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SMACNA ANNUAL CONVENTION

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Shop Layout: From Process to Productivity



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Why Process and Layout Count!

Process

- **~50%** of Variation in Worker Productivity is tied to a combination of Standard Communication, Operating Procedures, and Work Environment.

Establish written processes and procedures, and connect the process to the fabricated product

Chaotic Flow, or Out of Space, Planning new space

- **20% to 50%** of operating costs are related to material handling. (Single Product)
- Increases by **20-40%** if with multiple product types

Establish an ongoing improvement system, create/collect the needed information to simulate production. (10-30% improvement)

Process – Multi Cell or Shop Level

Process (Descriptive) - Describes the flow of work at a higher level, defining what happens and in what sequence without dictating how each step must be executed. (The Story Board)

Focus: Purpose, Sequence, Scope, Overall Structure

- Defines what needs to happen and in what sequence.
- Focuses on flow, dependencies, and decision points.
- Provides flexibility for innovation and optimization.
- Used by executives & strategists for big-picture planning.
- Gives context and purpose, connects procedures.



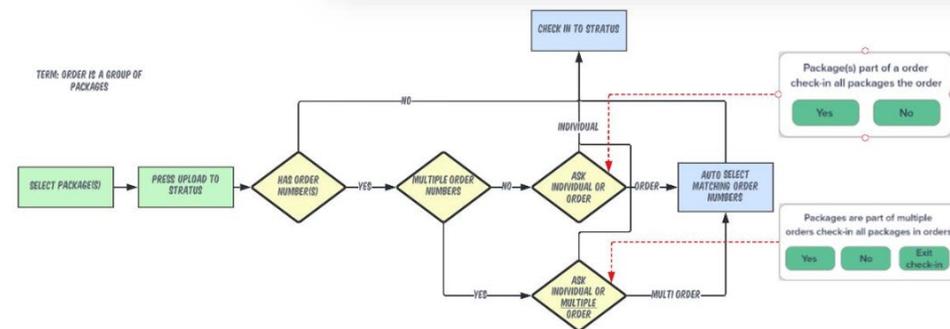
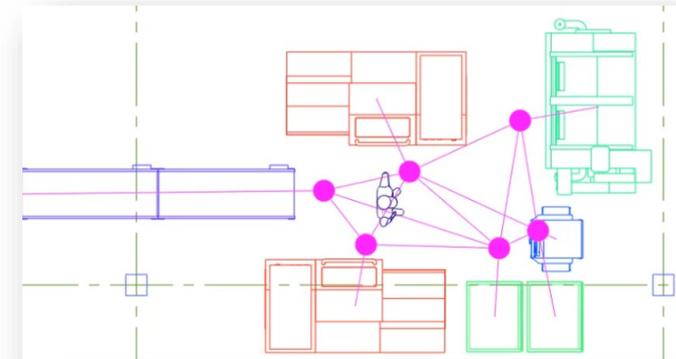
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Procedures – The Scene (Cell or Station Level)

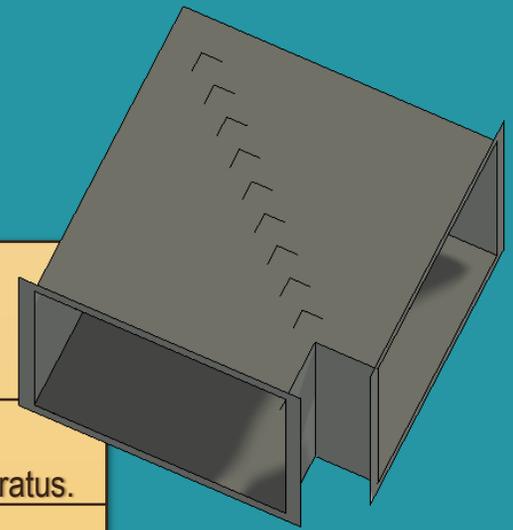
Procedure (Prescriptive) → Provides the **specific steps** and rules for executing a process, including **who does what, when, and how** it should be done. (Scenes)

Focus: Who, What, Where, When, How

- Defines how each step is executed in detail.
- Specifies who does what, when, and how.
- Ensures consistency, compliance, and repeatability.
- Used by field teams & operators for execution and training.



