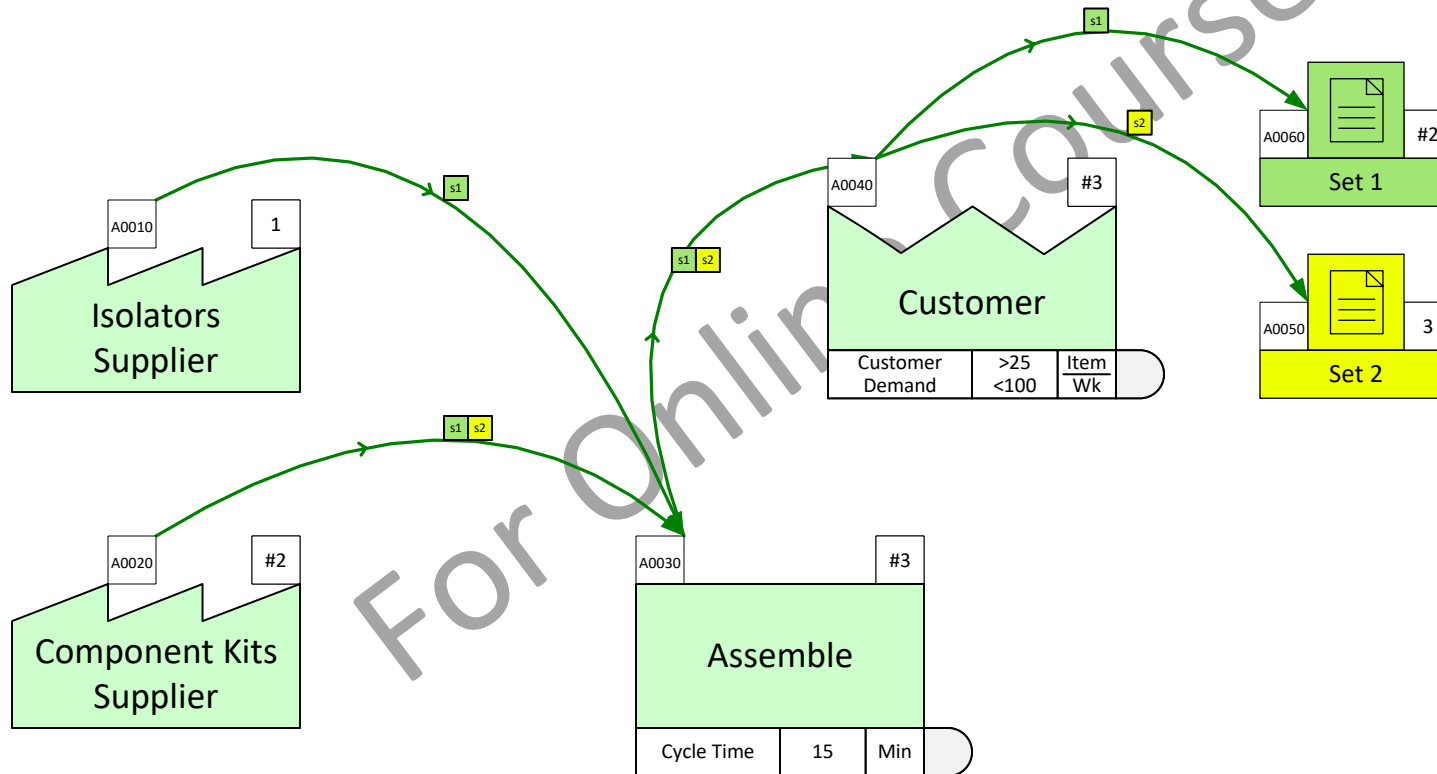
Supplier Demand Exercise 2

Each of the three products require a different number of isolators. How many isolators do we need per week from the Isolators supplier?

Follow these steps:

1. Make "Path Demand %" variable visible on the sequence arrows and enter appropriate demand % values to reflect the data in the table.
2. Make "the "Demand" variable visible on the supplier centers.
3. Solve the model to see the demand values.

Product	Number of Isolators
P1	4
P2	6
P3	0



s1 - Set 1

P1 - Product 1 (Qty 100.0)

P2 - Product 2 (Qty 25.0)

s2 - Set 2

P3 - Product 3 (Qty 75.0)

Auto Sec

Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

Optional Add-on Calculations

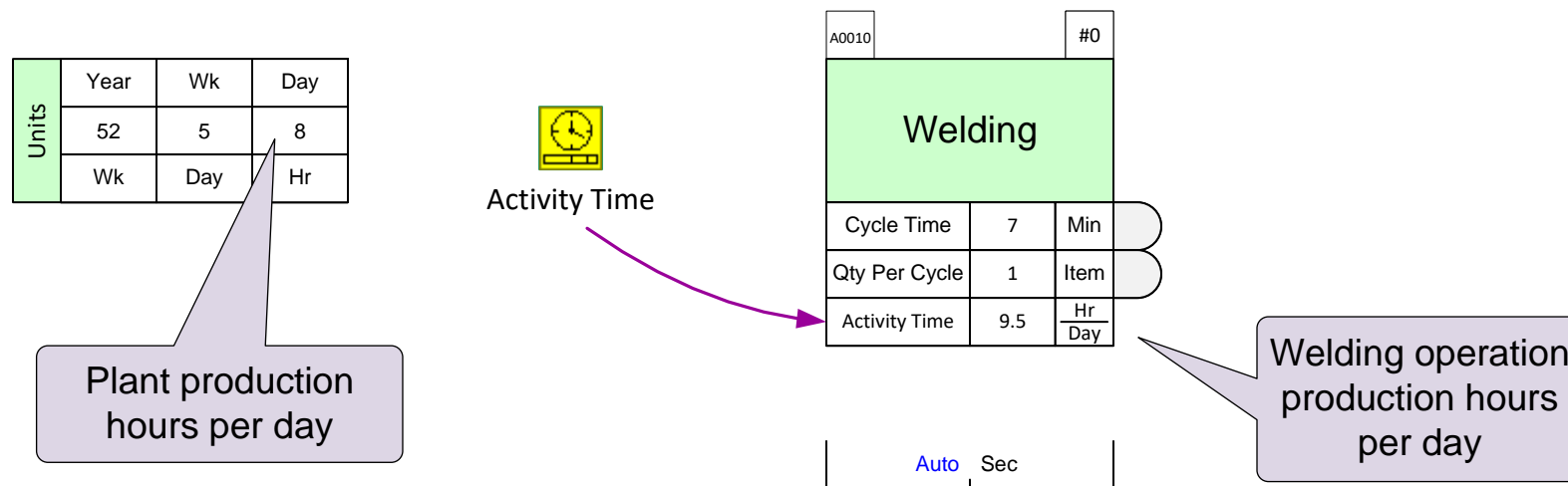
Many common calculations are built into main centers and sequence arrows. The yellow icons in the Quick stencils facilitate extension of the value stream model to handle additional data and calculations.

How to Use Add-ons

Just drag out the desired add-on from the stencil and drop it on the green center shape. It will automatically get attached to the bottom of the variable stack.

Example

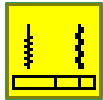
This plant has 8 Hrs/Day of production time as indicated in the Time Center. Therefore it is assumed the welding process is available for 8 Hrs/Day. However, what if the welding process is required to work 1.5 Hrs overtime? You can use the Activity Time yellow add-on to show the actual total production hours.



Add-ons Icon Positions in the Stencil

There is a unique correspondence between green icons in the stencil and the yellow icons that immediately follow the green icon. So yellow icons must be used ONLY with the green icons they “belong” to.

Add-ons for the Activity Center in Mix Manufacturing



Activity Changeover

Add-on to show changeover losses



Activity OEE Direct

Add-on to represent OEE % as a product of Availability, Quality and Performance



Activity Scrap

Add-on to show scrap %



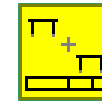
Activity Downtime

Add-on to show percentage of time (on average), the activity is not available



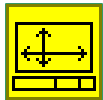
Activity Time

Add-on to use when available activity time is different from the rest of the value stream time



Activity Stations

Add-on to show number of stations working parallel in the activity



Activity Floor Space

Add-on to record floor space used by the activity



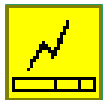
Activity Shortage

Add-on to show percentage of times a shortage in components stops production in the activity



Activity FMEA

FMEA of the activity



Activity Energy Intensity

Energy usage for the activity



Activity Inspection

Add-on to show percent of parts needing inspection at the activity. The demand for the activity is then based on the inspection percent



Activity Maintenance

Add-on to show maintenance loss.



