air academy ASSOCIATES

Value Stream Mapping
(with IPO and SIPOC)

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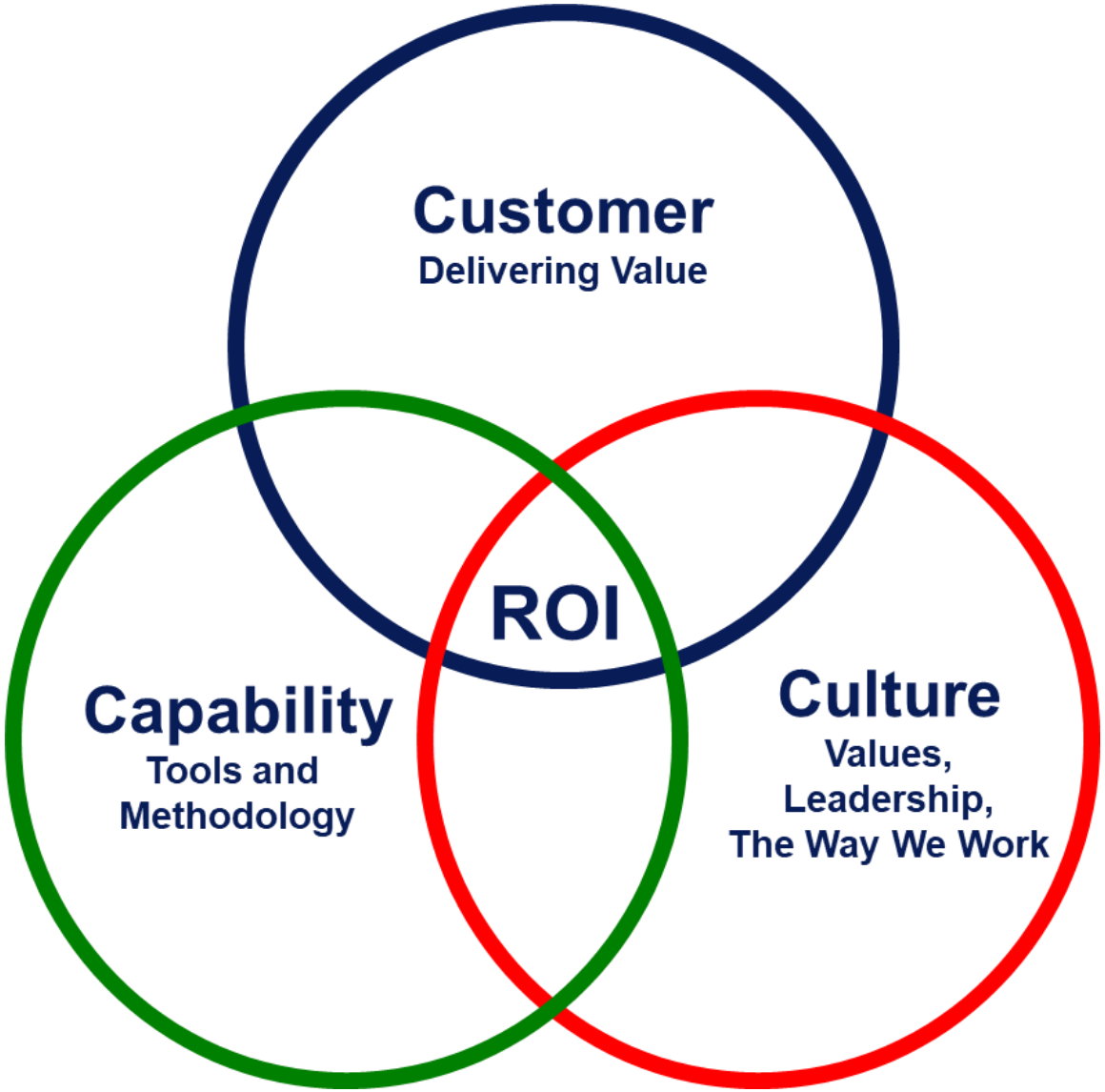
Value Stream Mapping

- In this session, we will discuss:
  - The definition of a Value Stream
  - Value Added and Non-Value Added Activities
  - Time Value Map and Process Cycle Efficiency
  - The What and Why of Value Stream Mapping
  - The Anatomy of a Value Stream Map
  - The DNA of a Value Stream and the IPO Diagram
  - Extending IPO to SIPOC

- A list of supplemental material and additional practice/review questions for this session are provided at the end of this presentation
- You can download the pdf of this presentation, along with any supporting data files, on the site where you are accessing this course

The Impact Zones of Lean Six Sigma
(the 3 Cs)

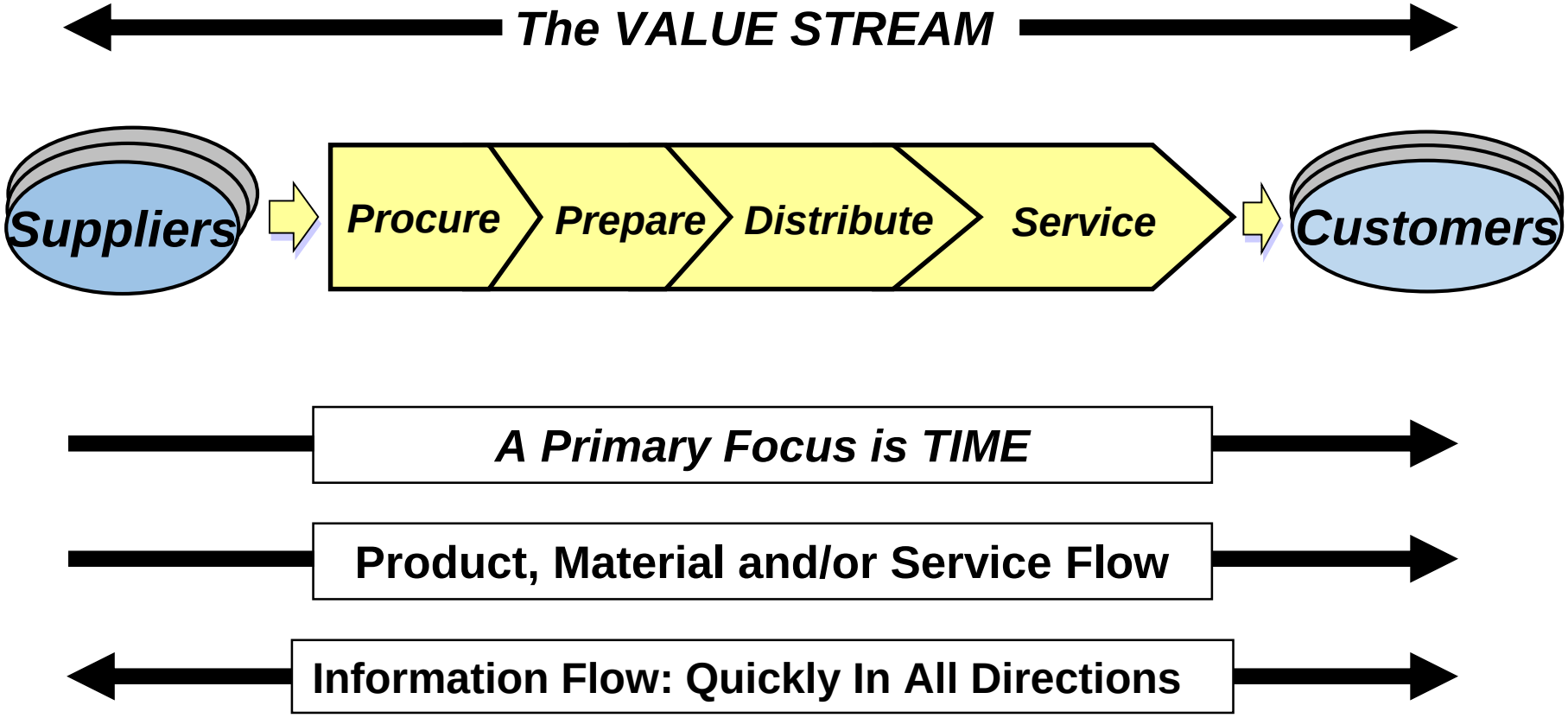


The 5 Guiding Principles of Lean Six Sigma

1. Specify value in the eyes of the Customer
   - Learn to see your processes from the perspective of your customer
2. Identify the value stream and eliminate waste/variation
   - Look at the combination of processes, not just a single process in isolation (how value is created for the customer), and remove waste and variation
3. Make value flow smoothly at the pull of the customer
   - Wait until you know what the customer wants before you start, and eliminate bottlenecks and impediments
4. Involve, align, and empower employees
   - Develop solutions using the people who are currently working in the process
5. Continuously improve knowledge in pursuit of perfection
   - Constantly challenge the organization to continue to learn more and more about their processes

Definition of a Value Stream

The VALUE STREAM is the entire set of processes or activities performed to transform the products and services into what is required by the customer.



Value Stream Activities

Value Added Activities

(VA)

- **Activities where the product or service is transformed into a state required by the customer.**
- **Activities which, when asked, the customer is willing to pay for.**

Non-Value Added But Required

(NVA-R)

- **Activities causing no value to be created but which cannot be eliminated based on current state of regulations, technology or thinking.**
- **a.k.a. Business Value Added (BVA)**

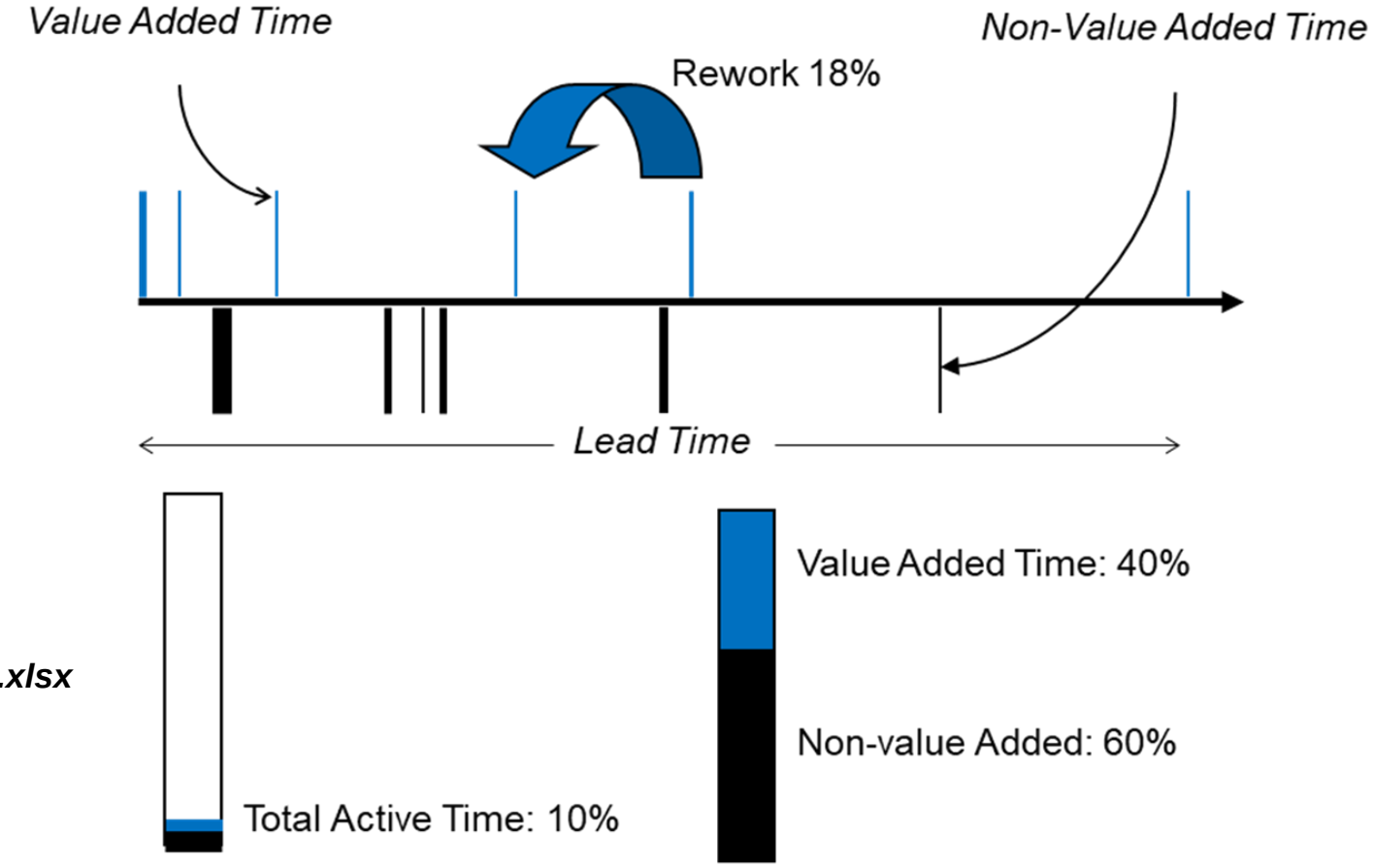
Non-Value Added Activities

(NVA)