Material Flow Bill Of Process (BOP)



Sequence	Station ID	Process	Work Center	Details
1	Cam	CAM File Creation	VDC	Generate cut files and labels using software like Trimble FabShop or Stratus.
2	PL-1	Plasma Table Cutting	Cutting	Load sheet metal, execute nested cuts for gores and throat/back pieces.
3	PL-1	Labeling & Sorting	Cutting	Parts are labeled and separated based on assembly sequence.
4	F-2	Throat & Back Forming	Forming	Use brake or roller to shape throat and back sections.
5	F-3	Gore Forming	Forming	Roll gores into shape and verify alignment.
6	A-1	Corner Insertion	Corner	Insert corners into duct sections as required.
7	S-2	Pittsburgh Seam Closing	Seal	Form and close Pittsburgh seam on elbow segments.
8	S-1	Sealing	Assembly	Apply duct sealant to seams to ensure airtightness.
9	IN-2	Insulation (if required)	Liner	Line inside with liner board or wrap acoustical insulation.
10	A-4	Final Assembly	Assembly	Assemble all gores, throat, and back to form full elbow.
11	QA-1	Quality Check	QA	Inspect for fit, seal, and completeness.
12	QU-3	Staging for Delivery	Shipping	Place finished elbow on job cart or pallet with labels for field delivery.

6 Steps to Build Repeatable Fab Shop SOP's (with AI)

1. Prep for video capture
 - 4 key areas (Structure)
 - Decide process or procedure
2. Shoot video of the operations (Existing)
3. Review video and create a descriptive transcript
4. Use AI to transform the transcript into a process or SOP
5. Review and approve for publishing
6. Store, organize, and reuse scenes and stories

Director

Cast (Workforce)

Sets / Locations

Props & Wardrobe

Scripts (Instruction Inputs)



Good Layout Goals

- Build a digital twin and planning system (floor plan 🙏)
- Label or code shop location, including queue area
- Optimize shop process areas around high-volume products
- Actively reduce product variation
- Isolate unplanned or disruptive work
- Incrementally increase in control
- Establish an ongoing improvement plan with the workforce

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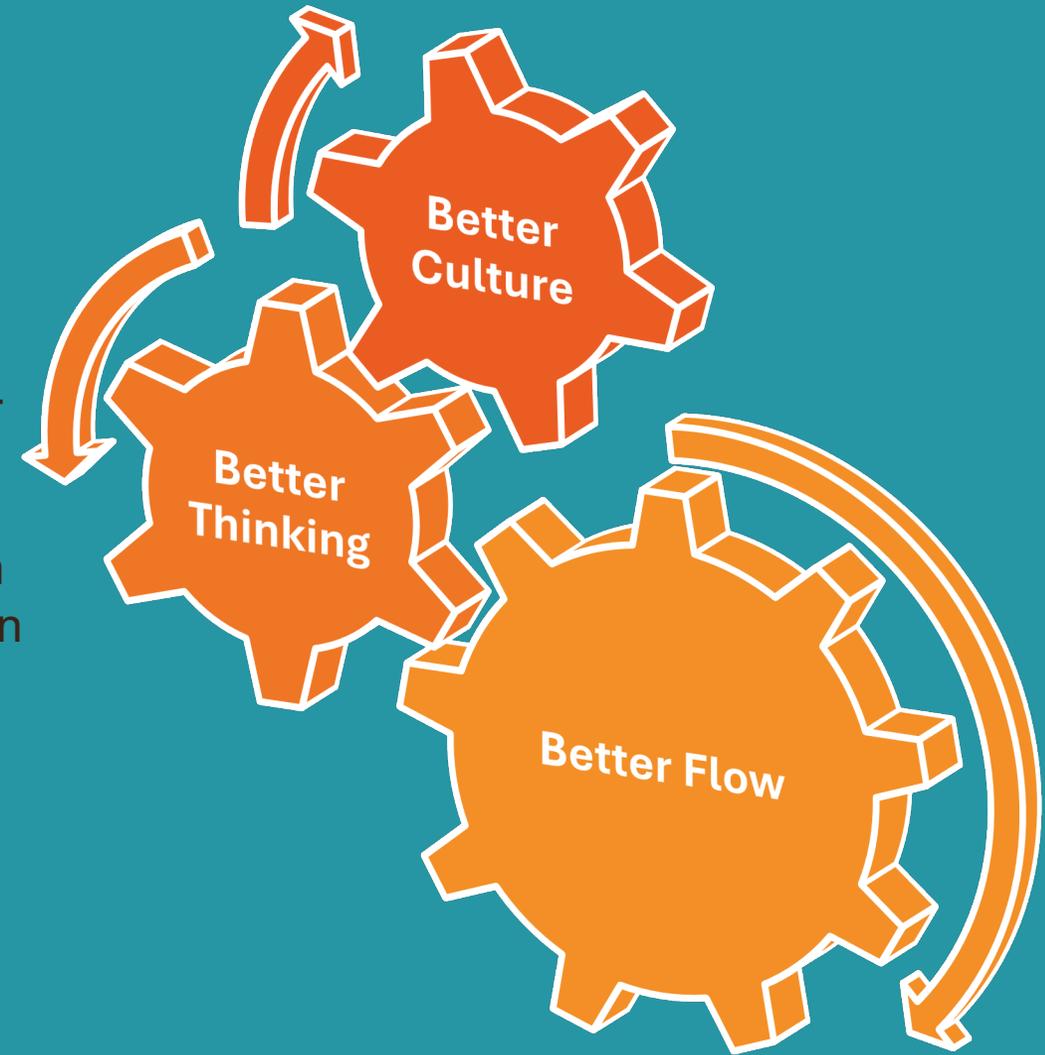
People Are a Pillar - Not a Cog