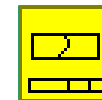
Activity NVA

Add-on to represent portion of activity cycle time that is non-value added



Activity Blockage

Add-on to show percent of times blockage from down stream process stops production in the activity



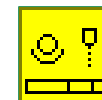
Activity Rework

Add-on to show percentage of units that need to be reworked



Activity Performance

Add-on to represent OEE performance and associated losses



Activity Man_Auto

Add-on to note machine / manual times



Activity EPEI

EPEI (Every Part Every Interval) calculations for the activity based on production sequence and related changeover times



Activity OEE Availability

Add-on to allow direct specification of OEE availability

Add-ons Usage Examples

Activity Stations

Milling Process with 3 Stations.

The 'Cycle Time' and 'Qty Per Cycle' are specified for a single station



Activity Stations

A0010	#0	
Milling		
Cycle Time	12	Min
Qty Per Cycle	1	Item
Stations	3	Stn
Auto Sec		

Activity Scrap & Downtime

Assemble process has 5% scrap and 12% downtime.



Activity Scrap



Activity Downtime

A0030	#0	
Assemble		
Cycle Time	14	Min
Qty Per Cycle	1	Item
Scrap Percent	5	%
Downtime Percent	12	%
Auto Sec		

Activity Changeovers

Stamping process has 4 changeovers per day



Activity Changeover

A0020	#0	
Stamping		
Cycle Time	1	Min
Qty Per Cycle	1	Item
Changeovers	4	CO Day
Time Per Changeover	15	Min CO
Auto Sec		

Activity NVA

Machining process with NVA of 2 Minutes within the Cycle Time of 8 Min



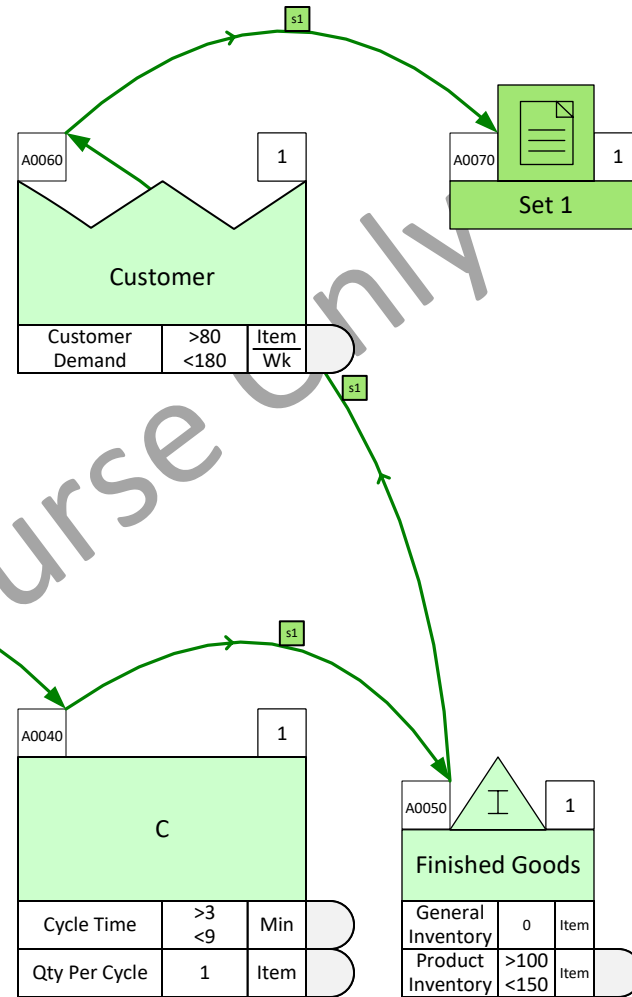
Activity NVA

A0040	#0	
Machining		
Cycle Time	8	Min
Qty Per Cycle	2	Item
Activity NVA	2	Min
2 Min		
6 Min		

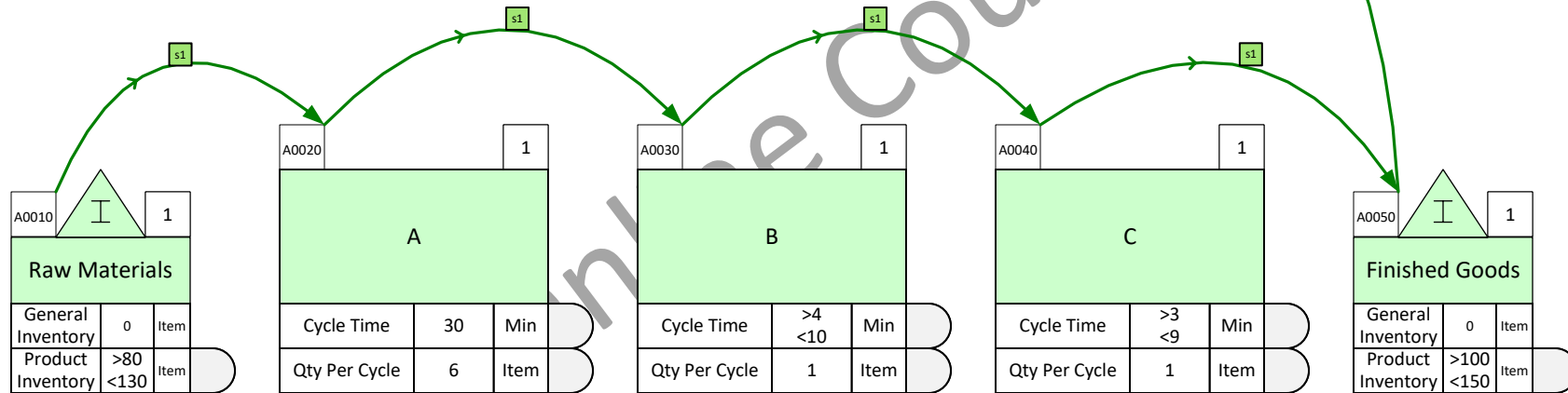
Activity Capacity Losses

Use Activity center add-ons to modify this model to show:

- Activity A: 12% downtime per day
- Activity B: 10% rework
- Activity B has 2 stations
- Activity A and B: One 30 min setup every morning
- Activity C: 35 min maintenance 2 times a week
- Activity C: 8% scrap



s1 - Set 1
 p1 - Product 1
 p2 - Product 2



Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

Resolve Capacity Deficiency

Use add-ons to assess if 1 hour per day overtime is sufficient to alleviate the bottleneck at the Final Assembly activity.

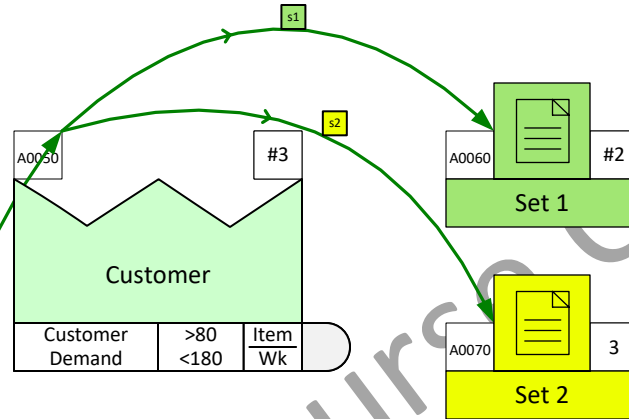
Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