- **Activities which consume resources but create no value in the eyes of the customer.**
- **Pure Waste.**

Time Value Map

- A time value map is a time scaled graph that illustrates the amount of active and inactive time spent during one complete cycle of a process.
- The active time segments are divided into value added and non-value added portions.
- The gaps between the active time segments represent idle time or delays in the process. Return arrows are used to indicate portions of the process where rework occurs.



time value map template.xlsx

Process Cycle Efficiency

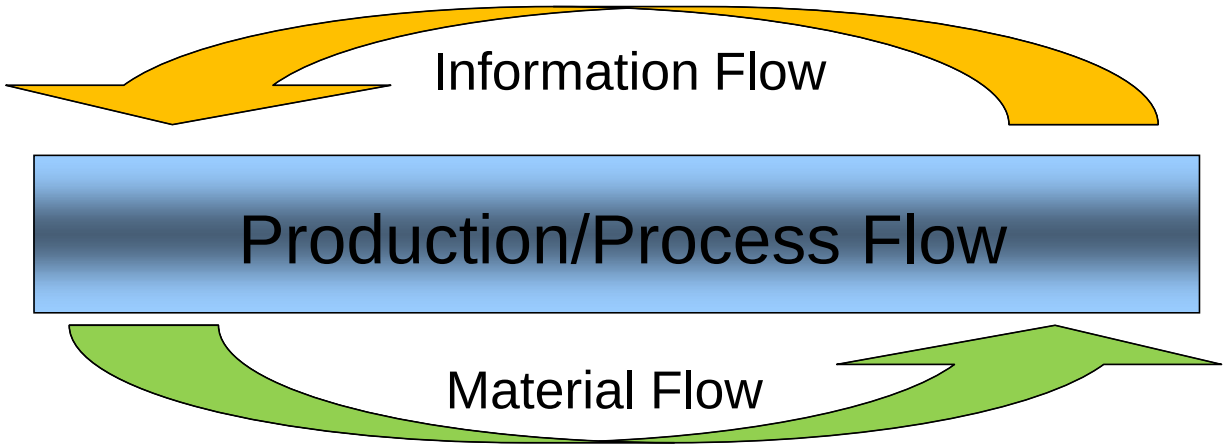
- Process Cycle Efficiency is a ratio of the value-added (VA) time in the process to the total lead time

$$\% \text{ Efficiency} = \frac{\text{VA time}}{\text{Total Lead Time}}$$

- Reference  ***time value map template.xlsx***

Value Stream Map

- A value stream map is a pictorial representation of the entire system
- Helps us see and understand the flow of *material* and *information* as a product/service makes its way through the value stream



- Links the flow of activities with the flow of information (how the system is controlled)
- Highlights which processes are the pacemakers or bottlenecks holding up other activities
- Points out sources of waste
- Allows selection and coordination of multiple improvement efforts in the same value stream

The Anatomy of a Value Stream Map

- Step 1: Identify the customer's requirements
- Step 2: Perform an upstream walk (product/process flow)
- Step 3: Record process information in the data boxes
- Step 4: Add material (work) flow information and information flow
- Step 5: Add timeline information

1. Customer Information
2. Process Flow
3. Process Data
4. Material and Information Flow
5. Timeline

“Shirts-R-Us” Current State Map

Step 1: Customer Information

In the top right area of the VSM:

- Identify the customer
- Add customer requirements in a data box underneath, including the typical quantity requirements
- Include any other specific requirements, as desired (examples: packaging, number of shifts, method of delivery, etc.)
- It is OK that more than one customer is served by this value stream, but make sure that the primary processes used are similar.

“Shirts-R-Us” Current State Map

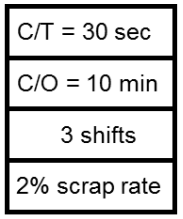
Step 2: Process Information (process flow)

- Perform an upstream walk through each process step, observing and documenting how things flow. The flow is drawn from left to right across the bottom of the map, in the order of processing steps (not physical layout).
- Be sure to observe and document as much information as possible when walking the process (see next page).

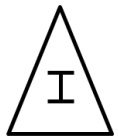
"Shirts-R-Us" Current State Map

Step 3: Process Information (process data)

- Beneath each step, draw a data box and document relevant items such as:
  - Cycle time (C/T)
  - Changeover time (C/O)
  - Number of shifts
  - Uptime
  - Scrap rate
- Capture the location and amount of inventory (draw triangles for each location); this can be expressed in pieces or in time (hours, days, or weeks of inventory).

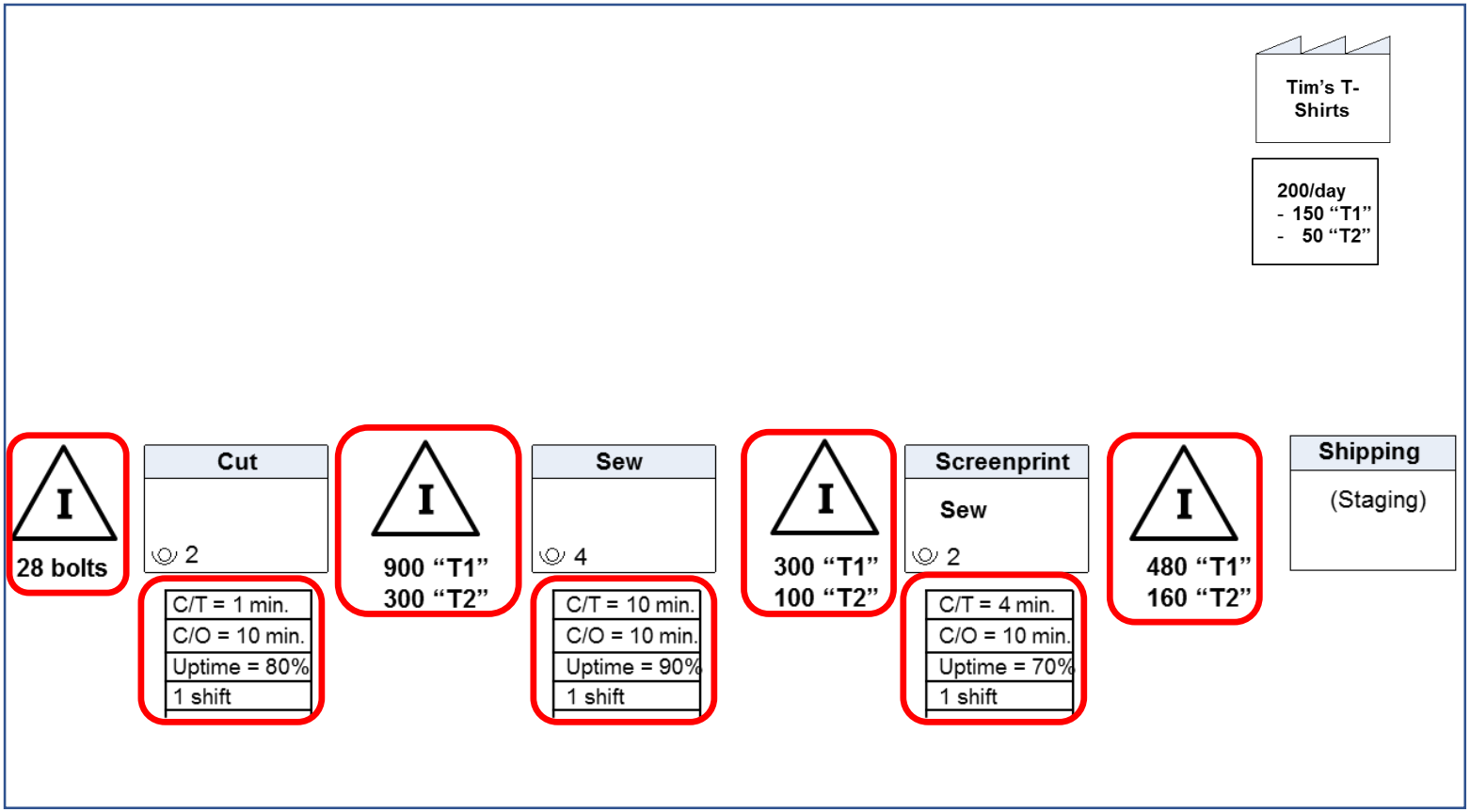


Data box



3,000 units

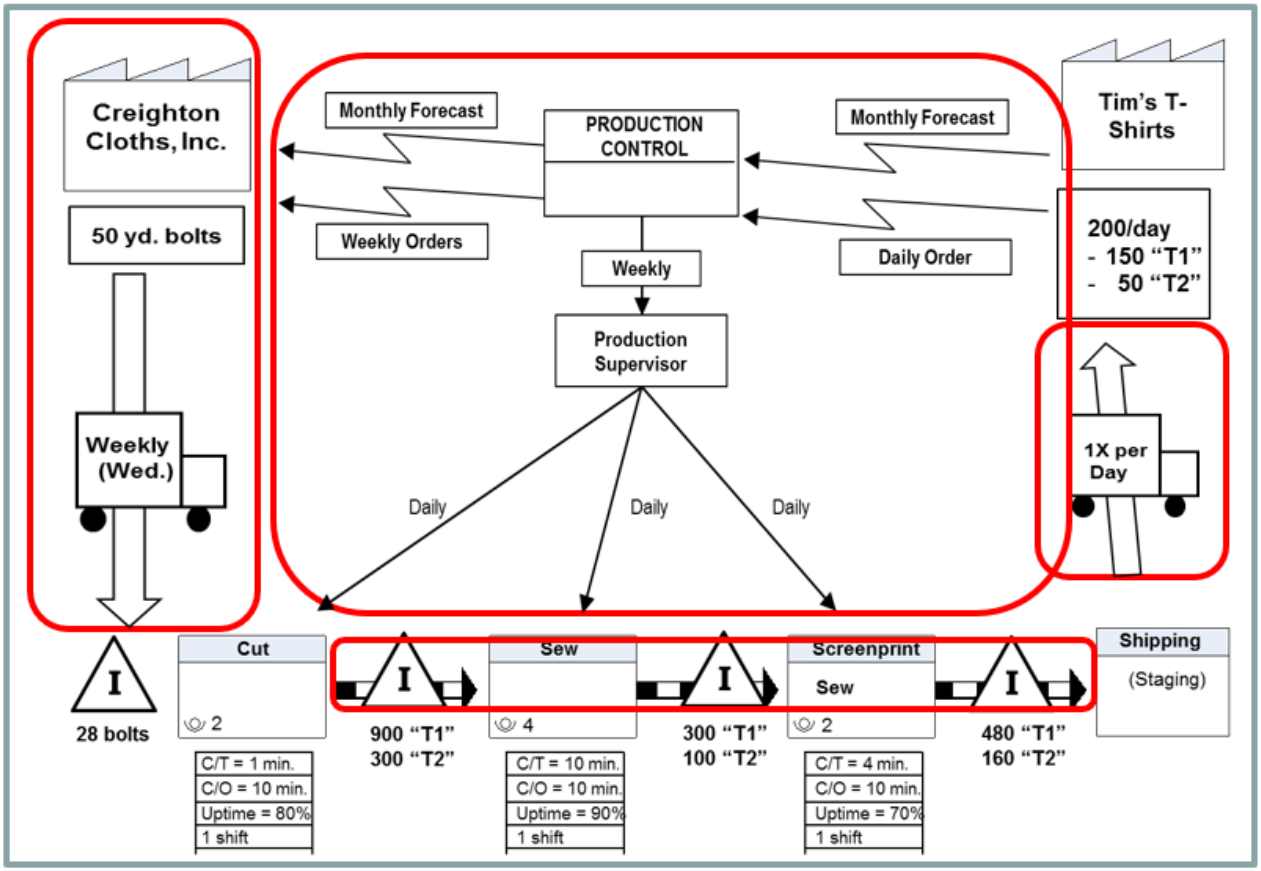
Inventory



"Shirts-R-Us" Current State Map

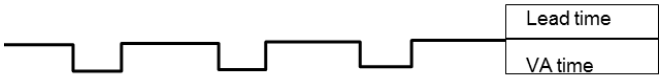
Step 4: Material and Information Flow

- Depict the flow of material and/or information controlling the process. How does each process know what to make? How does the supplier know what to send and when?
- Document information such as:
  - Forecasts and orders from the customer
  - Forecasts given to the supplier
  - Material release rates
  - Any computer information/MRP
  - Delivery to the customer, including method and frequency
- Arrows connect the next process.