Every major management system
Lean, TPS, Six Sigma, Agile — says the same thing:
People are a pillar, not a cog

Better Thinking: Workers should be problem solvers, not just button-pushers (60% improvement in problem-solving)

Better Flow: Workers should see the upstream/downstream impact to reduce waste and improve production

Better Culture: Workers should understand the purpose of the work they do — and that drives pride and innovation (35% Drop in Turnover)



“The Toyota Production System is built on two pillars: **Just-in-Time** and **Respect for People.**”

— The Toyota Way, Jeffrey Liker

Chaos to Control Strategy

3P's Layout Strategy

Project Layout - (Fixed Space) – Layout optimizes around a product that has a fixed location or limited mobility. (May nest Product or Process)

Boost production

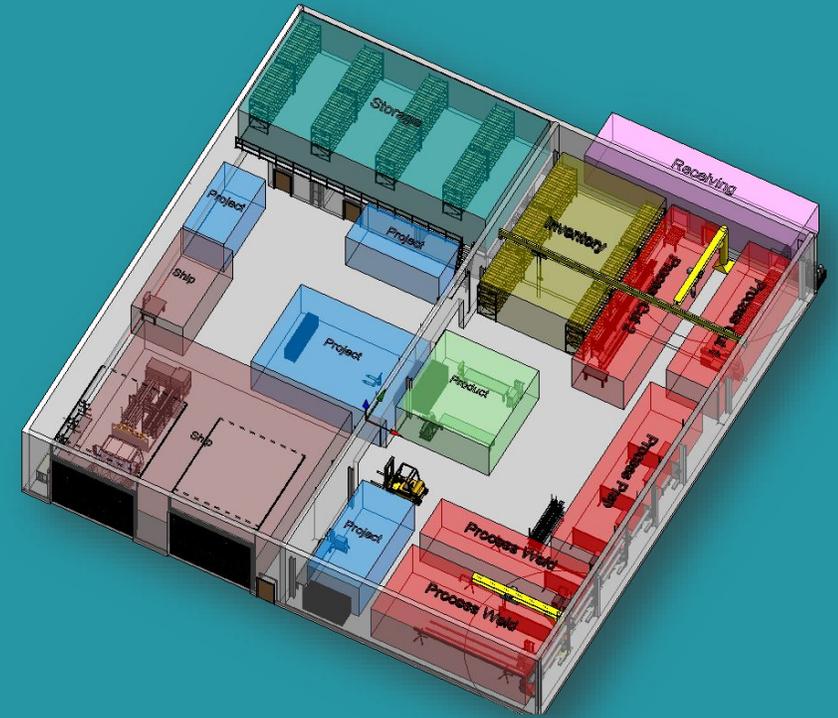
2-5x

Process Layout - Layout optimizes around value added events/operations where the product is variable.

Boost production

5-10x

Product Layout (Cell) – Layout optimizes around value added events/operations where the end product is consistent within a set deviation.



Block/Zones

Project Layout (Incubator)

Product varies widely and may be too large to be moved
Employees' temporary product and process areas

Pros

- Very flexible
- Isolated Does not interrupt process area flow
- Less layout planning and setup time
- Resilient
- **Facilitates training and employee enhancement (value added)**

Cons

- Limited control of everything!!! (labor, materials, flow, safety, etc.)
- High transportation/ handling costs
- Limited equipment and resources
- Limited planning and setup options
- Large volume and variation of processes
- Difficult to determine cycle times and analyze/ simulate processes