A0010	2
Optional Components	
Cycle Time	8 Min
Qty Per Cycle	1 Item

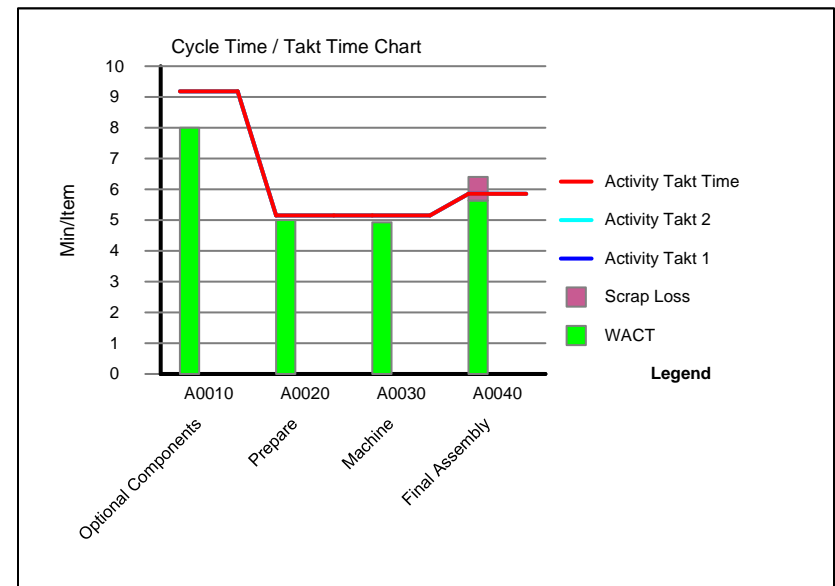
A0020	#2
Prepare	
Cycle Time	30 Min
Qty Per Cycle	6 Item

A0030	#2
Machine	
Cycle Time	>4 <6 Min
Qty Per Cycle	1 Item

A0040	#3
Final Assembly	
Cycle Time	>3 <9 Min
Qty Per Cycle	1 Item
Scrap Percent	12 %

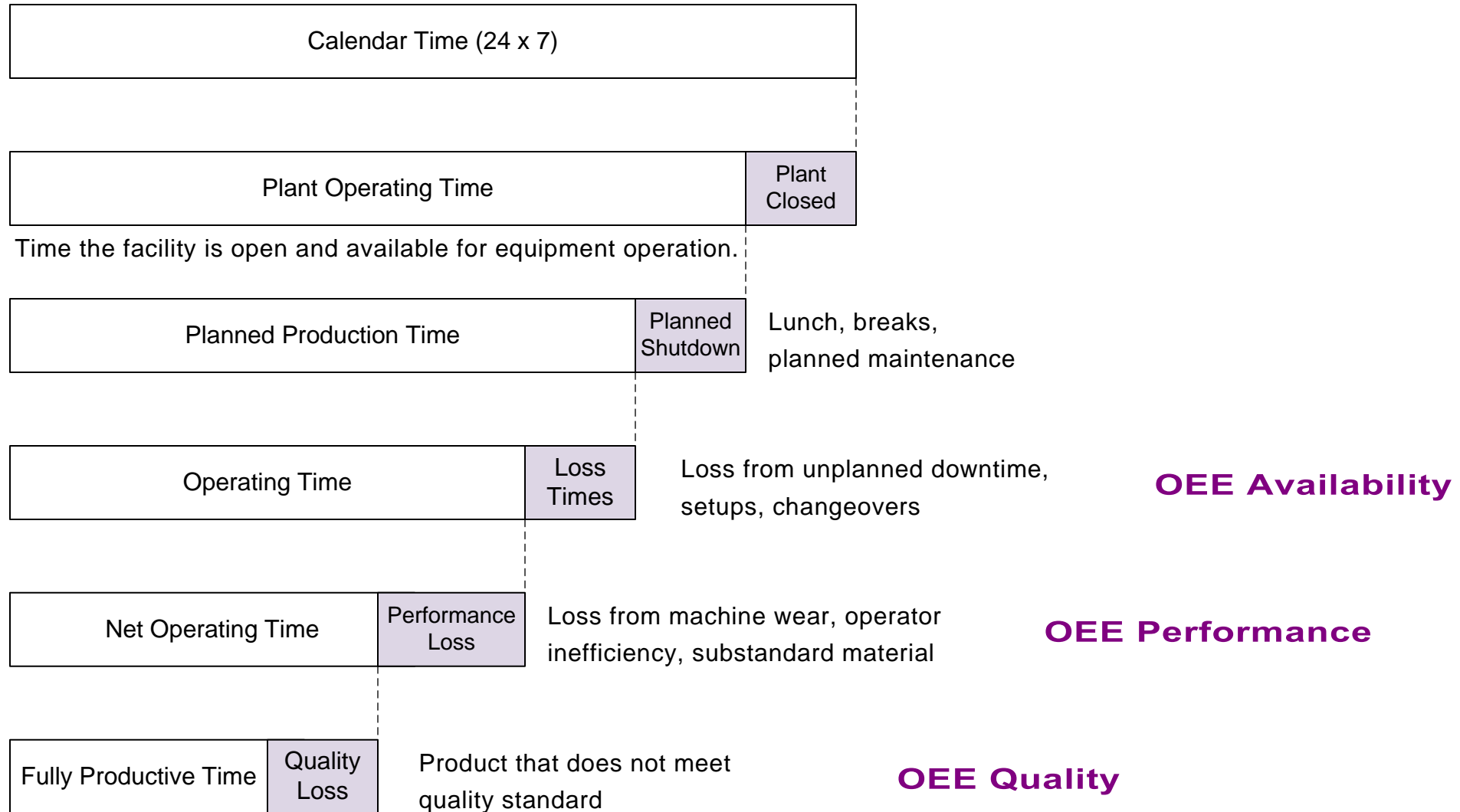


- s1 - Set 1
- p1 - Product 1 (Qty 150.0)
- p2 - Product 2 (Qty 80.0)
- s2 - Set 2
- p3 - Product 3 (Qty 180.0)



CT / TT Chart

OEE Losses



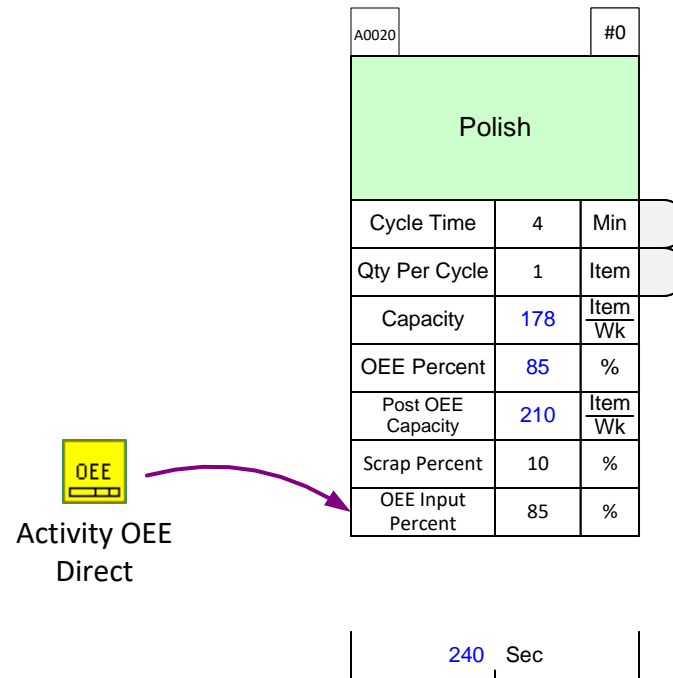
OEE = Fully Productive Time / Planned Production Time

= OEE Availability * OEE Performance * OEE Quality

OEE Direct

OEE can be specified either in terms of its components (like scrap, downtime, etc.) or simply as the overall OEE value.