“Shirts-R-Us” Current State Map

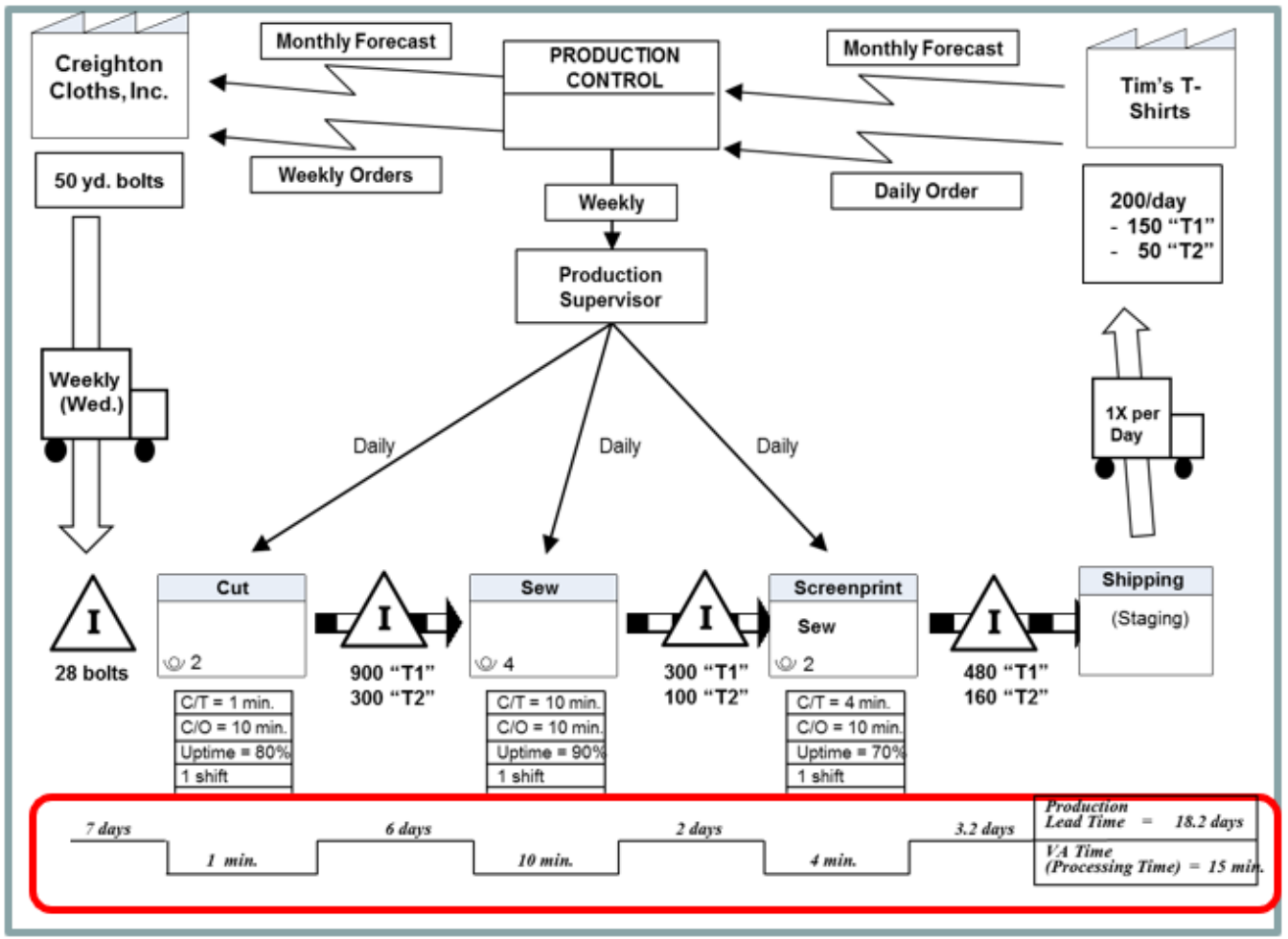
Step 5: Add Timeline Information



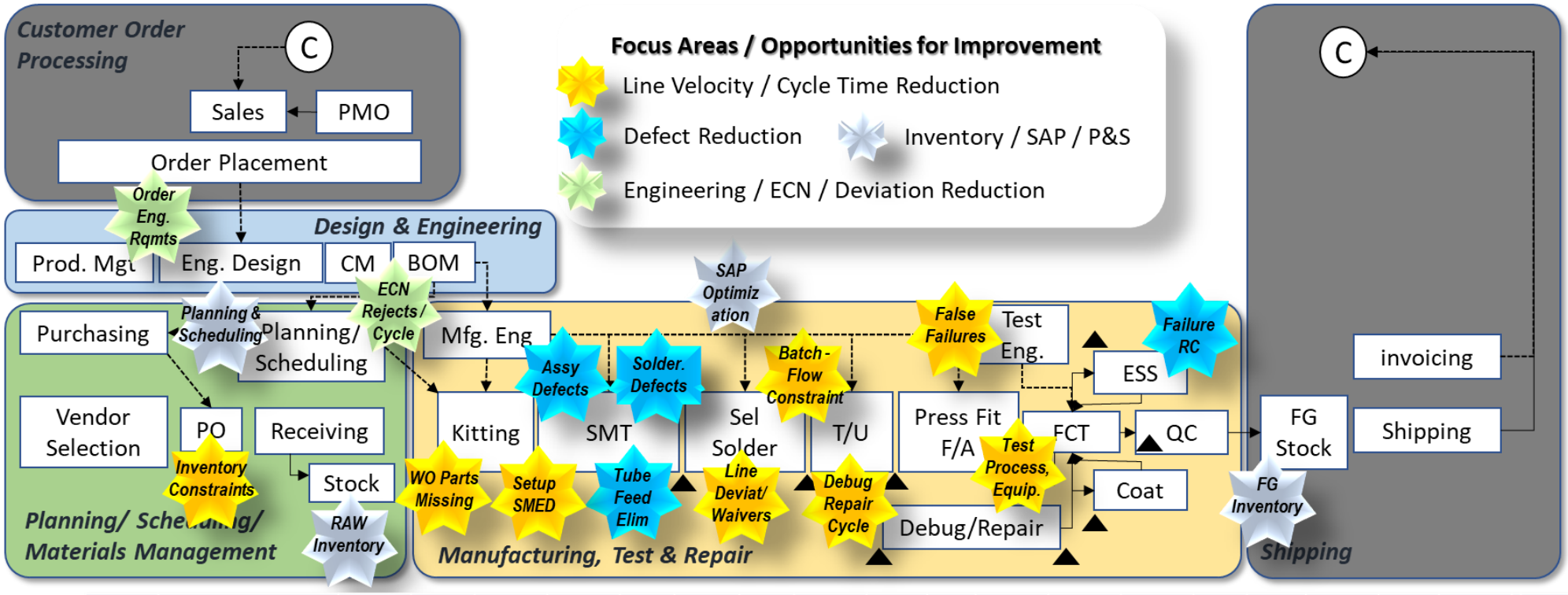
- Processing time (value-add time) is usually the sum of all cycle time for the process (often shown in the “well” on the timeline below each process step).
- Lead time is the time it takes one part to make its way through the entire system, beginning with arrival as raw material through shipment to the customer.(sum of all cycle time and waiting time)
- Lead time (in days) for each inventory triangle can be calculated using:

$$\frac{\text{Inventory Quantity}}{\text{Daily Customer Requirement}}$$

VSM Icons.xlsx



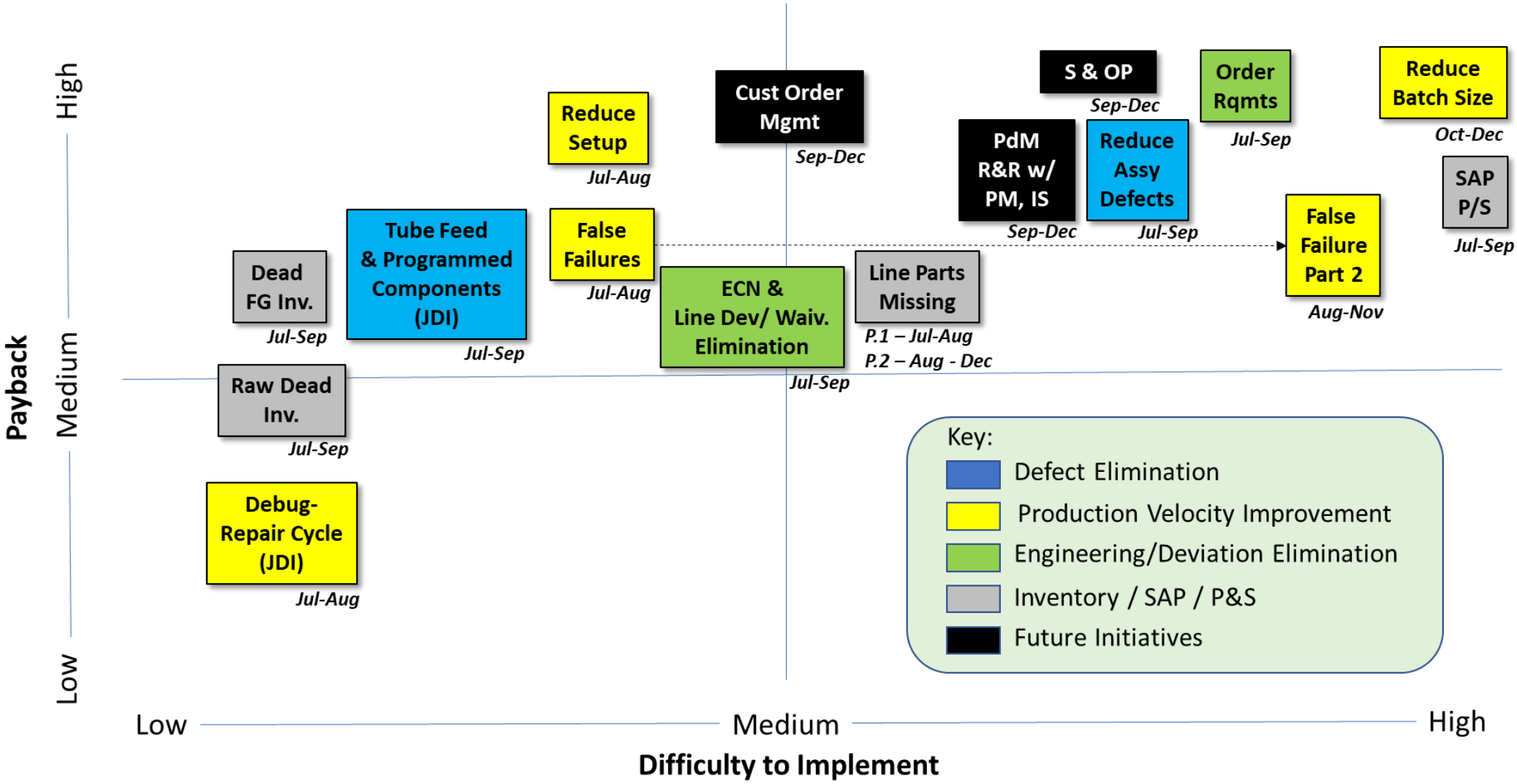
Value Stream Mapping Example
Current Improvement Initiatives / Projects



		Kitting	SMT	Sel Solder	T/U	PF	Assy	FCT 100	Debug/ Repair	Coat	FCT 500	Debug/ Repair	ESS - FCT 600	Debug/ Repair	FCT 700	QC	Repair	FG Stock	Ship	Total Cycle Time
7668	Cycle Time (Days) - 450 Boards		3.77	3.23	0.03	0.6	0.61	0.64	3.83							0.4		0.03		13.14
B114	Cycle Time (Days) - 24 Boards		9.1	6.2	9.4	0.3	3.5	3	9	17.9	1.2					0.9		0.03		60.53
12030-1	Cycle Time (Days) - 9 Boards		4.7	3.6	1	3.2	4.9	0.6	7	7.6	1.8	11	5.5	15	1.1	0.3	10	0.2		77.5
Mixed	MFG. WIP (Point in Time)	457 R/Ts	112	184	247	71	62	68	633							21				