Labor

Raw Materials

Tools/Equipment

On Site



Limited Labor

Components
Products

Tools/Equipment

On and Off Site



Process Layout

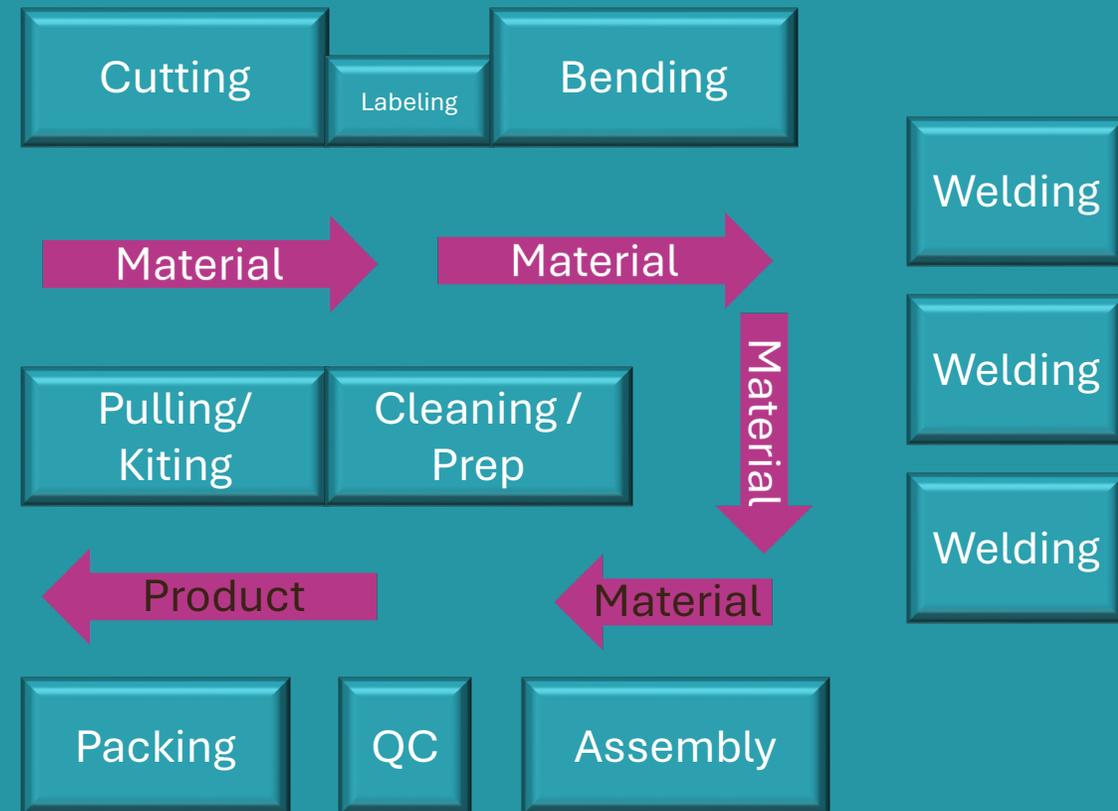
Optimizes around value-added events where the Product is variable

Pros

- Supports large volume fixed equipment
- Boosts Production
- Maximum use of machines
- More flexibility than product spaces
- Simple supervision (vs project space)
- **Maximizes use of specialized skilled workers**

Cons

- Higher down time risks
- Takes up more floor space
- High volume of tool changes
- Multi project scheduling
- Hard to scale



Product Layout (Cell)

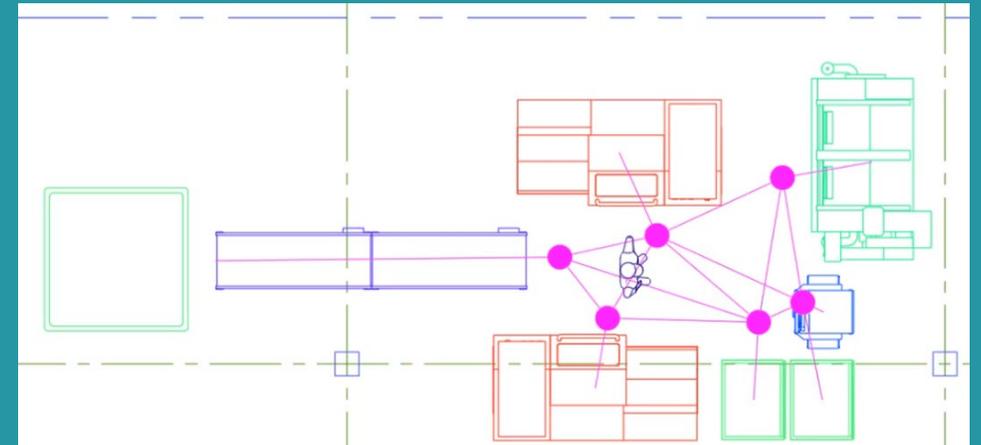
Optimizes around value-added events where the **Product is Consistent/Fixed**.

Pros

- Can be easily simulated and analyzed!!
- Optimize Production Flow
- Minimal optimized footprint
- Minimizes material handling
- Shortest cycle time
- Easy supervision and tracking
- Scalable
- **Maximizes use of unskilled workers**