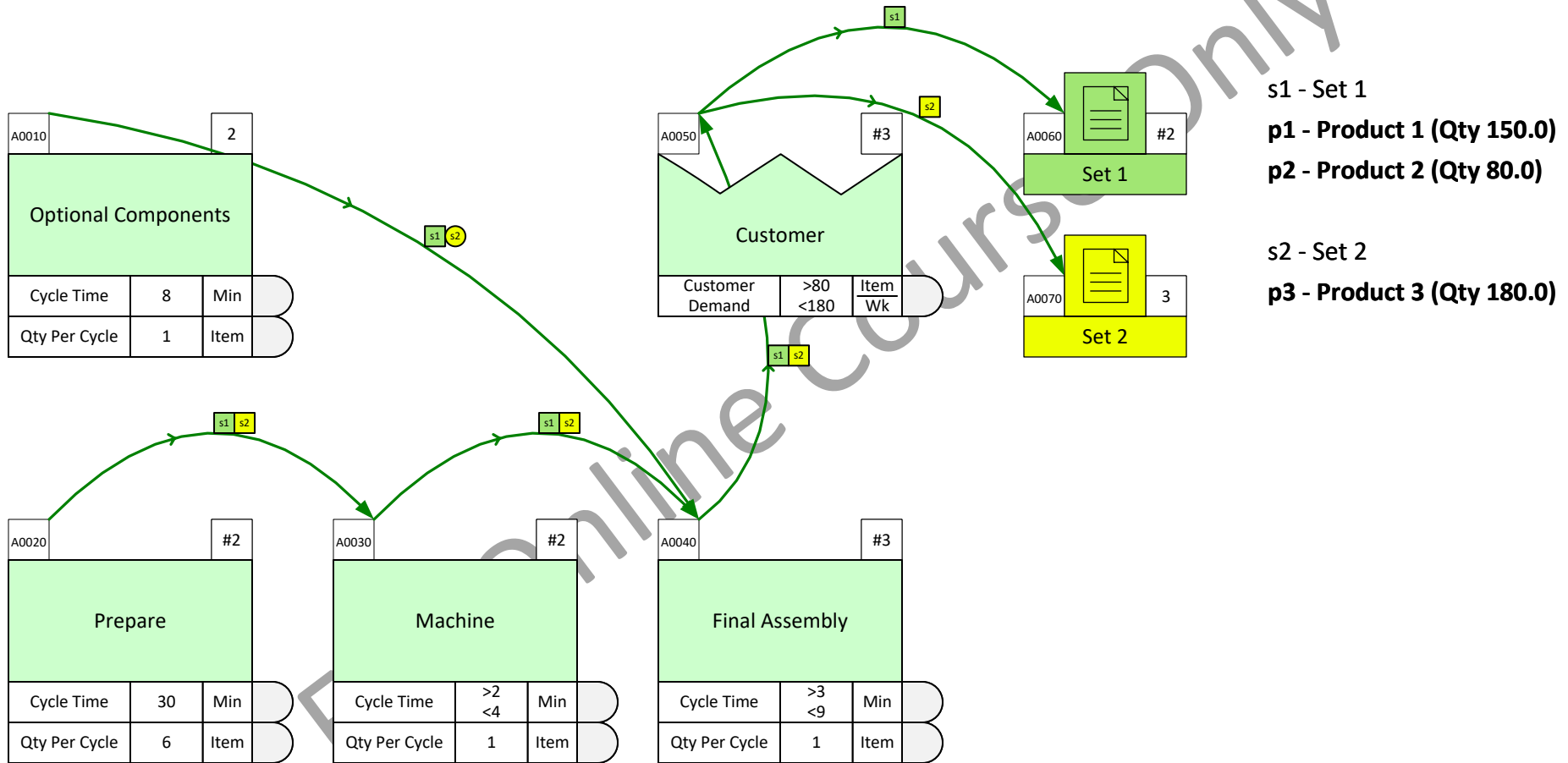
In the example below, the **Activity OEE Direct** add-on is used to specify the overall OEE at the Polish station. Note that if component values are ALSO specified (like **Scrap %**), these are considered as PART OF the overall OEE value.



Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

Activity Time for Shared Resource

The equipment at the Machine operation has been upgraded and is now under-utilized. Management wish to allocate 3 hours per day to another value stream. Can you still meet the demand targets given that you will need an additional 30 minutes per day for setup? Make the appropriate modifications to the map and use the CT/TT chart to check.

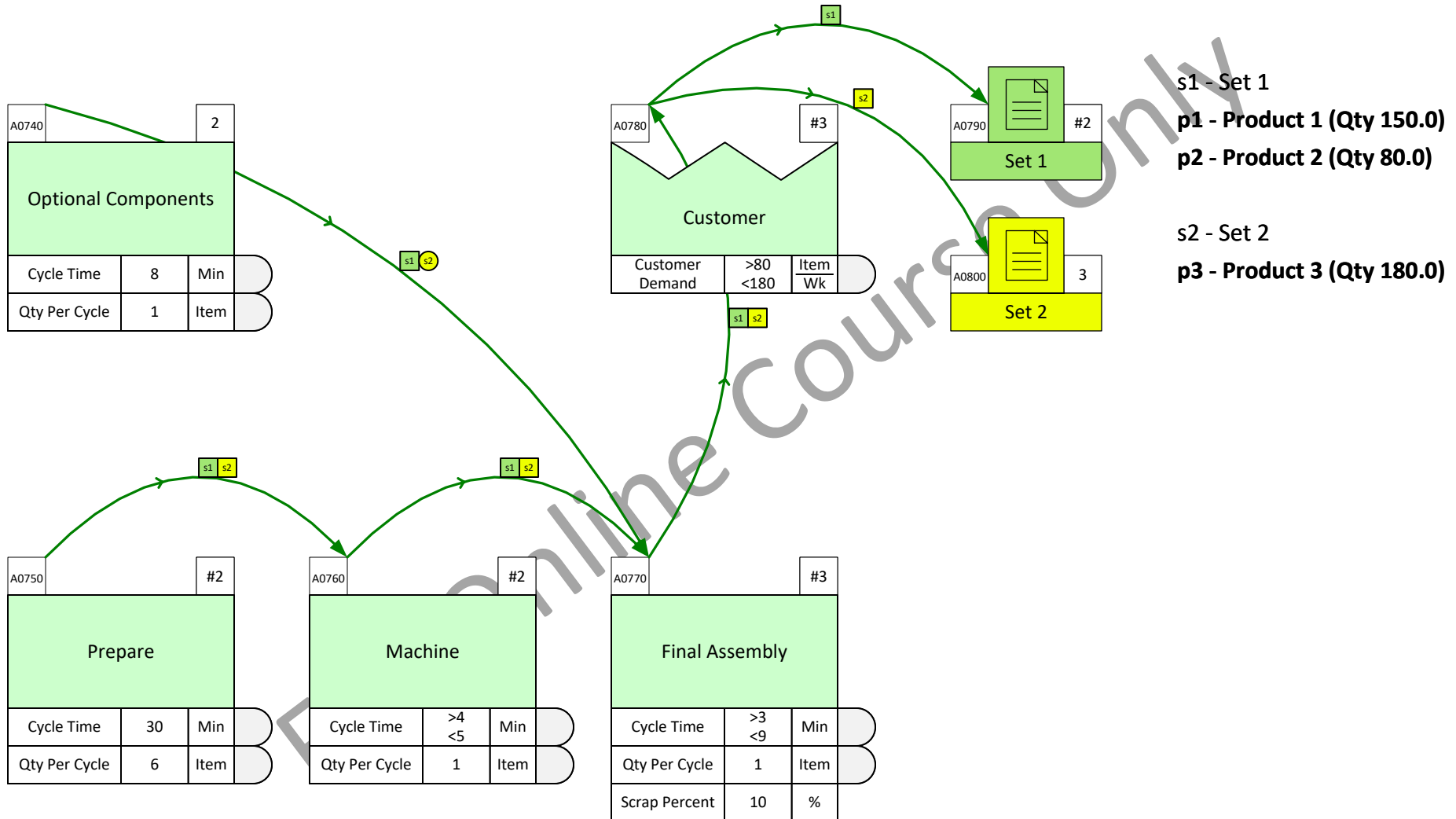


Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

Prod Data Kaizen Data 55

Changeovers

With the current demand mix, we need 3 changeovers per day at the Machine operation. Each changeover requires 22 minutes. Can we still meet demand?