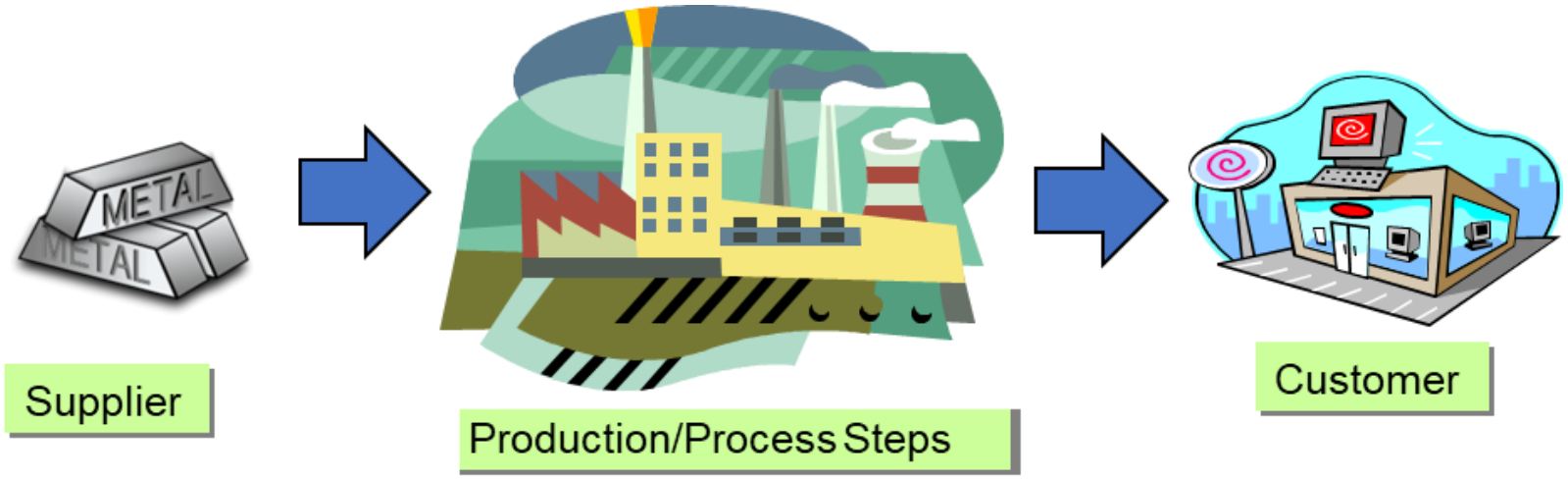
Effort/Benefit Grid

Project Comparison – Payback vs. Difficulty to Implement



Scoping a Value Stream

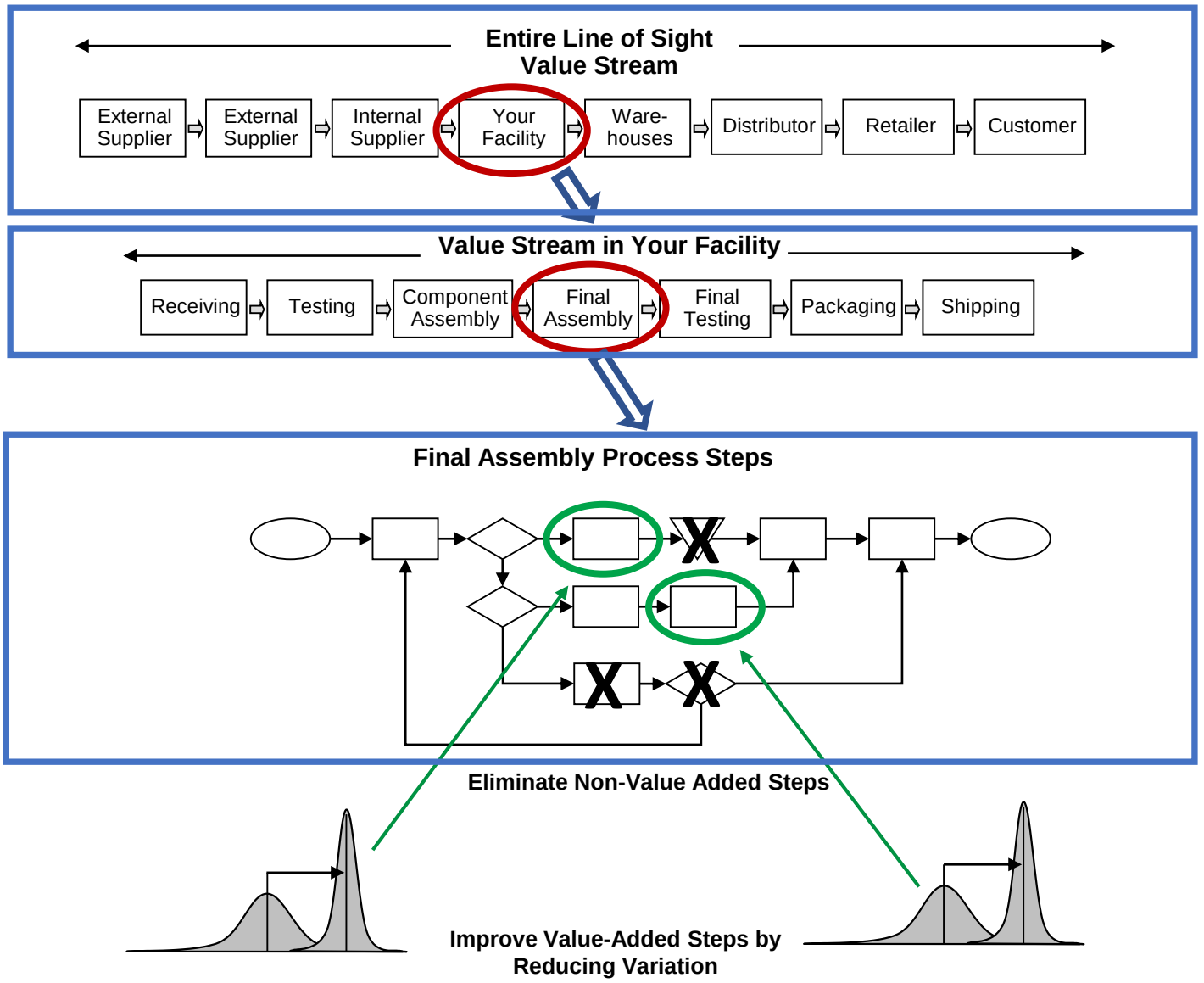
- You may scope your value stream to just those activities door to door in your facility or to include both internal and external locations such as suppliers, warehouses, etc. as well. It usually depends on what you can control.



VSM Outpatient Example.pdf

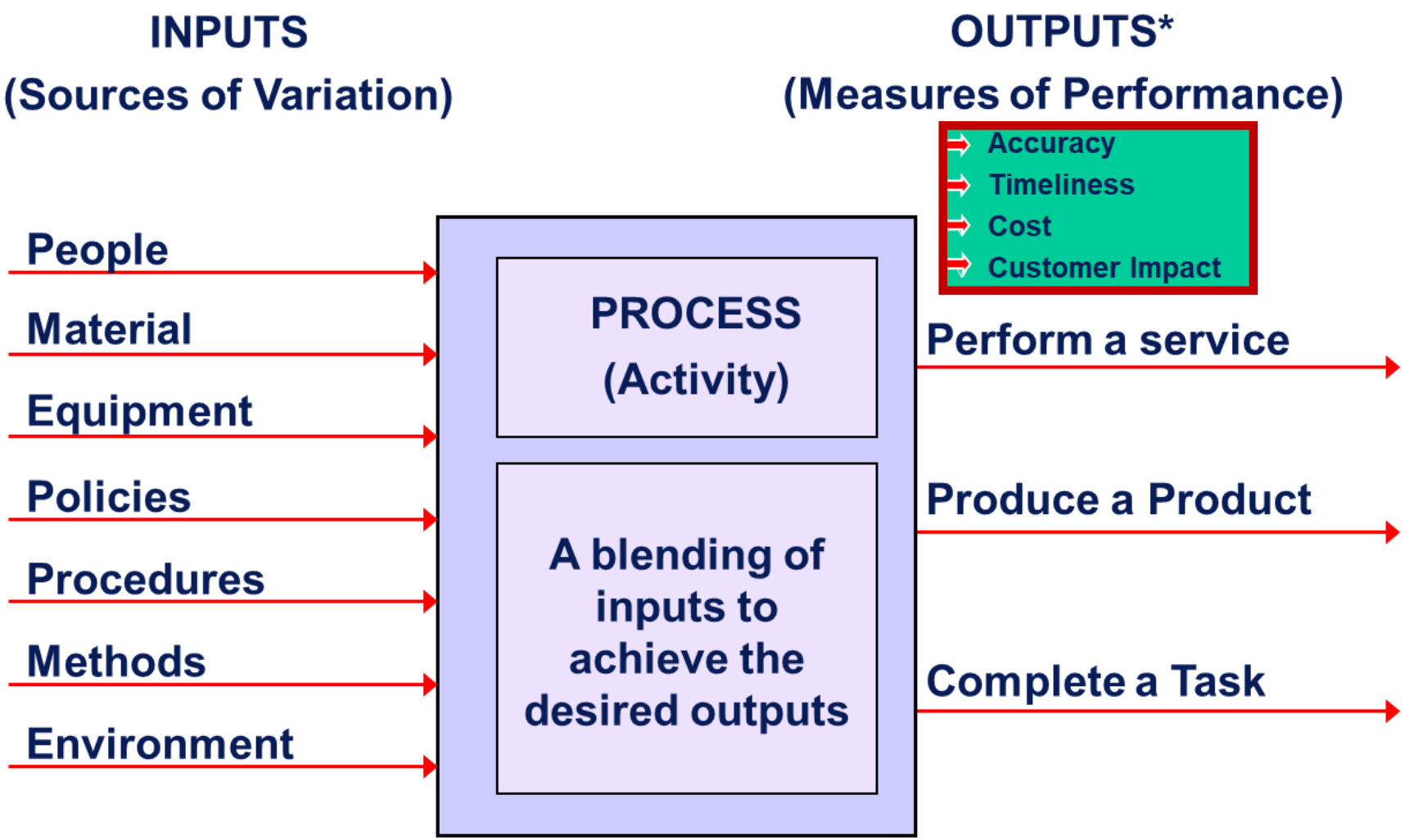
VSM Detailed Breakdown Example.pdf

Value Stream Drill Down



Process improvement efforts typically begin on a single process or process step rather than attacking the entire Value Stream at the same time.

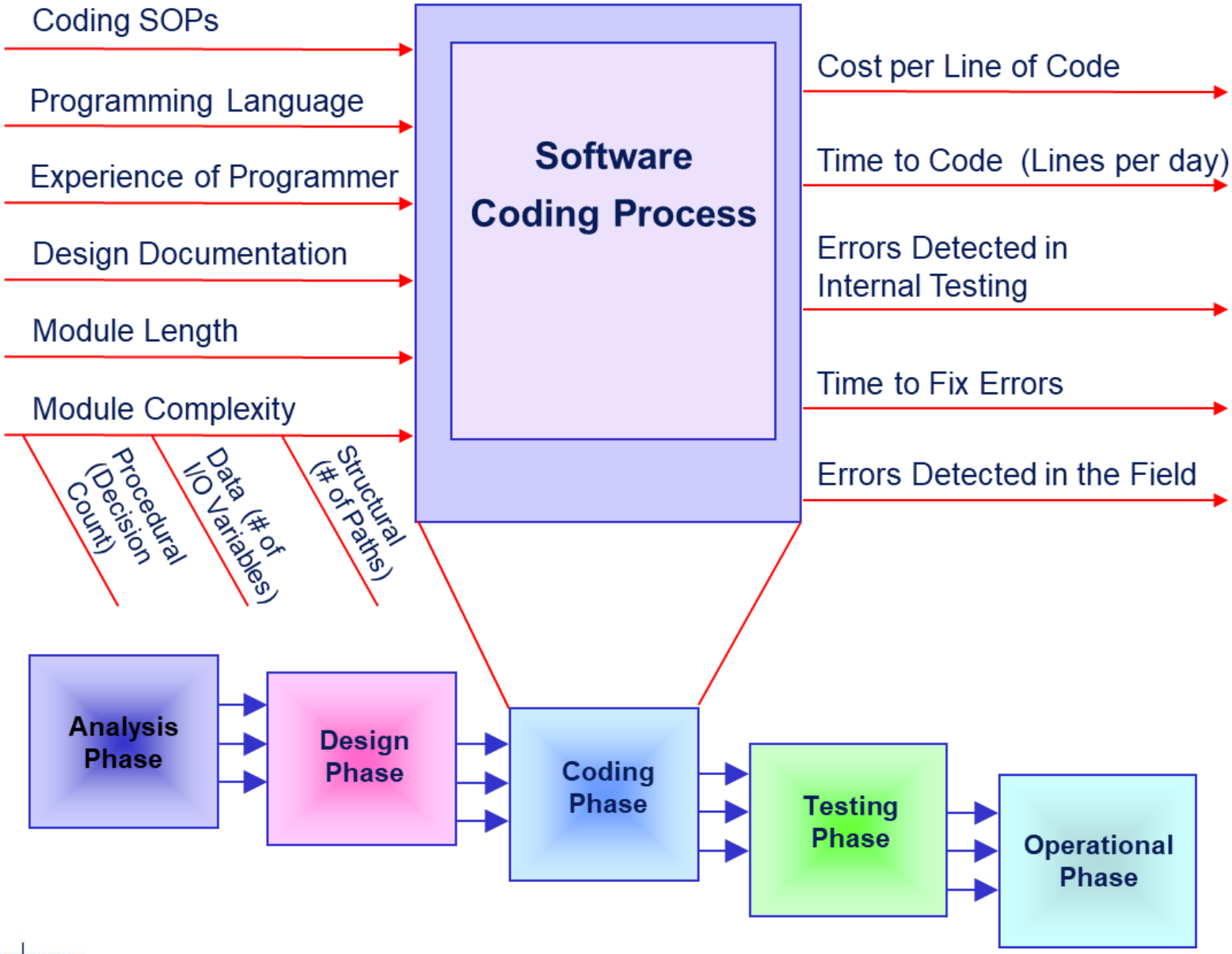
Definition of a Process: the "DNA" of a Value Stream