Cons

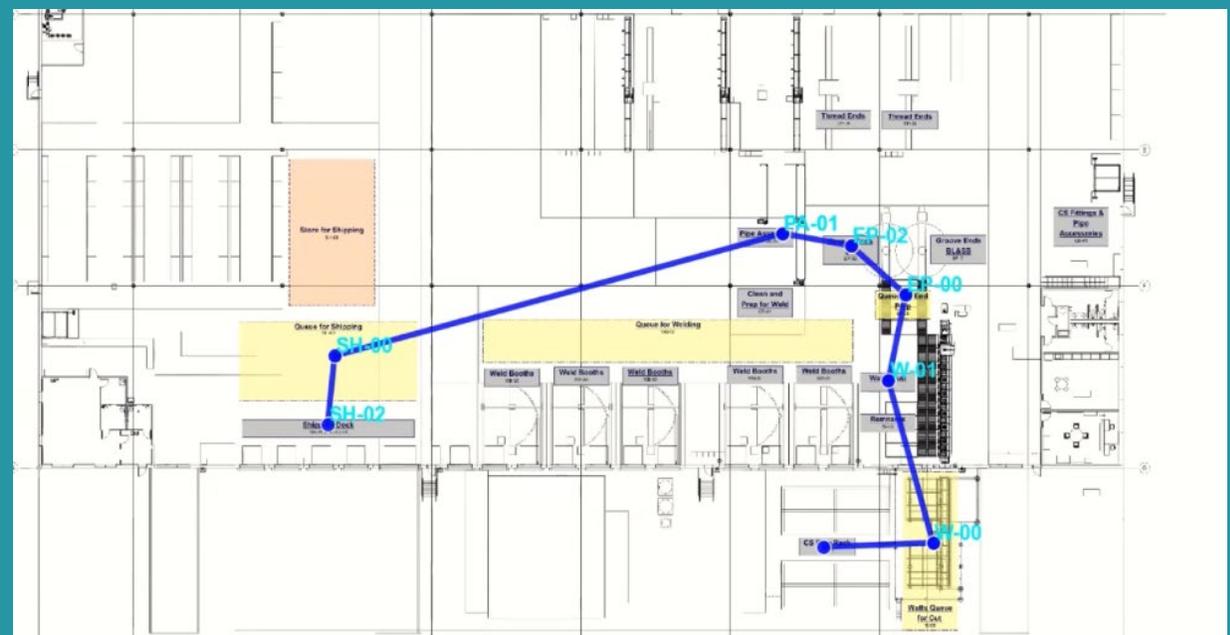
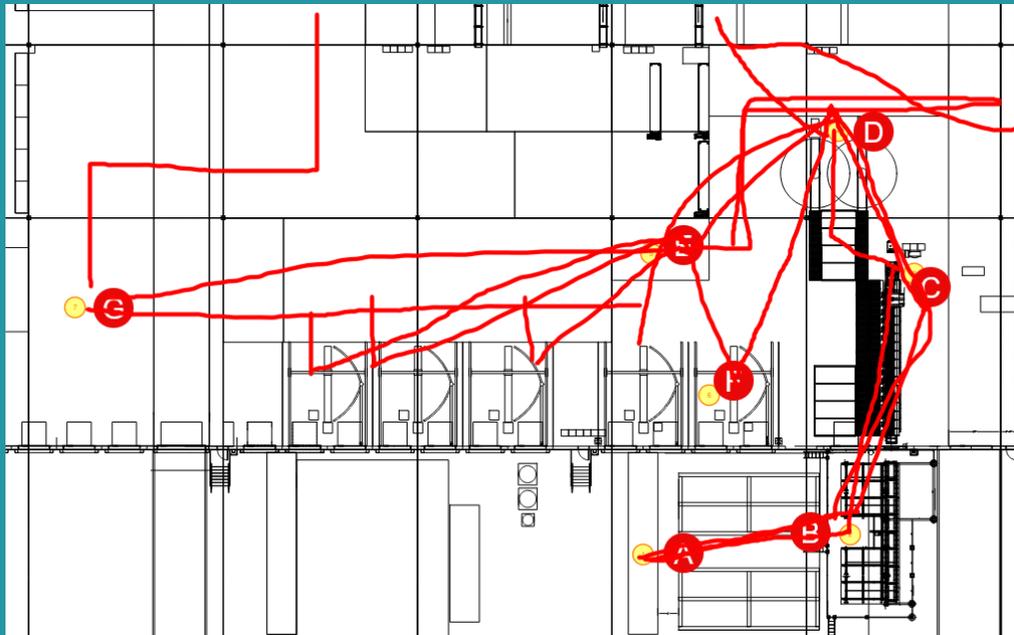
- Rigid system (fragile)
- Volume dependent
- Usually more heavily impacted by supply chain
- Costly layout (equipment, planning)
- **No added value to staff**



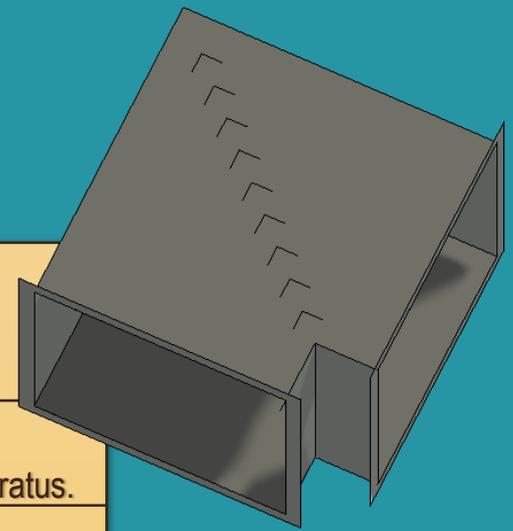
Shop Flow and BOP

Material + Process Produce the best layouts

- No Guessing, just data
- Predict Project and Package durations
- Know where your products are at
- See disruption before it happens
- Understand Project Impact
- Understand downtime impacts