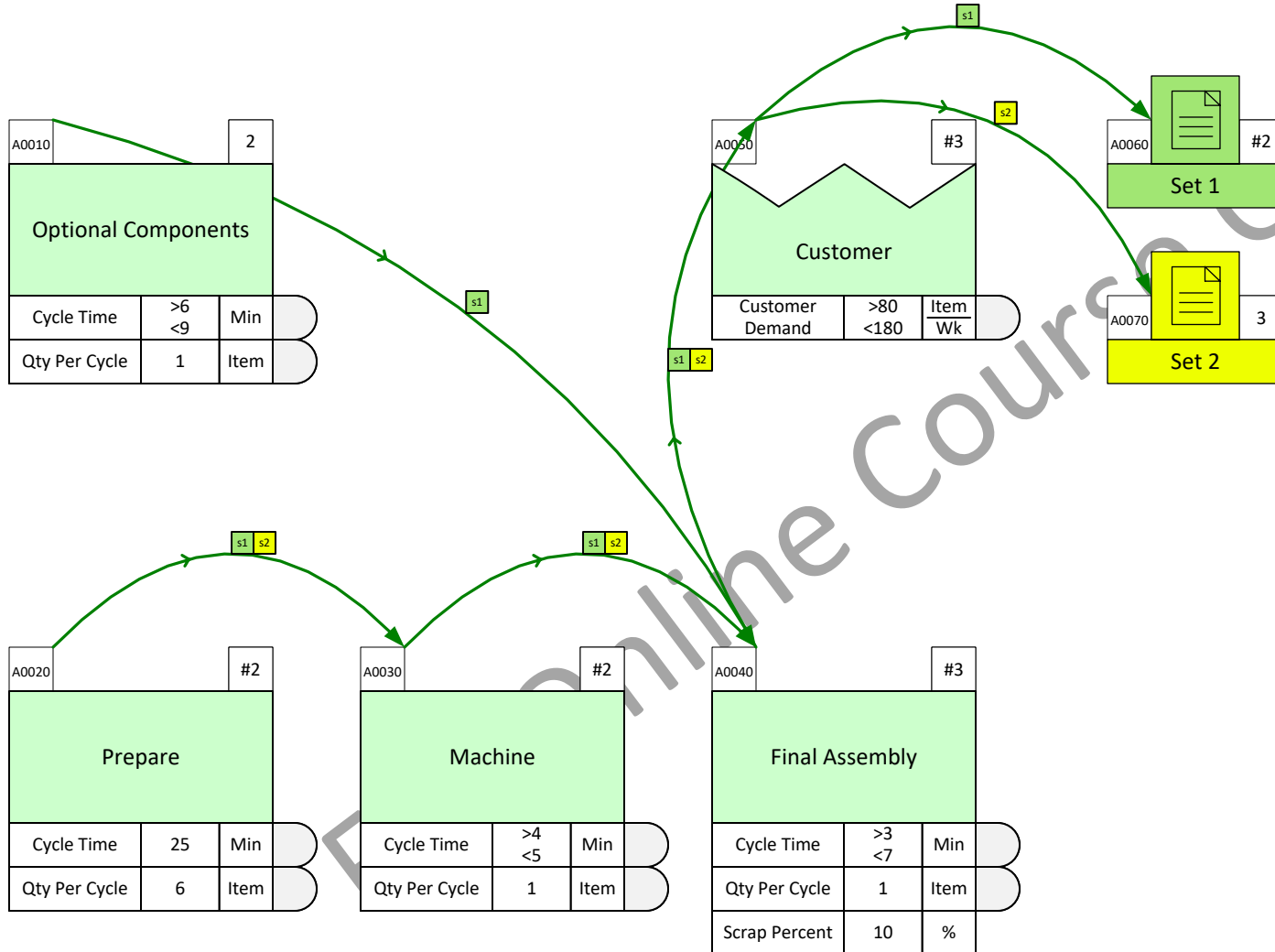


Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

CT / TT
Chart

Demand Growth

The demand for Product 2 (P2) is expected to increase from the current 80 Item/Wk to 160 Item/Wk. Use the CT/TT chart to identify any activities which will have capacity issues?



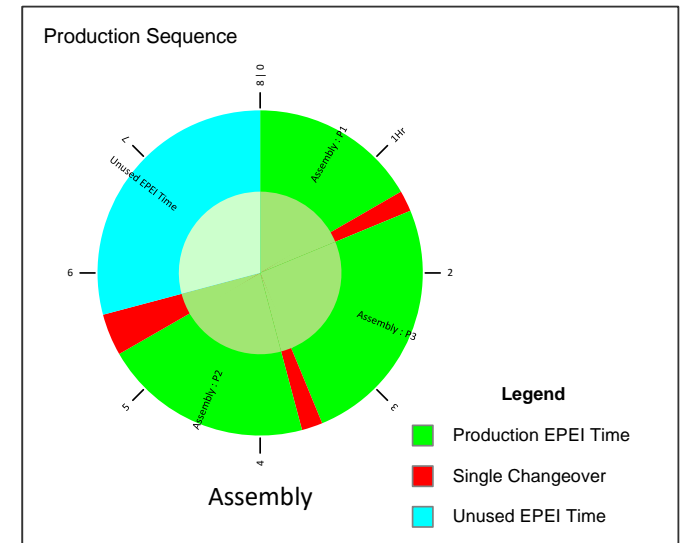
- s1 - Set 1
- p1 - Product 1 (Qty 150.0)
- p2 - Product 2 (Qty 80.0)
- s2 - Set 2
- p3 - Product 3 (Qty 180.0)

Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

EPEI – Every Part Every Interval

EPEI is a load leveling method popular in mixed production. The aim is to make the smallest batches of all products within the shortest period of time. Helps minimize inventory and improves flexibility so the line can react more quickly to variations in demand.

The EPEI calculations is simply the sum of the times for all batches plus the changeover times between the batches. The result can be presented in a product wheel like this.



Data required for EPEI Calculation

Inputs of EPEI

- Desired interval
- Available time for production
- Cycle Time for each SKU
- Sequence of product C/O
- CO time from one SKU to next

A0010		P
Milling		
Cycle Time	5	Min
Qty Per Cycle	1	Item
Desired EPEI	1	Day
Actual EPEI	Auto	Wk
Product Sequence	>1 <3	Seq
Single Changeover	2	Hr
Minimum EPEI	Auto	Hr

Outputs of EPEI

- Unused time available
- Actual EPEI time
- Minimum EPEI time
- EPEI Chart

Activity EPEI add-on and Activity EPEI Chart

The two shapes have to be used in conjunction to create an EPEI chart. See the numbered steps below

2 Drag the 'Activity EPEI chart' on the page and glue it to the applicable activity via the connector at the end of the leader line

3 Right click the chart control shape and select "Plot.."

1 Drag out the 'Activity EPEI' add-on and fill in the data fields. Then solve the map

A0010		P
Machining		
Cycle Time	5	Min
Qty Per Cycle	1	Item
Desired EPEI	1	Day
Actual EPEI	Auto	Wk
Product Sequence	>1 <3	Seq
Single Changeover	2	Hr
Minimum EPEI	Auto	Hr