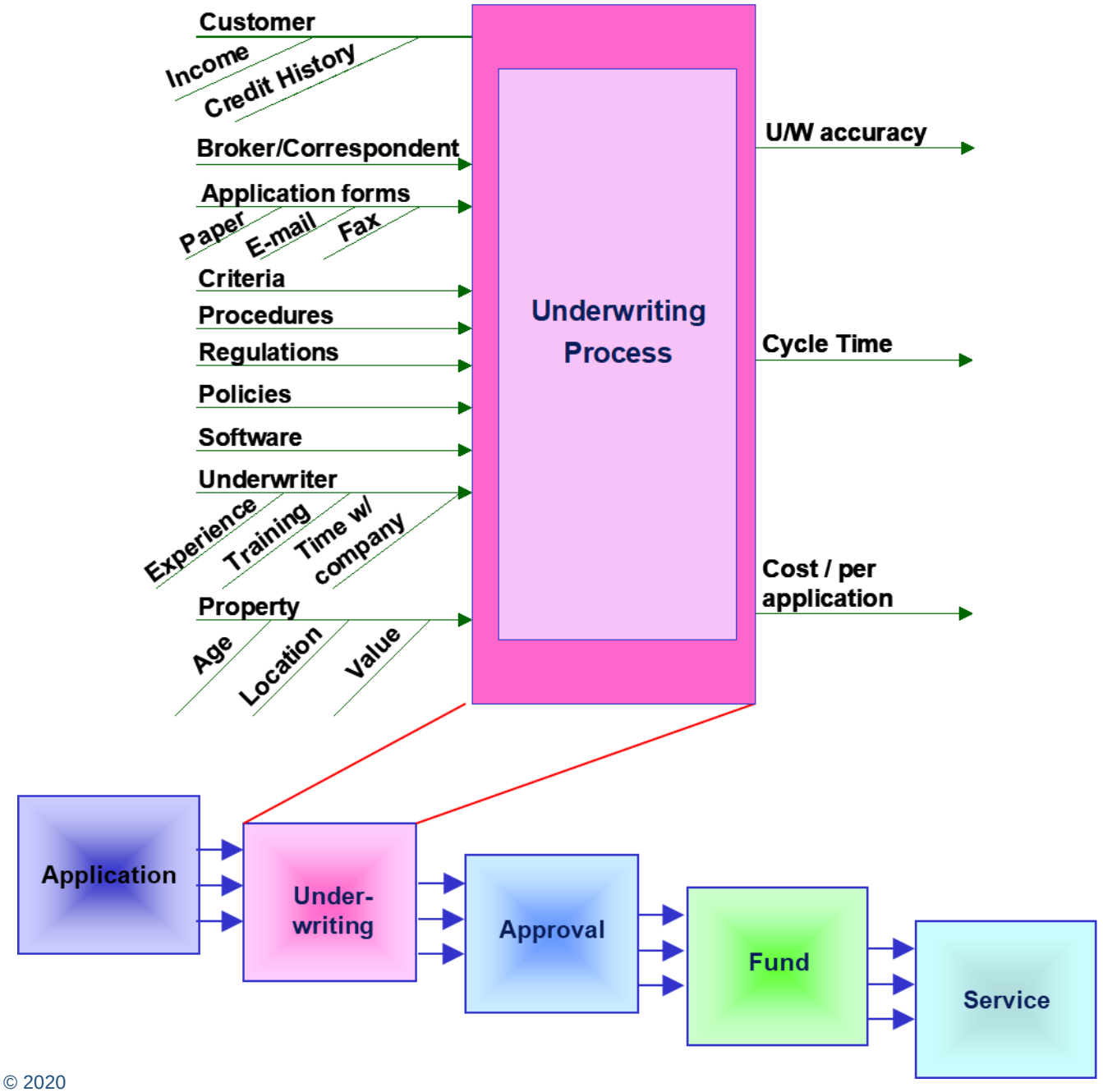
* = Critical-to-Customer (CTC)

* = Critical-to-Quality (CTQ)

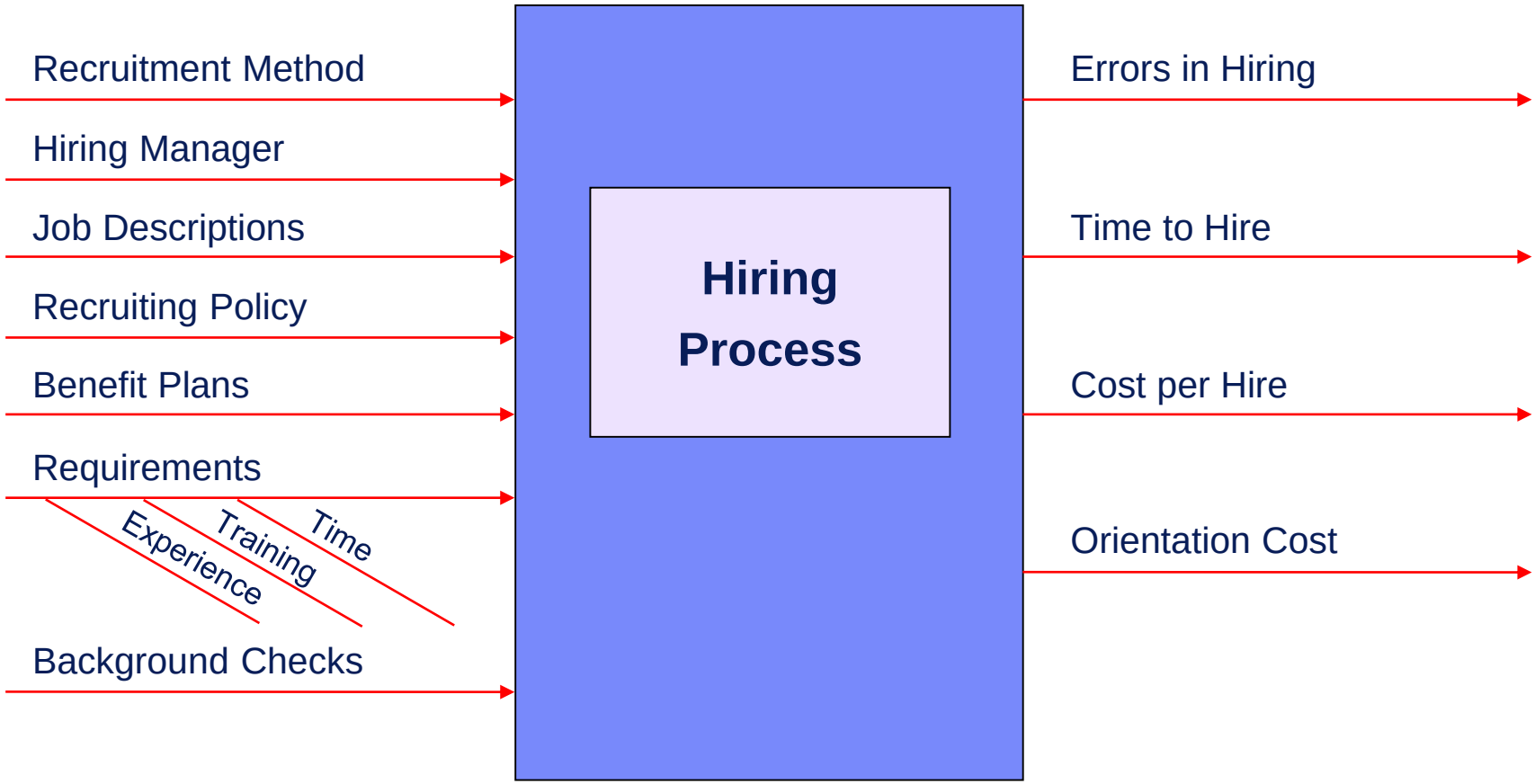
Input – Process – Output (IPO)



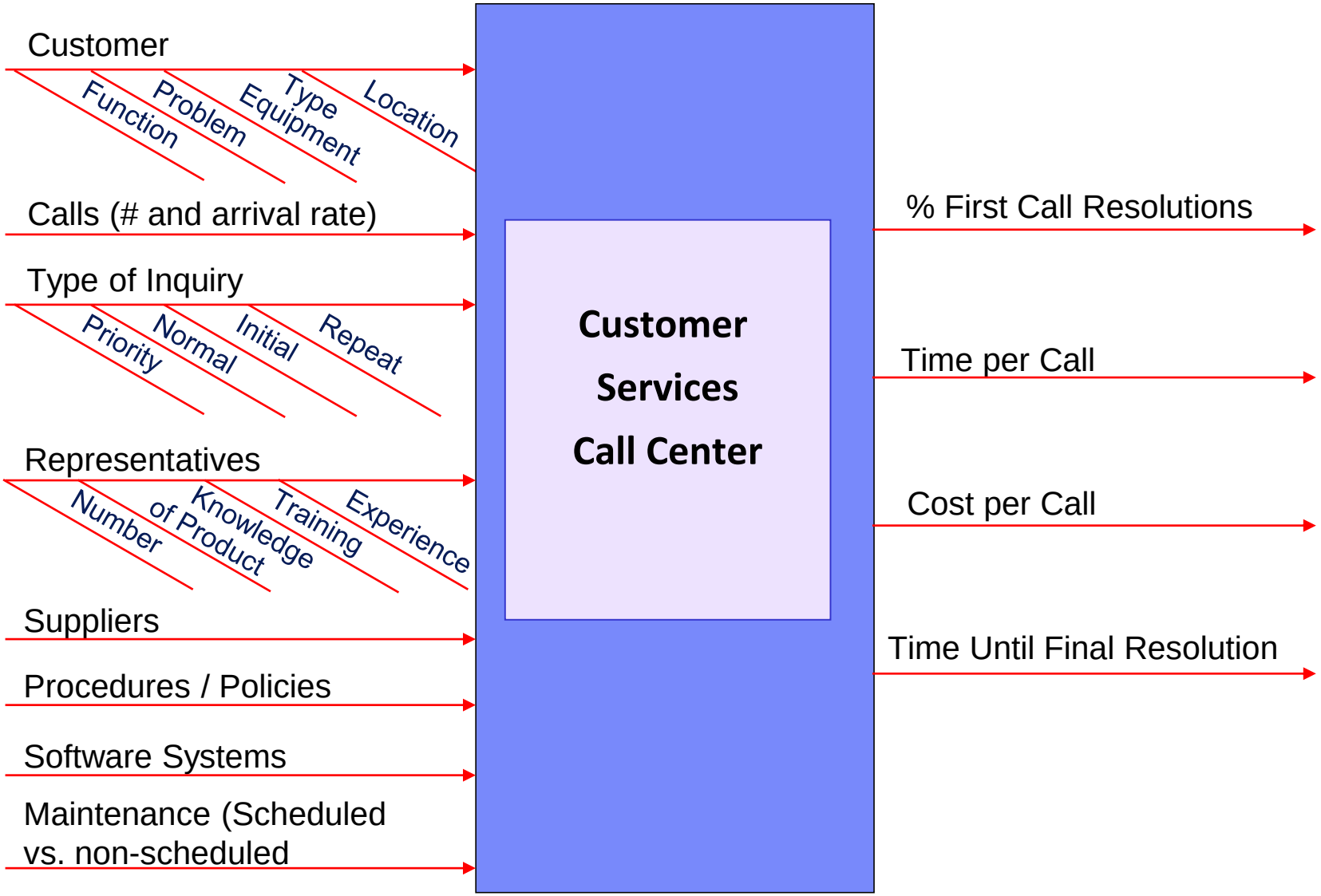
Input – Process – Output (IPO)



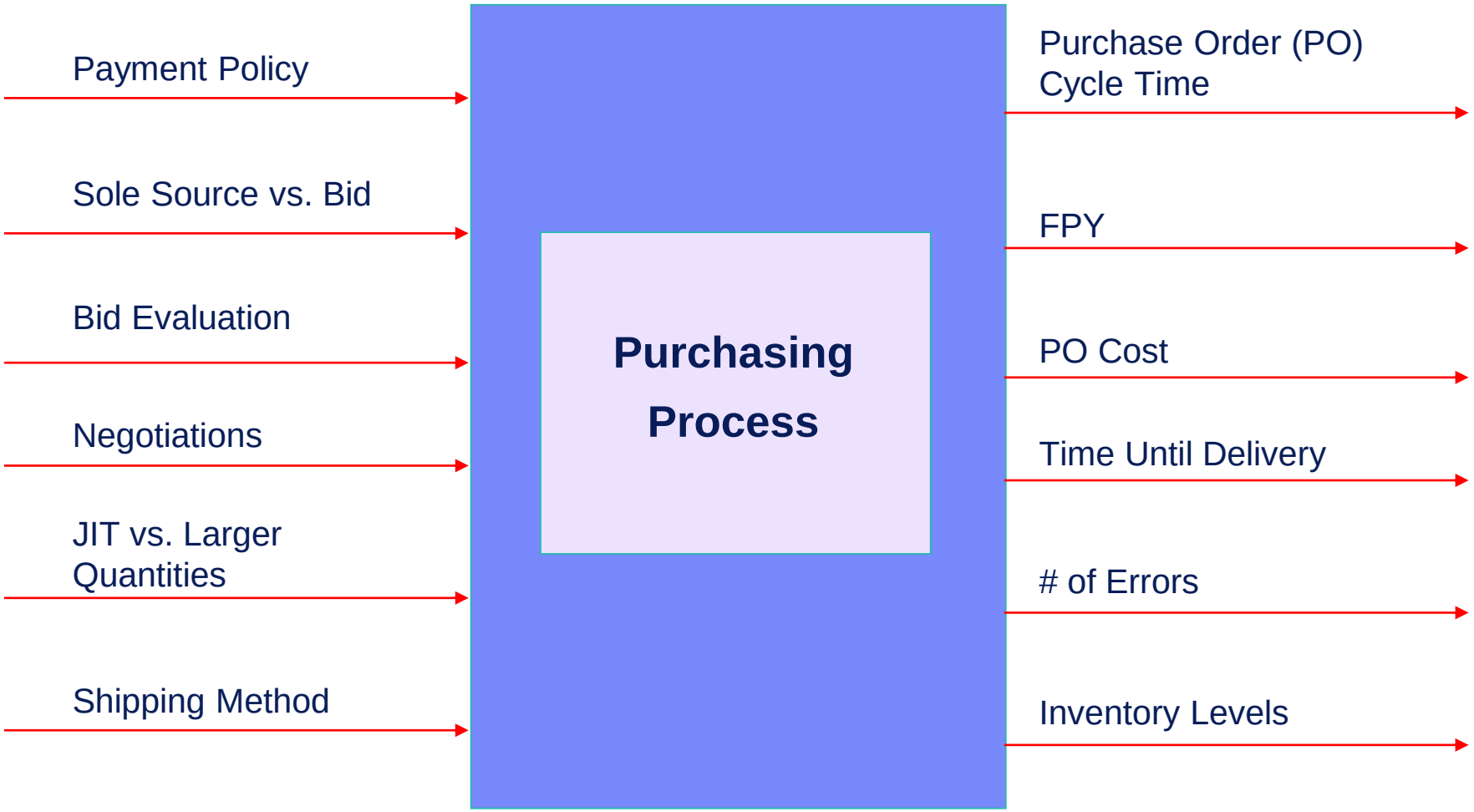
Input – Process – Output (IPO)



