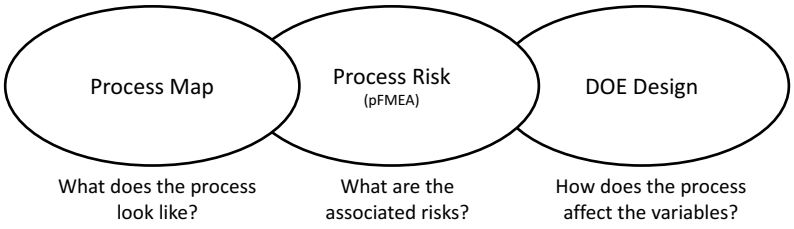
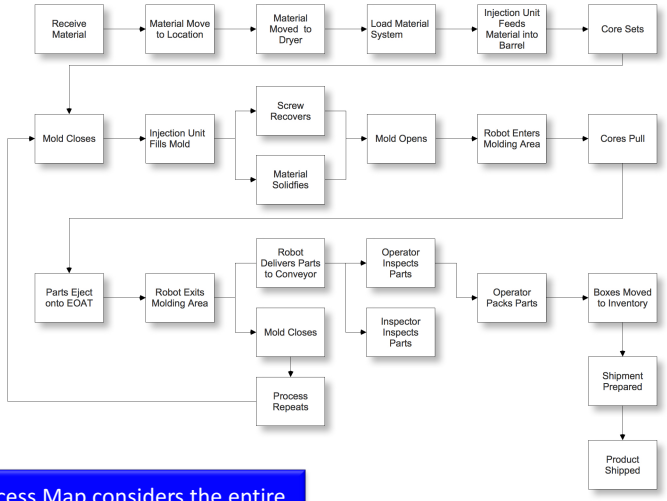
Planning
Design of Experiments

Training for Operational Excellence

Planning Map



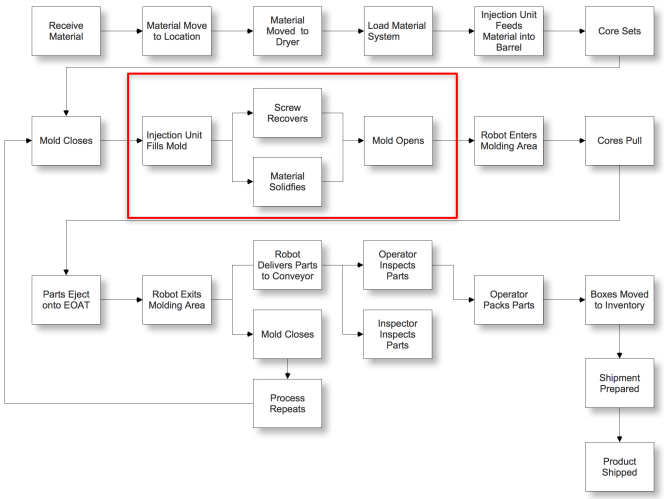
Process Map



The Process Map considers the entire value stream for the delivery of the material to the shipping of the product