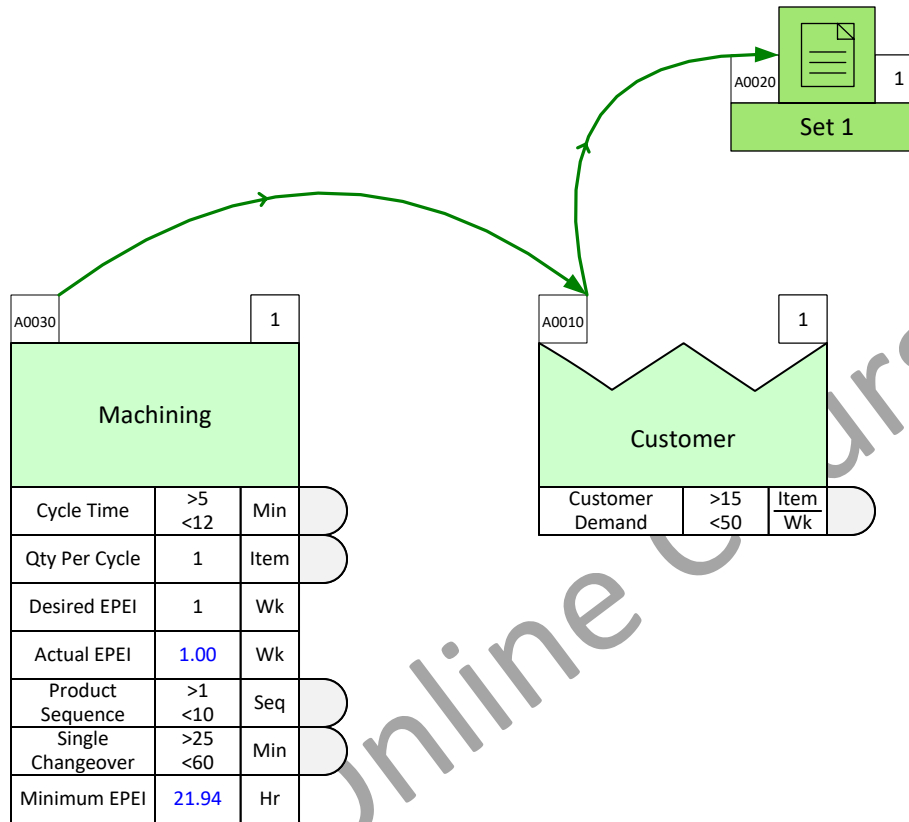
Production Sequence

Legend

- Production EPEI Time
- Single Changeover
- Unused EPEI Time

EPEI Chart Exercise

Plot the EPEI chart to explore possible improvements at the Machining process.



s1 - Set 1

- p1 - Product 1 (Qty 25.0)**
- p10 - Product 10 (Qty 15.0)**
- p2 - Product 2 (Qty 20.0)**
- p3 - Product 3 (Qty 25.0)**
- p4 - Product 4 (Qty 25.0)**
- p5 - Product 5 (Qty 15.0)**
- p6 - Product 6 (Qty 50.0)**
- p7 - Product 7 (Qty 20.0)**
- p8 - Product 8 (Qty 45.0)**
- p9 - Product 9 (Qty 25.0)**

Units	Year	Wk	Wk
	52	48	6
	Wk	Hr	day

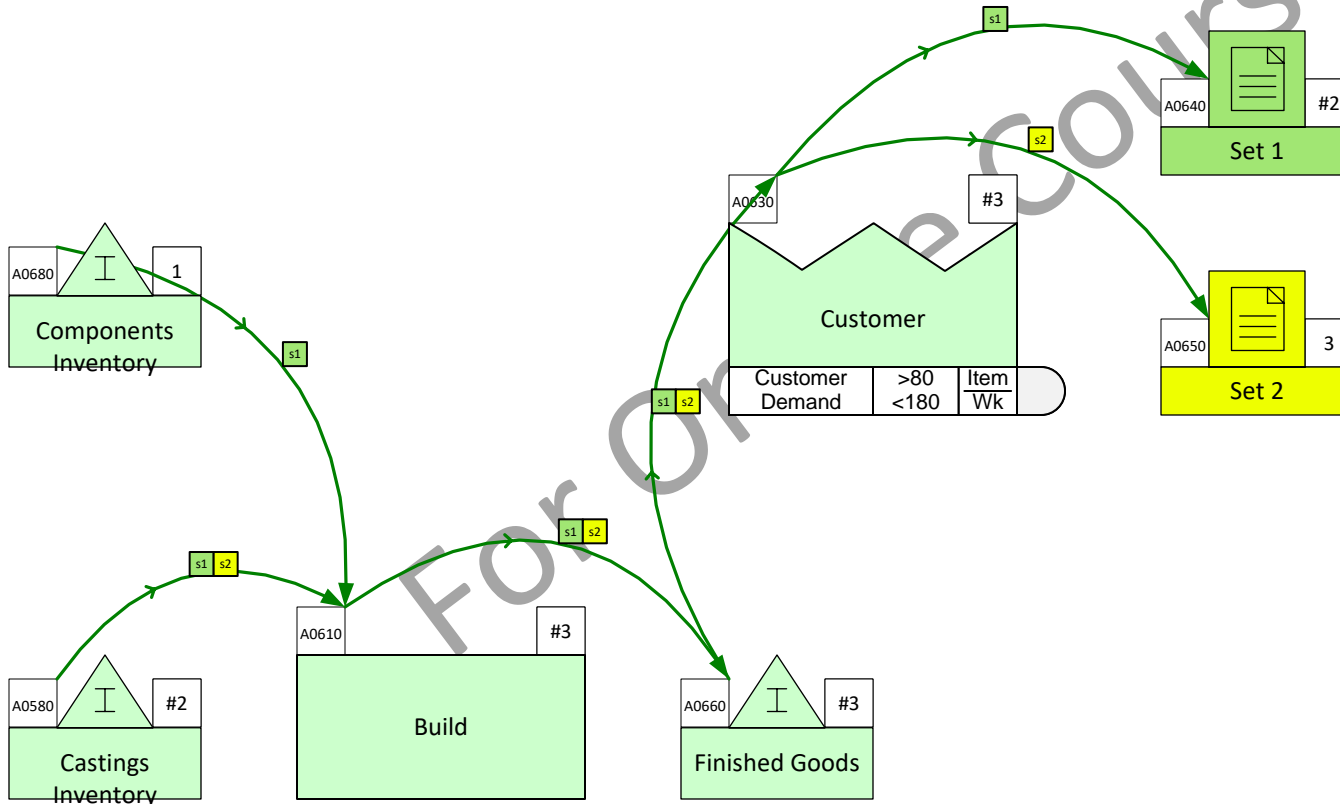
Activity Based Cost Calculations

Using the data in the table, set up this model to calculate the value of each of the 3 products at the Finished Goods inventory.

Steps:

1. Through the Views dialog, make the "Added Unit Cost" and "Cumulative Unit Cost" variables visible on the map.
2. Enter the "Added Unit Cost" values from the table.
4. Open the product specific values dialog for the "Cumulative Unit Cost" variable at the Finished Goods inventory.

Center	Added Unit Cost		
	P1	P2	P3
Components Inventory	\$1.00	\$1.00	N/A
Castings Inventory	\$5.00	\$5.00	\$5.00
Build	\$5.00	\$5.00	\$3.00
Finished Goods	\$0.00	\$0.00	\$0.00



s1 - Set 1

p1 - Product 1 (Qty 150.0)

p2 - Product 2 (Qty 80.0)

s2 - Set 2

p3 - Product 3 (Qty 180.0)

Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

Resource Analyses

Are 8 Machinists sufficient to meet the customer demand?

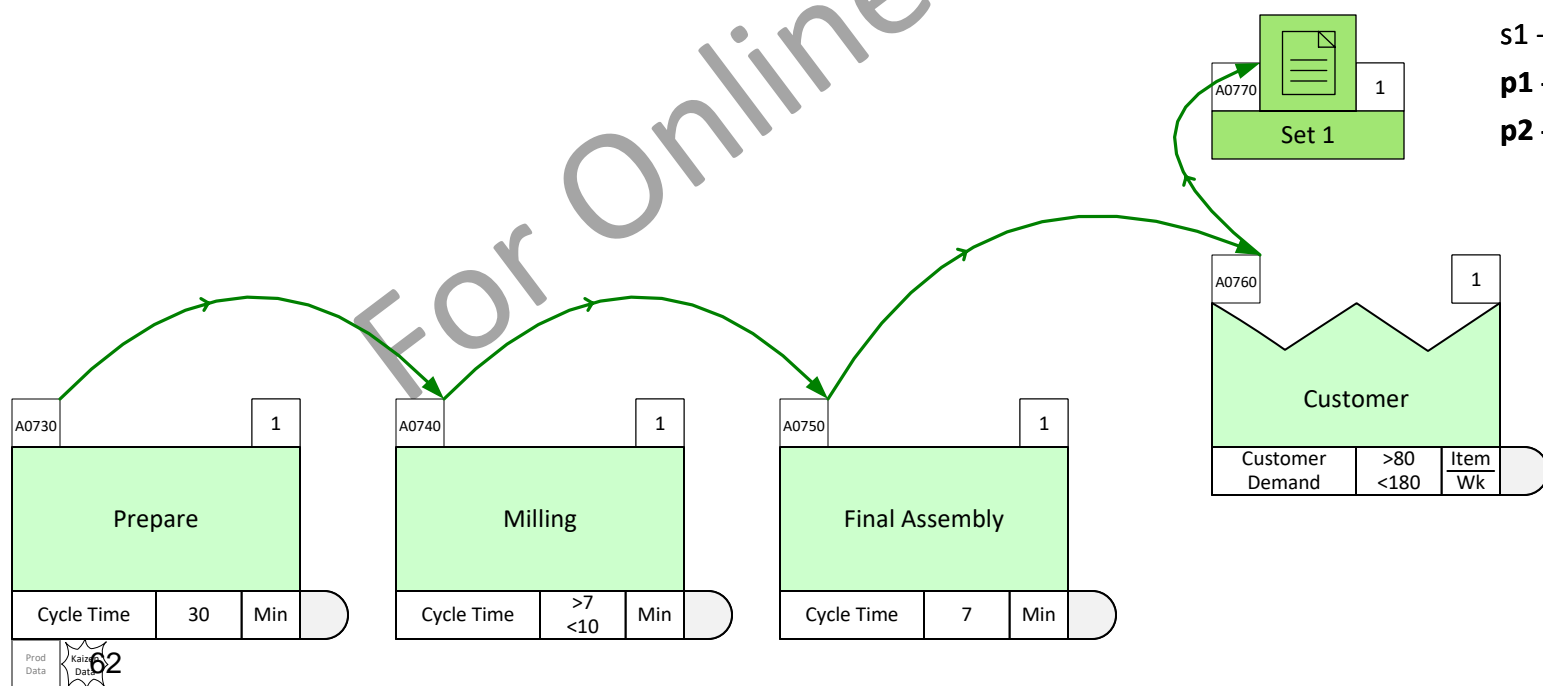
Steps:

1. Drop a Resource Center on the page and name it "Machinists"
2. Enter data values to show we have 8 machinists and each available 8 hours per day.
3. Add Resource Pipes and enter data to show that machinists spend 10 minutes per item on Milling and 9 minutes per item on final assembly.
4. Solve the model and plot the Resource Balance chart.



This topic was covered in detail in the Mix Time course, lesson 5. You can access the course notes at:

<https://evsm.com/MixTimeV12>



s1 - Set 1

p1 - Product 1 (Qty 150.0)

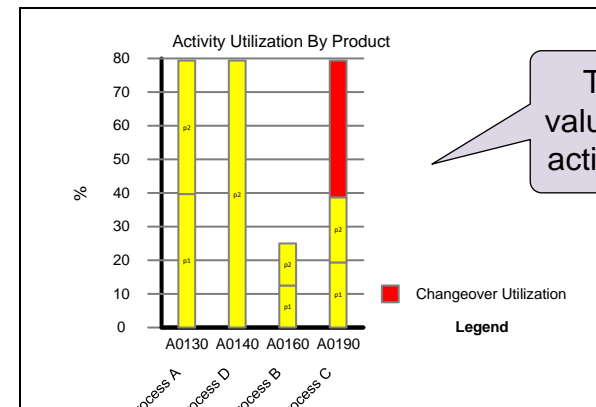
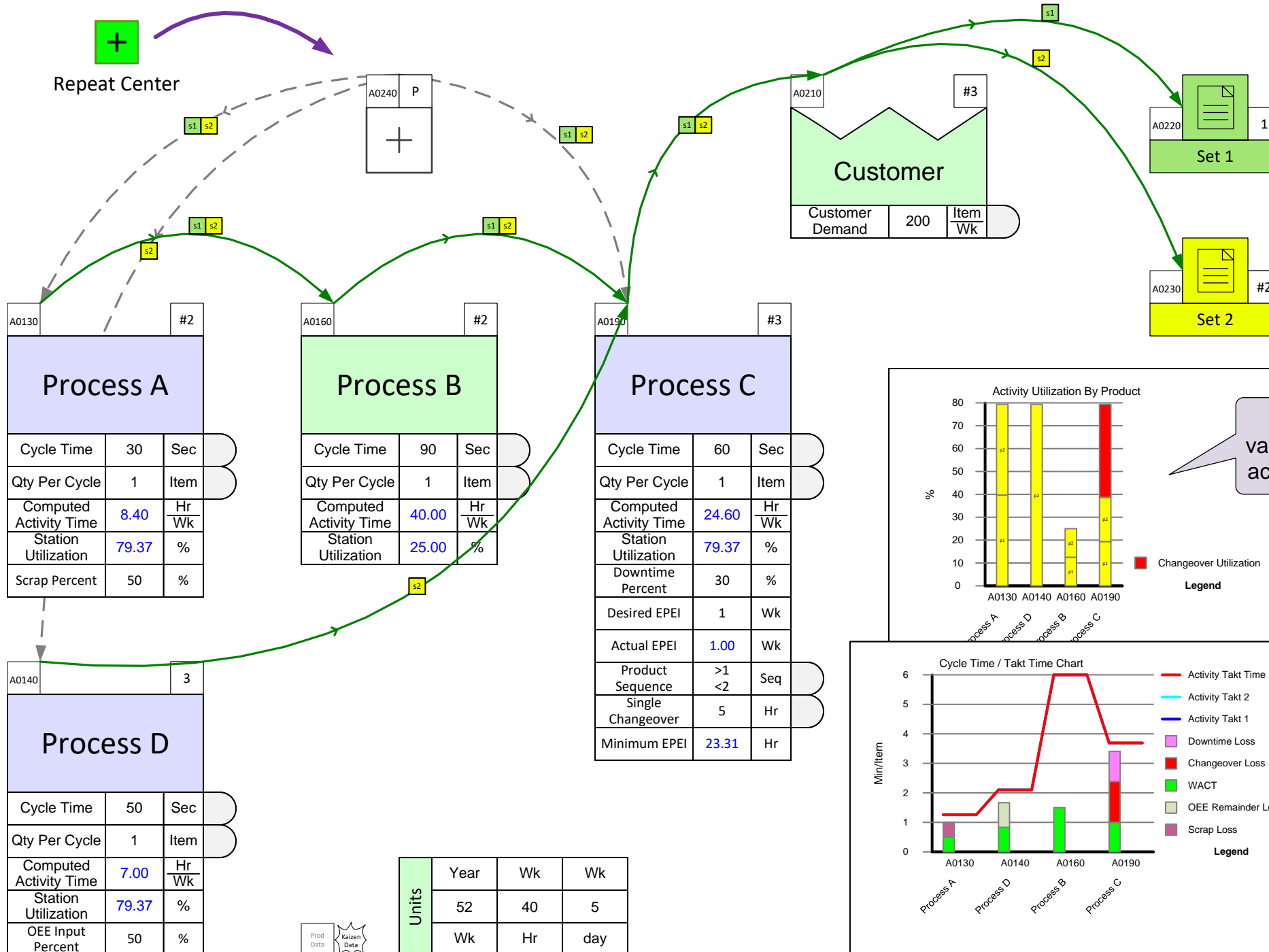
p2 - Product 2 (Qty 80.0)

Units	Year	Wk	Wk
	52	40	5
	Wk	Hr	day

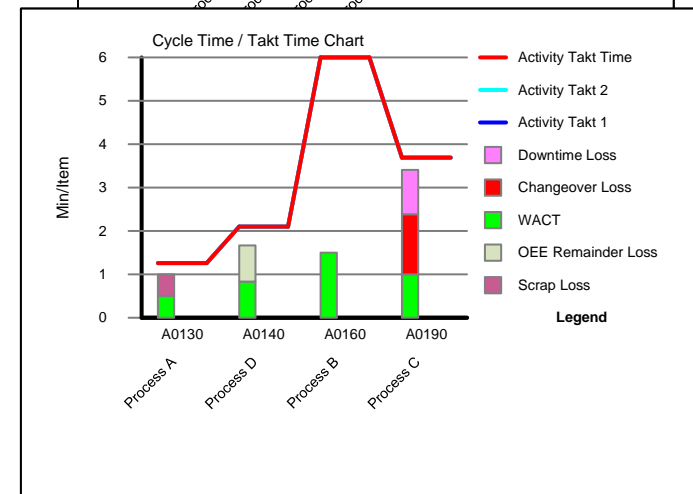
Modeling Multi-use Equipment

The Repeat Center can be utilized when equipment needs to be used at multiple places in the value stream. The Repeat Center makes it straightforward to see which activities share the equipment and correctly estimate key metrics like capacity and lead time.