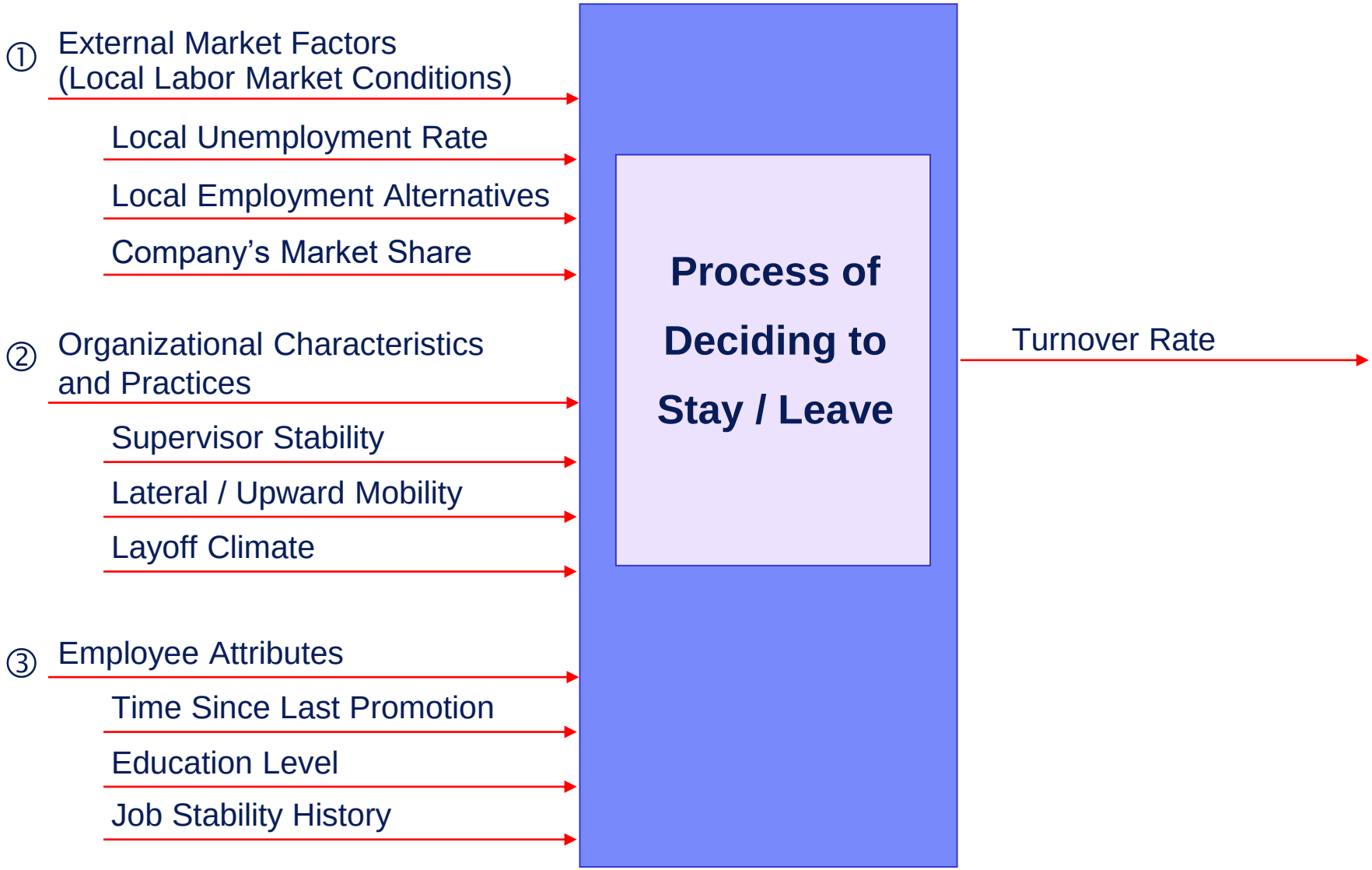
Input – Process – Output (IPO)



Input – Process – Output (IPO)

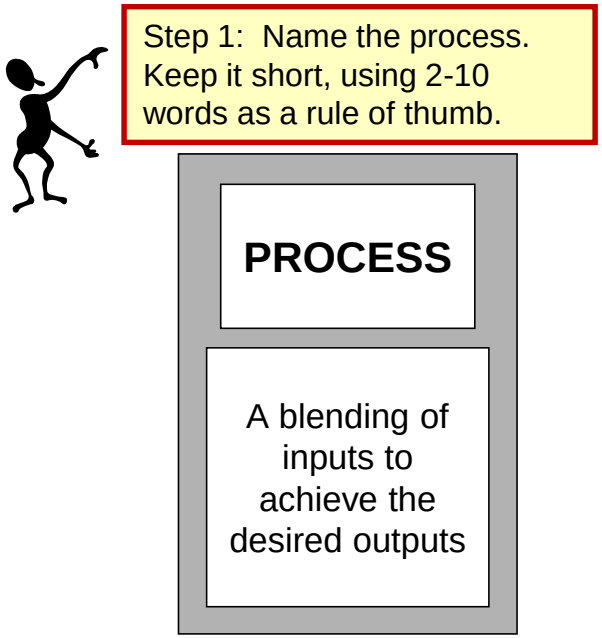


Input – Process – Output (IPO)



*Adapted from Harvard Business Review article on Boston Fleet Bank, April 2004, pp 116-125

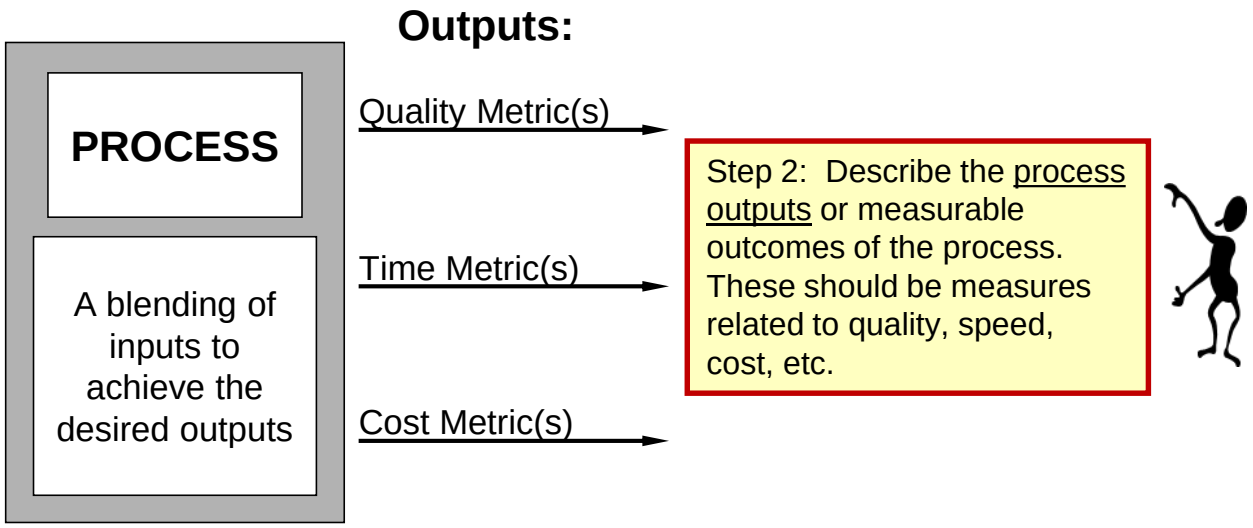
The Anatomy of a Process
(constructing an IPO diagram)



Some examples of processes are:

Purchasing	Payroll
Accounts Receivable	Help Desk
Accounts Payable	Shipping
Hiring	Scheduling
Training	Web Site Creating
Documentation	Management of Lean Six Sigma
Advertising	Database Management
Drug Testing	Personnel Placement

Constructing an IPO (cont.)



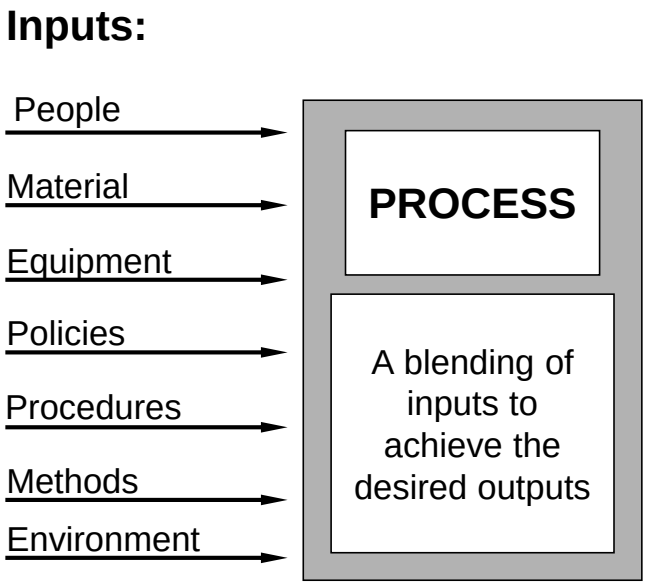
The outputs should be measurable outcomes from the process that will help us determine (i.e., measure) if a process is improving. These are: "Critical to Customer (CTC)" or "Critical to Quality (CTQ)" outcomes that are measurable.

Some examples of outputs are:

# items misfiled	Loans past due
% on time shipments	Orientation cost
Time to return calls	Stock price
Errors per document	$ saved
Processing time	Wait time
Calls per day	% on time arrival
Cost per employee	% Market share
Customer wait time	# of returns

Constructing an IPO (cont.)

Step 3: Describe the process inputs. These are the sources of variation that impact the output.