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Bill Of Process Station Volume

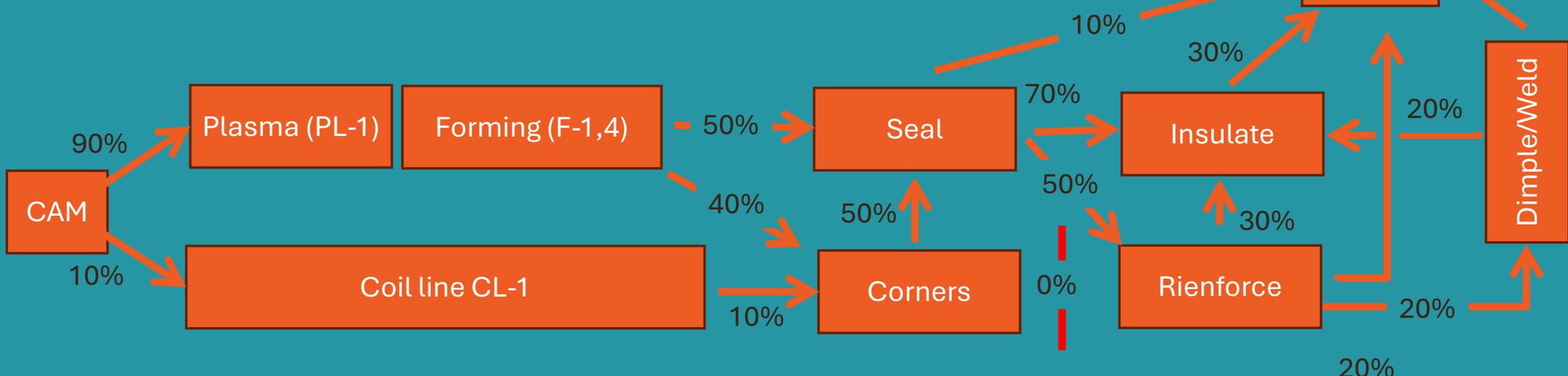
Goal is easy - Highest volumes have the least movement

Fitting	CAM	Coil Line	Plasma	Forming	Corners	Seal	Reinforce	Dimple/Weld	Insulate	QA
Rect. Elbow 90°	X		X	X	X	X			X	X
Straight Duct 60"	X	X			X	X	X		X	X
Pants	X		X	X	X	X	X	X	X	X
Square to Round	X		X	X		X				X
Offset Transition	X		X	X		X			X	X
Radius Elbow	X		X	X		X	X	X		X
Drop Cheek Elbow	X		X	X	X	X			X	X
Double Wall Duct	X		X	X	X	X	X		X	X
Boot Offset	X		X	X		X	X	X		X
End Cap with Tap	X		X	X		X		X	X	X
Volume:	100% S	100% ST	100% ST	90%	50%	100%	50%	40%	70%	100% E
Has Que	N	N	N	Y	Y	Y	Y	Y	Y	