Process Map

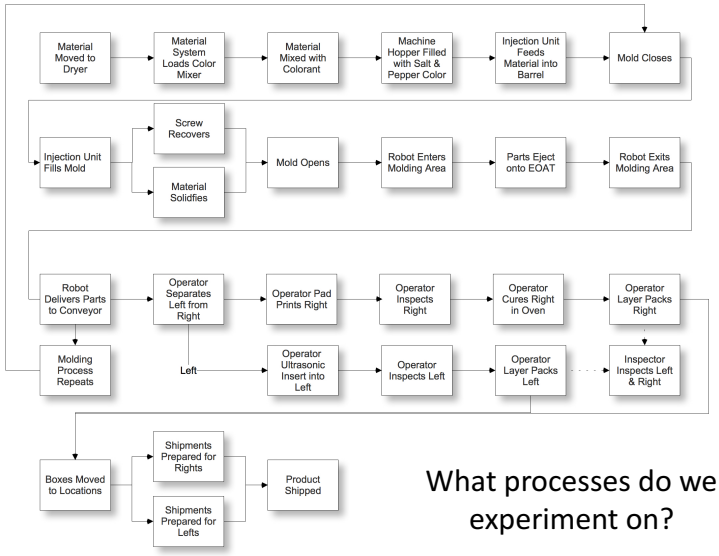
Process Map



www.gapimprove.org

Planning Map

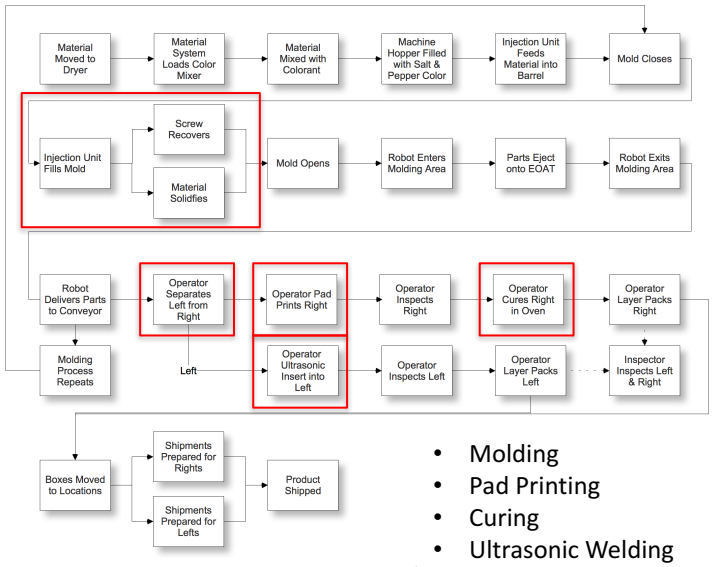
Process Map



What processes do we experiment on?

Process Map

Process Map



- Molding
- Pad Printing
- Curing
- Ultrasonic Welding

Customers Needs

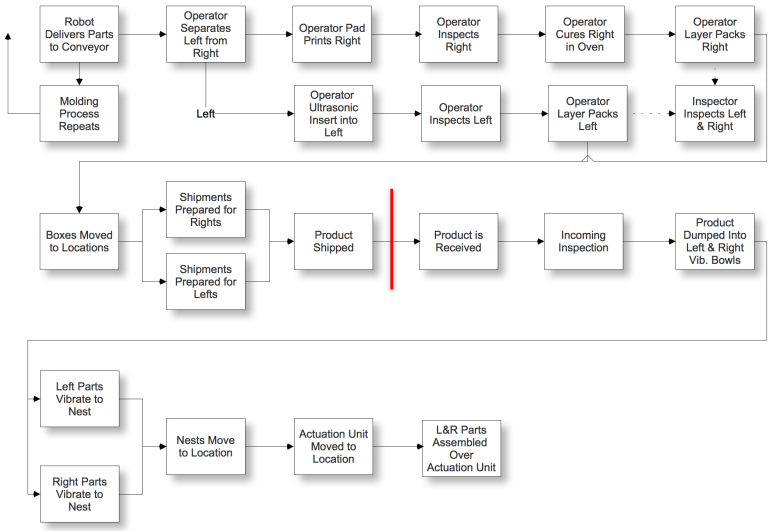
It is important to understand our customers validation process and the next process that our parts go through after they leave our facility.

Examples of Customers Needs:

- The next step of the process is high speed automation
  - Do we know how the part is presented to the automation?
- Design validation
- Assembly process validation
  - What are the sample size they need to qualify their equipment?