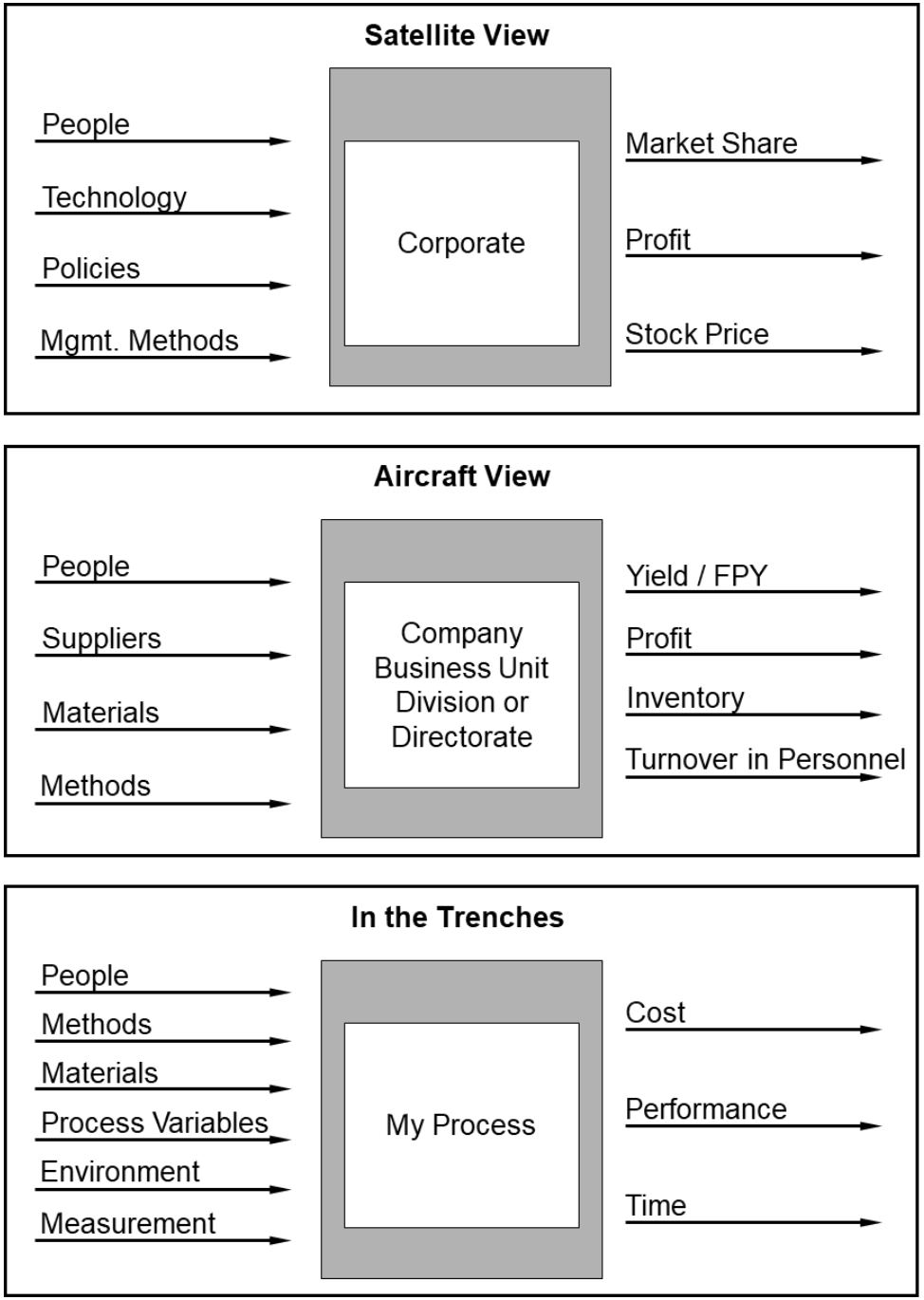


The inputs to a process are items that affect the outcome of the process. You may or may not have control over these items.

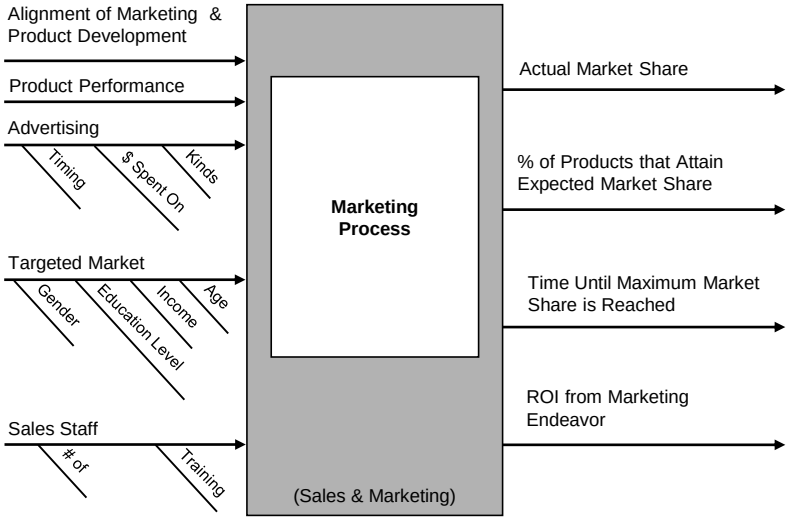
Some examples of inputs are:

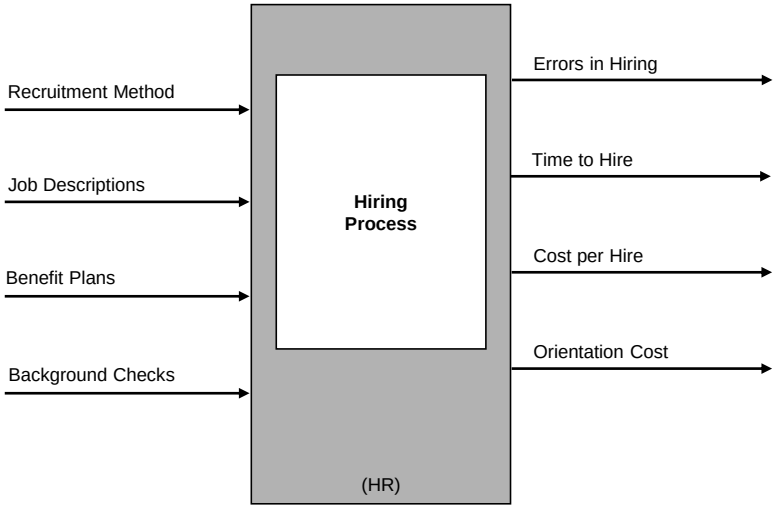
# of People	Advertising time slot
Payment method	Hours training
# days training	Years experience
# of phone calls	Market size
Type network	Monthly revenue
Day of week	Appointments per hour
Time of day	Size of monitor

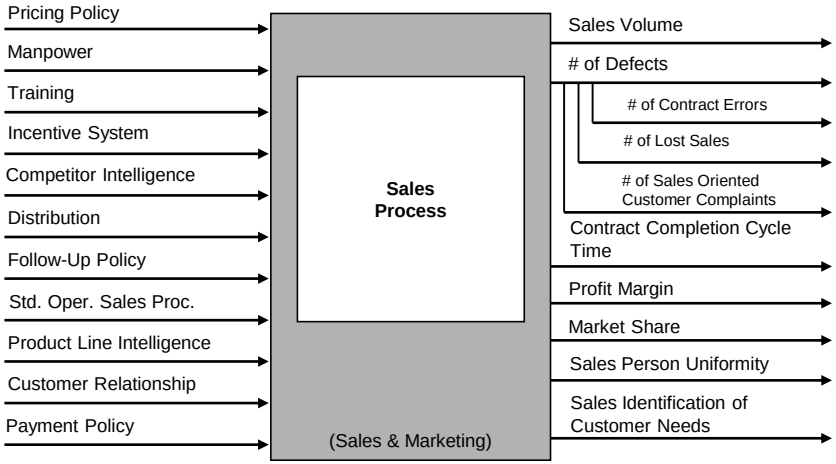
IPOs are Applicable at any Level of Abstraction