In this example, the three blue processes share the same station (machine). The Repeat Center is connected to all three with pipe arrows (not sequence arrows). The eVSM Solver then takes care of allocating machine time based on cycle times and demand for each activity.

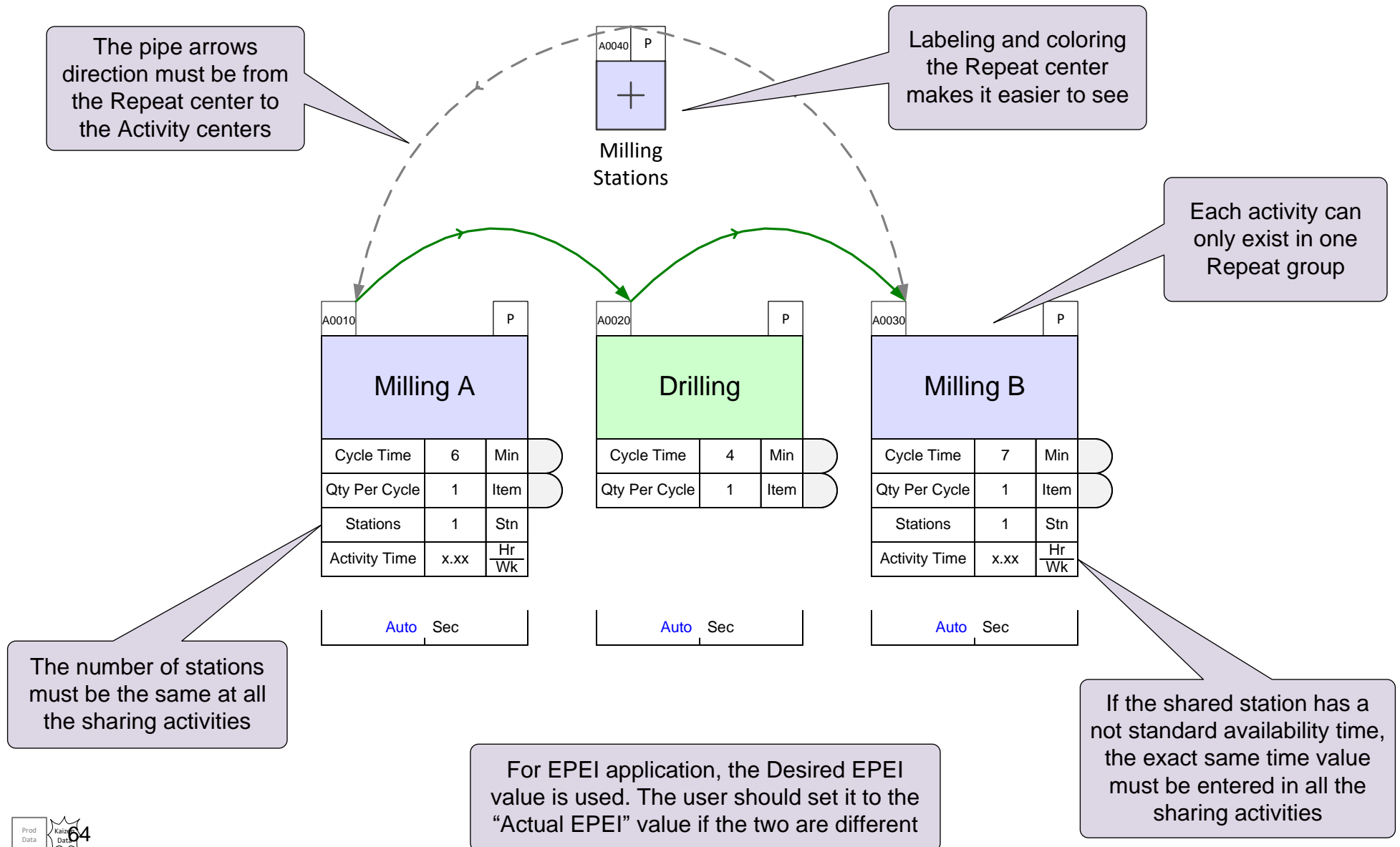


The station utilization values at the repeat usage activities should be similar



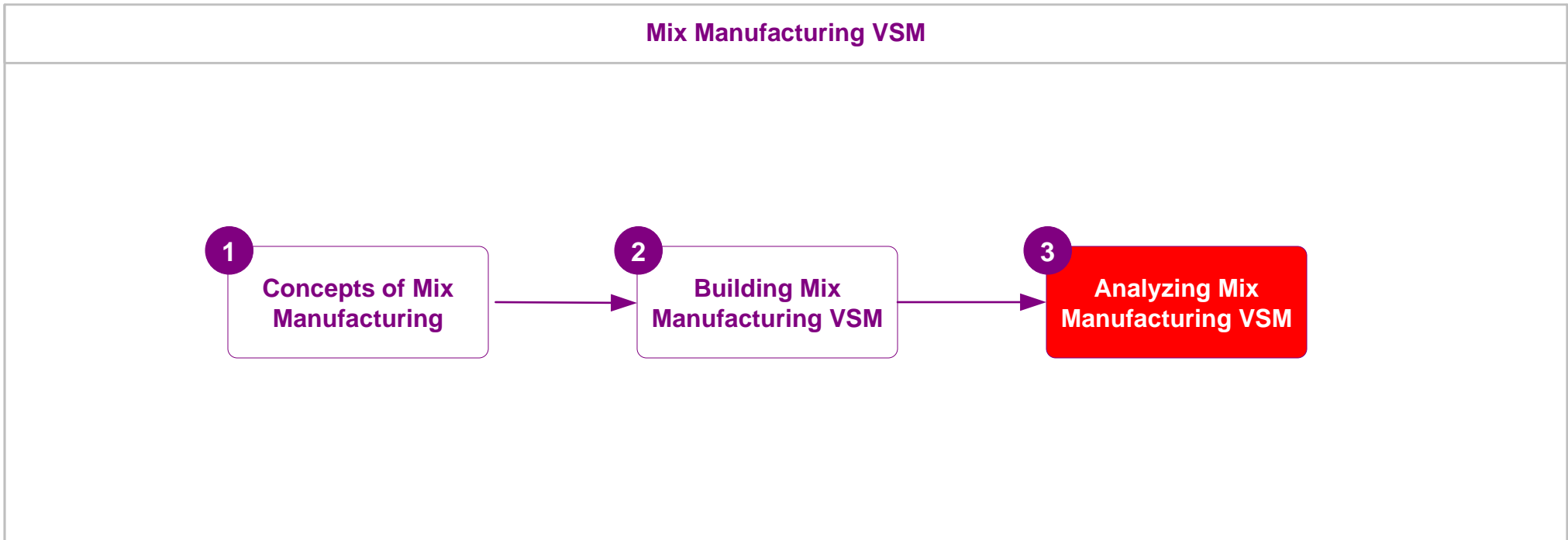
Repeat Center Modeling Tips and Rules

For each repeat use station, simply drop a Repeat center on the page and connect it to the processes involved with Pipe arrows. Then when the model is Solved, the software will handle all the repeat use adjustments. Here are some rules and recommendations.



You Learned

- How to work with the Mix Manufacturing standard charts.
- How to specify general and product specific inventory.
- The scope Mix Manufacturing add-on calculations and how to use them.
- Reviewed a number of What-If scenarios the value stream model can be used for.



Recommended Next Steps:

1. Sketch your first value stream with the Sketch Mix Manufacturing stencil.
2. Create a value stream model.
3. Email any questions to support@evsm.com.
4. Go through the eVSM Improvement Framework course - accessed from: <https://www.evsm.com/my-skills>

Analyze the Value Stream Model

—Useful Links—

eVSM Toolbar Guide

evsm.com/toolbarguide

eVSM Productivity Guide

evsm.com/productivity

eVSM Blogs

evsm.com/blog

eVSM Support FAQ

evsm.com/support

Download the Latest Version

evsm.com/install