Note: When applicable, add the customers 'next' process step to our process map

Customer Included Process Map



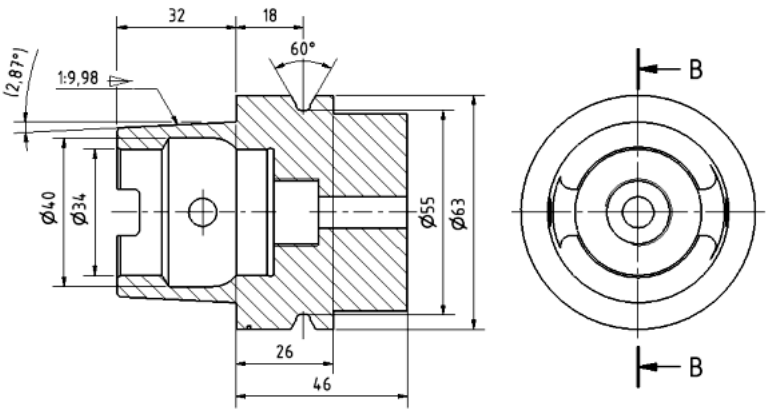
Process Risk

Why should we care about Process Risk?

- Understanding our risk helps us design an escalation process
- This knowledge helps us determine a critical spares list
- RPN's provide direction for improvements
- By reducing risk we increase our ability to meet our promises

What Tool Will We Use to Evaluate Risk? - pFMEA

Process Risk - Part Interrogation

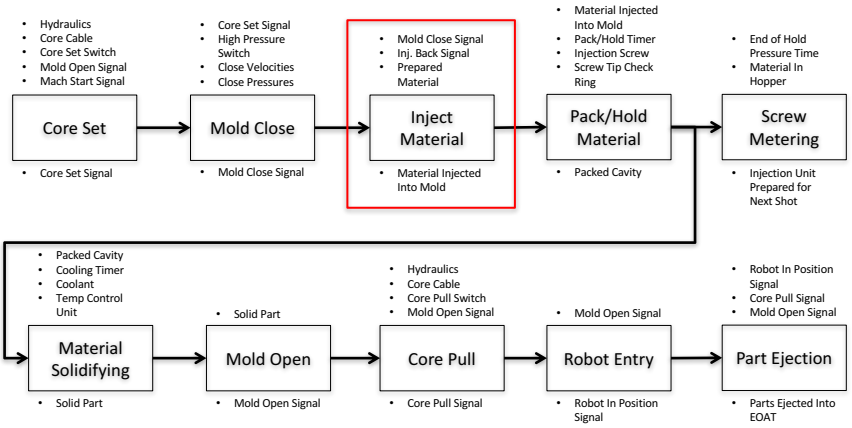


How does the process affect:

- 34mm ID?
- 32mm Length?
- 55mm OD?

Planning Map

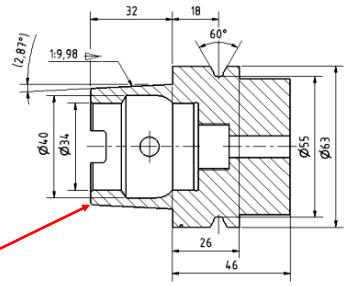
Process Risk - Process Map



Risk

Process Risk - pFMEA

Line No.	Process / Operation	Potential Failure Mode	Potential Effect(s) of Failure	S E V	Potential Cause(s) of Failure
1	Core Set	Core Not Set	Core set signal not made		Short wire
2					Plug not plugged in
3					Switch not set
4					Cores not turned on
5	Mold Close	Mold Not Closed	Mold close signal not made		High pressure switch not made
6					Too low close pressure
7	Inject Material	Material Does Not Inject	Screw does not move		Mold close switch not made
8					Screw back switch not made
9					Plastic temp too low
10		Material Degrades	Burning		Injection velocity too high
11					No venting
12	Pack Cavityl	Cavity Not Packed	Pressure does not build in front of screw		Worn screw
13					Worn Check-ring
14					Pack timer too low



DOE Design

Now we are into the design, we need to decide what we are trying to achieve:

- Understanding our process – fractional factorial
- Modeling our process – full factorial
- Optimizing our process – response surface
- Determine the number of factors
- Determine the number of levels

DOE Design

Multiple Processes, How Many Samples

- Injection Molding – Depends on the number of runs and how many replicates
- Pad Printing – Depends on the number of molding runs/replicates + the number of ink factors + silicone pad force
- Curing – Depends on the number of molding and pad printing runs + the number of curing factors
- Ultrasonic Welding – Depends on the number of molding runs/replicates + the number of weld factors