Que to Ship

QA

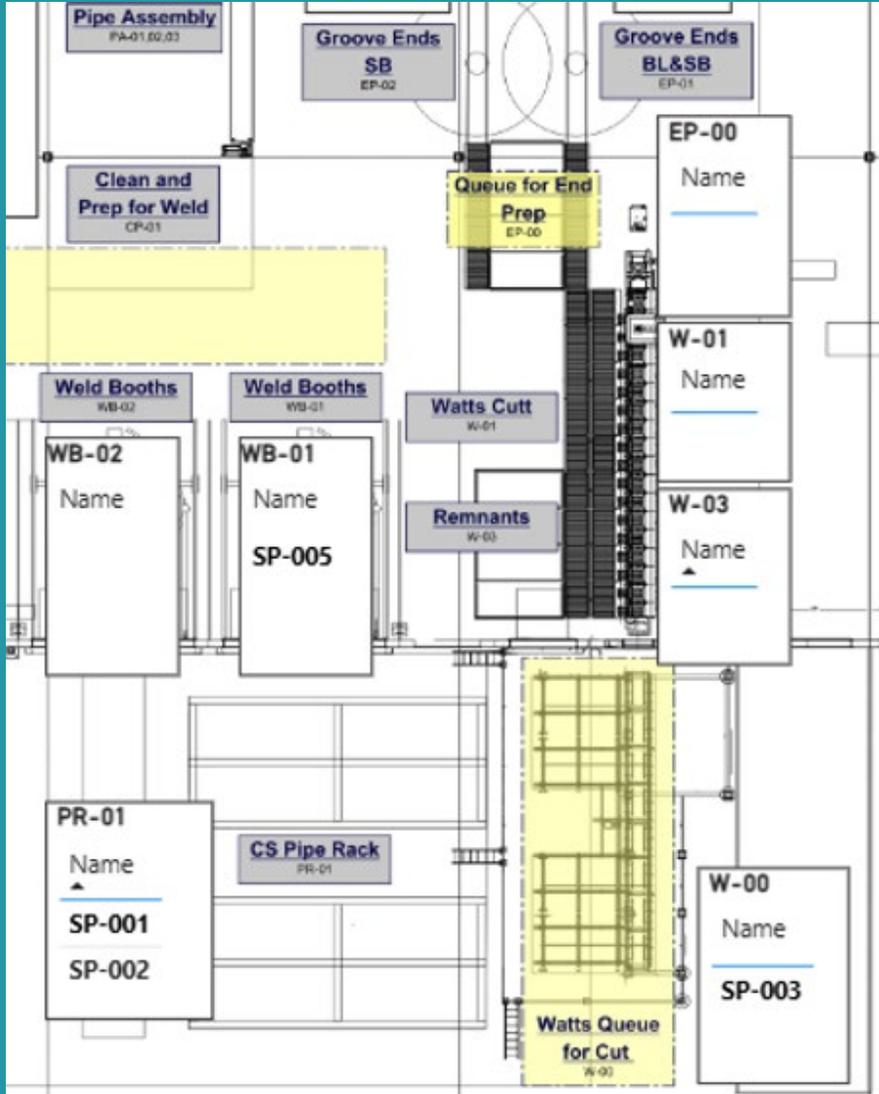
Dimple/Weld



Shop Dashboard



BINSKY



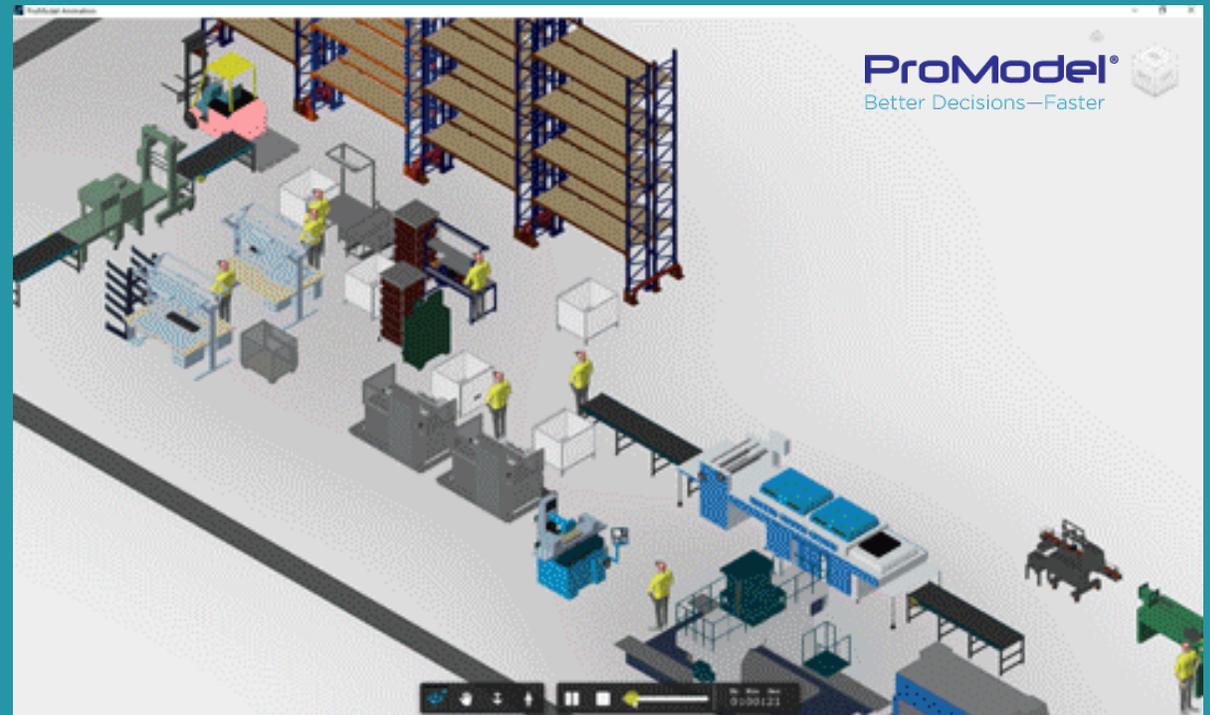
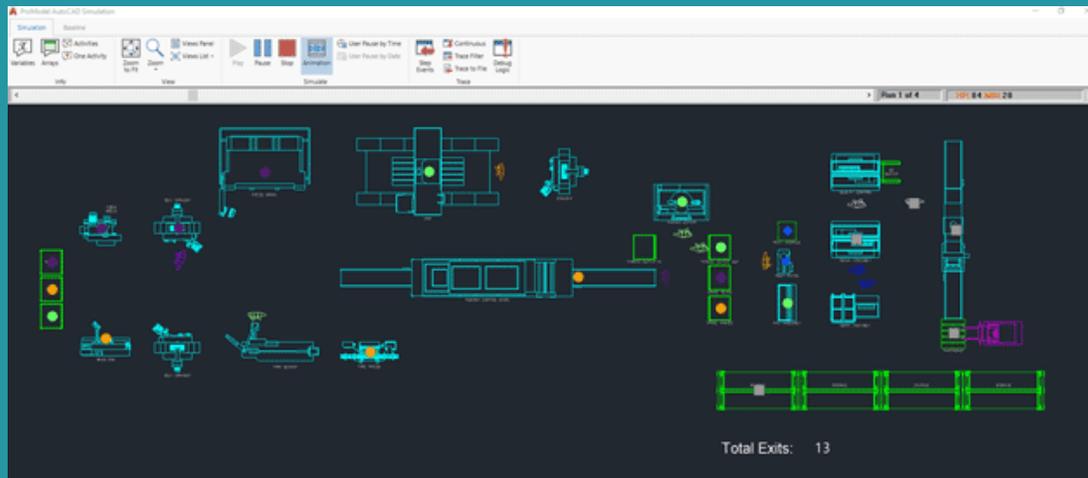
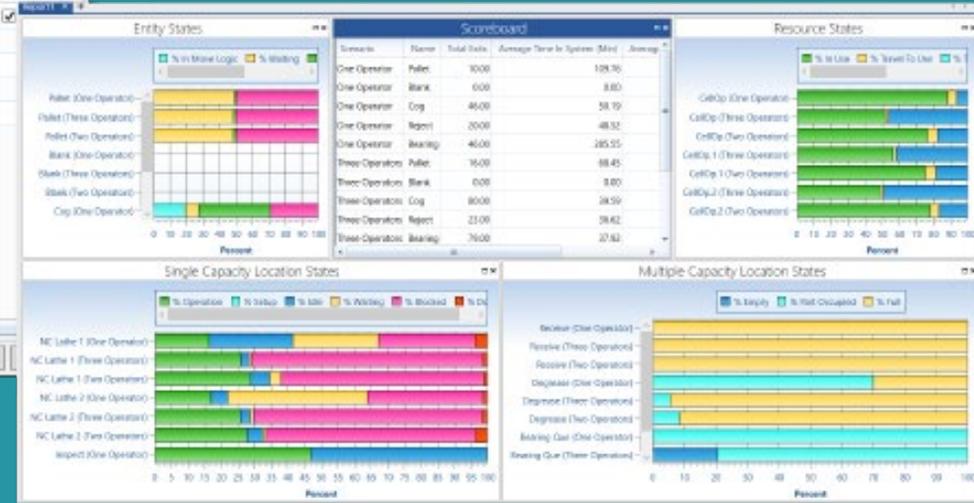
Shop Simulation

Simulations can be nested
Simulations can be updated with time studies.
Simulations can be templated

Projections on:

- Times
- Throughput
- Labor
- Material handling
- Ergonomics
- Automation
- Robotics

Parameters	Baseline	One Operator	Two Operators	Three Operators
Simulate Scenario?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Last Simulation Run				
Number_of_Operators	1	1	2	3
Cost_per_CellOperator	20	20	20	20
Cost_per_Machine	20	20	20	20



Cell or Station Stats (12 Point)

Cycle Time	Time to process one unit (including value-adding and non-value-adding steps).
Volume / Mix	How many and what types of fittings pass through? (Volume + variation)
Sequence Position	What comes before and after this station? Can it handle branching logic (e.g. insulation only on some parts)?
Queue In / Out	Buffer size, WIP limits, and FIFO discipline. Important for Lean flow control.
Touch Time vs. Wait Time	Shows non-value-added time and bottlenecks. Tracked via Value Stream Mapping.
Floor Space / Layout Footprint	Space needed for equipment, material flow, operator movement, and WIP.
Accessibility / Ergonomics	Operator access, safety zones, visual management, motion waste.
Operator Skill Level and Number	Number of operators, Required certifications, training, or manual skill to operate.
Defect Rate / Quality Metrics	% of units reworked or rejected. Supports Six Sigma defect tracking.
Utility Requirements	Electrical, compressed air, HVAC. Used during cell move/expansion planning.
Machine Uptime / Downtime	For preventive maintenance scheduling and uptime efficiency.
Changeover Time	Time to switch from one work type or order to another. Critical for flexible cells.