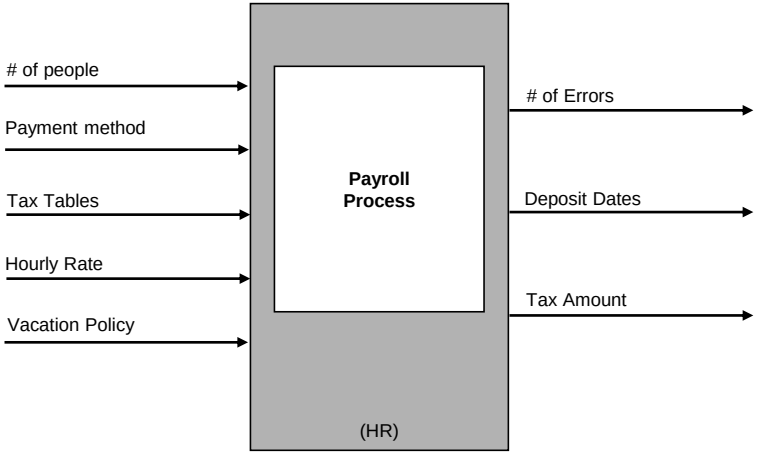


IPO Examples

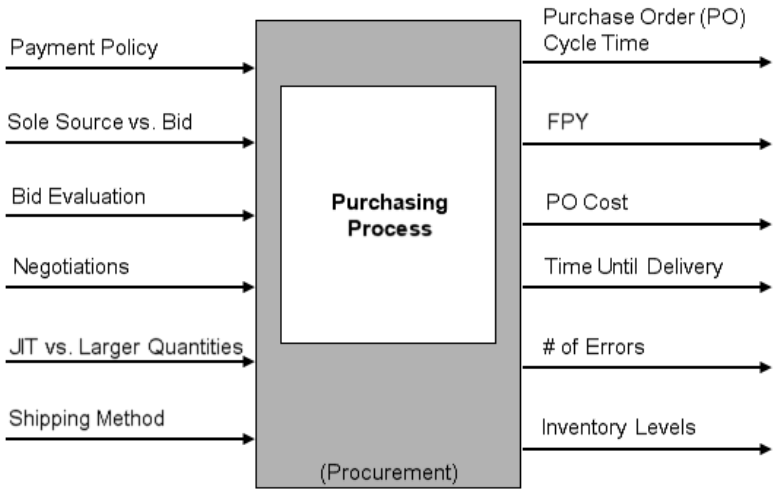


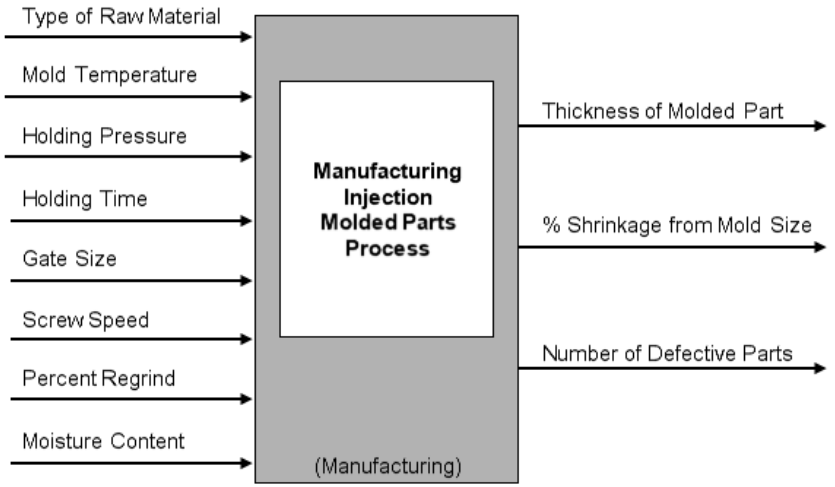


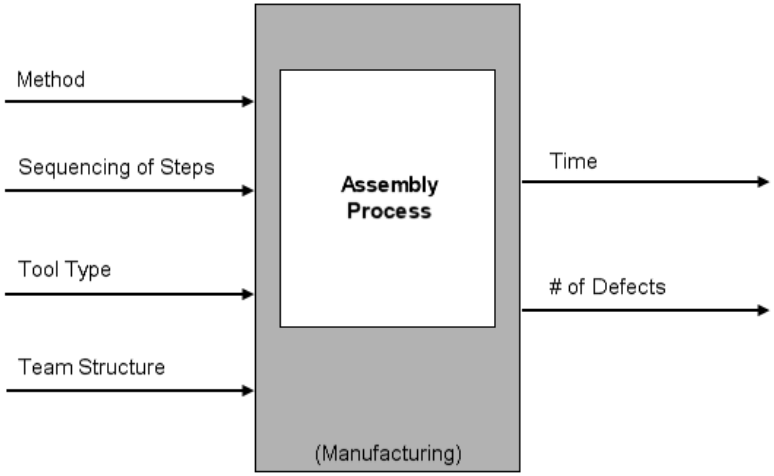


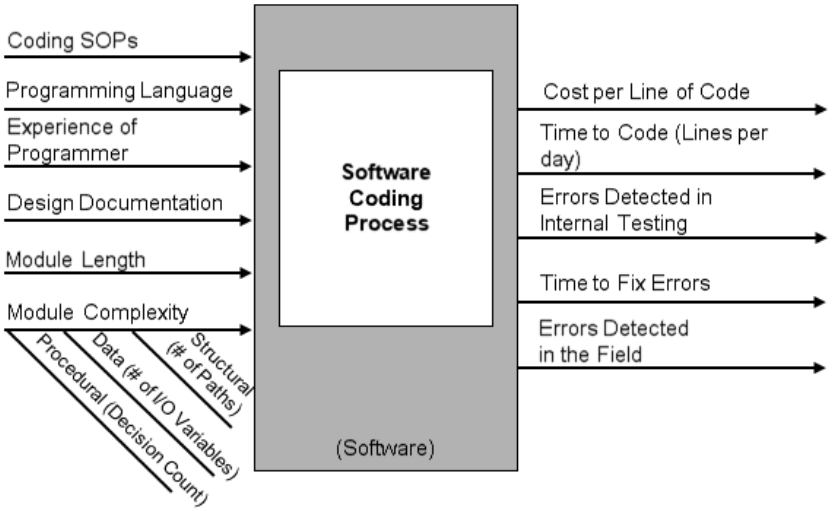


IPO Examples

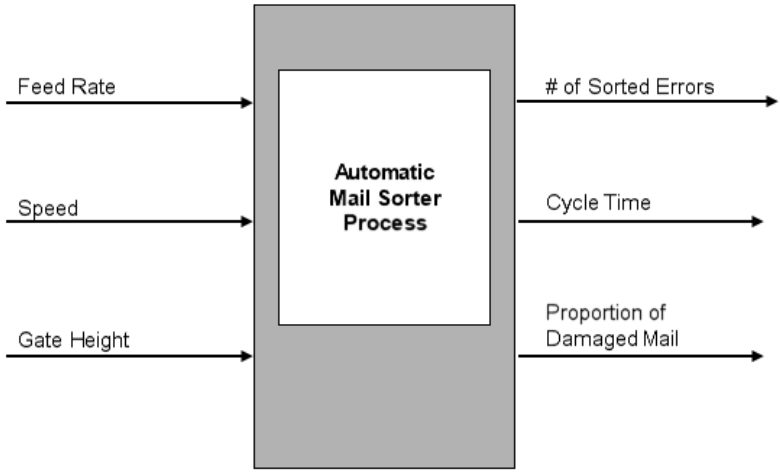


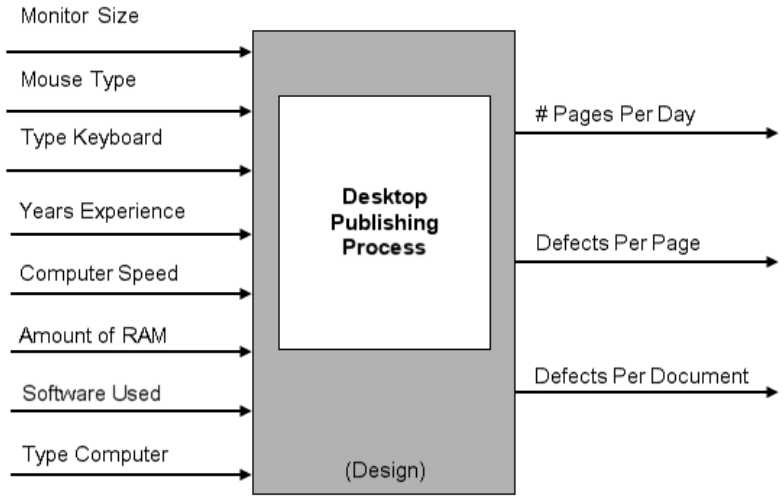


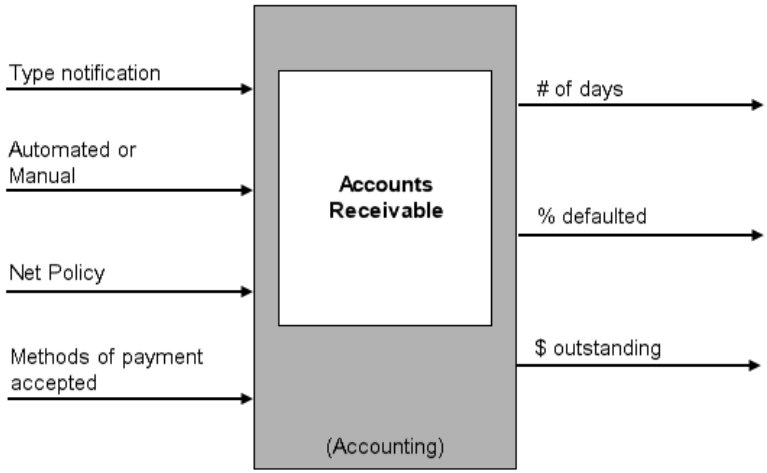


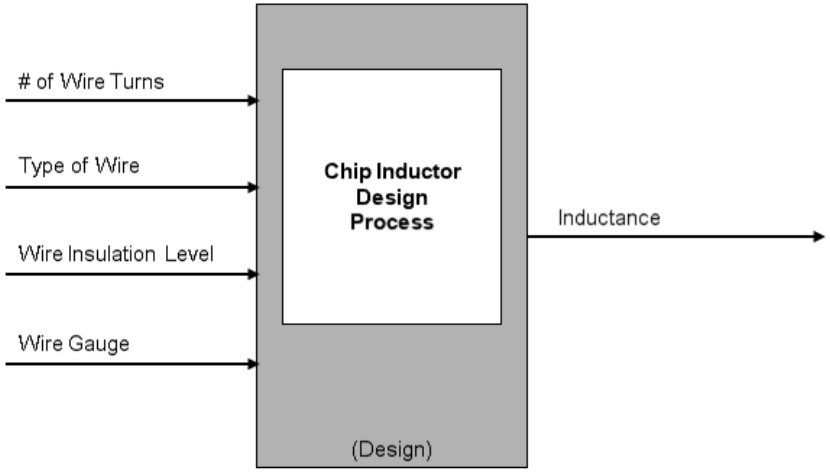


IPO Examples



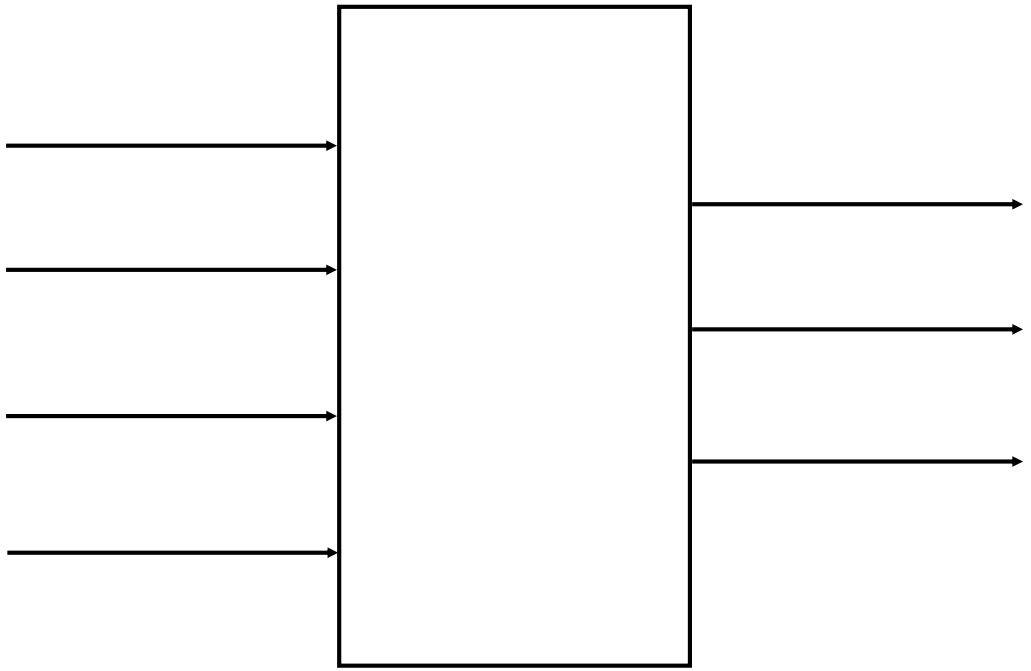






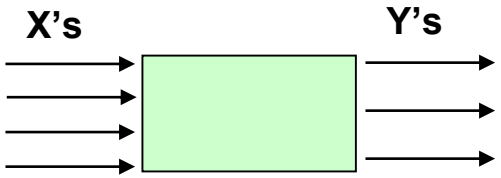
IPO Exercise

- Develop your own IPO diagram for some process that is or will be an integral part of your improvement effort. Use the template below to identify at least 4 input variables and at least 3 output variables (quality, time, and cost). More arrows can be added if needed.



- Reference ***IPO Diagram.xlsx***

Discovering Relationships

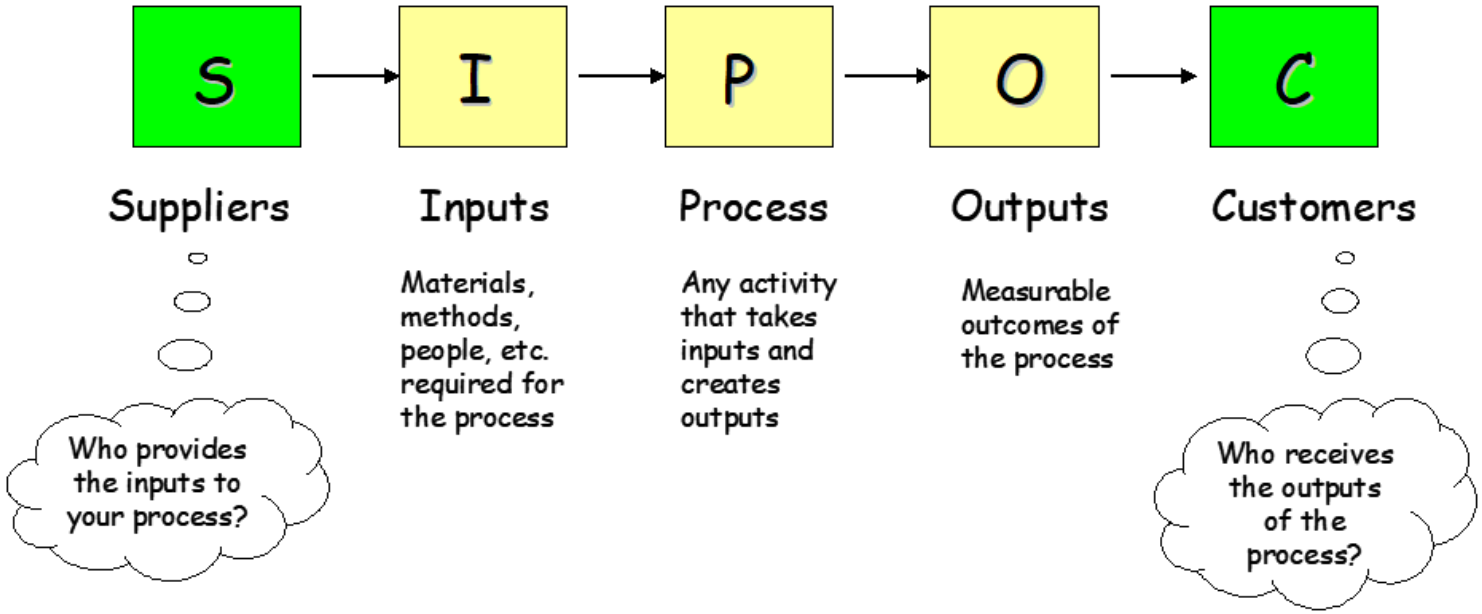


$$Y = f(X)$$

- Pronounced "Y is a function of X"
- Y's are the outputs and X's are the inputs – the process outputs are a function of the process inputs – they depend on the inputs
- One of the goals in Lean Six Sigma is to study the relationship between the X's (inputs) and the Y's (outputs), identify which X's are most critical, and determine how to change or control those critical X's to achieve the desired output and satisfy the customer

Creating a Higher Level Process Map
(from IPO to SIPOC)

- A SIPOC diagram is an extension of a simple IPO diagram
- It includes information about suppliers and customers
- To create a SIPOC diagram:
  - name the process
  - identify the outputs and customers
  - identify the inputs and suppliers



Key Takeaways

- As a review, you may want to pause the video at this point and summarize the key learnings from this session, at least from a high-level view. When you are finished, you may resume the video and complete the session.

Key Takeaways

- Value is in the eye of the beholder (i.e., the customer). An organization may have many value streams, e.g., from order to delivery or from order to cash
- Value Stream Mapping (VSM) is a valuable tool for looking at the entire system of delivering value to a customer. It helps us determine where bottlenecks are and where the greatest opportunities for improvement are
- VSM integrates the flow of the product or service, together with the information and material flow that is needed to manage and control the value stream
- Although it contains the Process Flow, VSM is much more inclusive than just process flow
  - It shows the customer information
  - It provides data on each of the processes or steps within the value stream
  - It shows supplier and material flow
  - It provides timeline information
- The DNA of a value stream is a process, and most improvement projects are done at the process level
- An IPO diagram is a very simple graphical construct that describes a process
- The outputs of a process must be measurable
- The key to improvement is to find critical relationships between inputs and outputs
- SIPOC is a simple extension of IPO and includes both Customers and Suppliers – it provides a higher level view of a process map and can be used to help us better SCOPE a project

Supplemental Material

- Suggested Reading:
  - ***Lean Six Sigma: A Tools Guide*** by Adams, Kiemele, Pollock and Quan (pp. 67-78)
  - ***Design for Six Sigma: The Tool Guide for Practitioners*** by Reagan and Kiemele (pp. 173-176)
  - Air Academy's app: ***Six Sigma Quick Tools***

- SPC XL™ software training tutorials:
  - https://airacad.com/our-insights/training-videos/spc-xl/

- The data files for this session can be downloaded from the site where you are accessing this course.

Additional Practice / Review Questions

1) What is a value stream and why is it important?

2) What is the difference between a value-added (VA) activity and a non-value-added (NVA) activity?

3) Give some examples of NVA activities.

4) What is a Time Value Map and why is it important?

5) What is Process Cycle Efficiency?

6) What is a Value Stream Map (VSM) and why is it important?

7) Name the 5 steps in constructing a VSM.

8) What is the DNA of a Value Stream?

9) What is an IPO diagram and what are the 3 steps in constructing one.

10) What do the outputs of an IPO diagram represent?

11) What is the difference between an IPO diagram and a SIPOC diagram?

12) What are some reasons we might want to use a SIPOC diagram?

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