Senior Project

Line Reconfiguration L-31 Vicryl Regular and Plus

Ethicon Inc.

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Background

Johnson & Johnson's mass production of sterile sutures and other products ushered in the widespread practice of modern antiseptic surgery that dramatically raised survival rates.

Heat Tipping

A heat tipping process is needed to facilitate inserting the sutures into the barrel ends of a surgical needle.

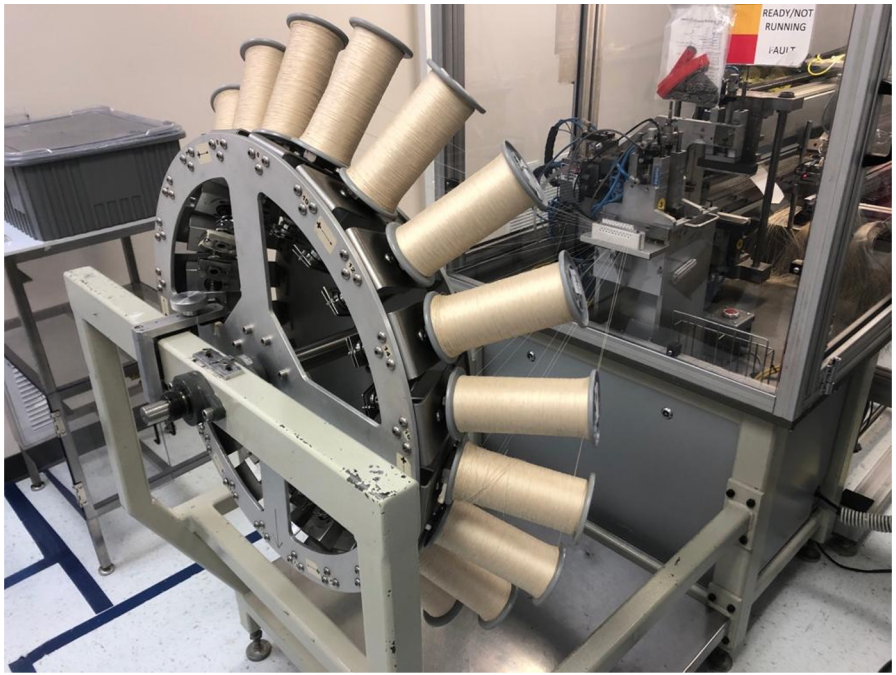
The process begins with tensioning the suture. Then, heating the suture and releasing the tension of the suture. By releasing the tension and cutting the portion of the suture it creates a heat tipped end.

Line 31 (L-31 Vicryl)

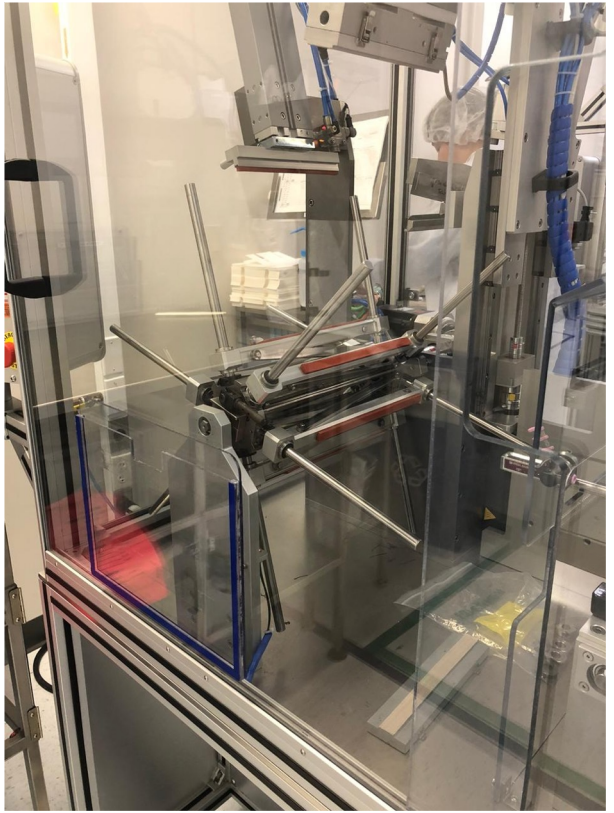
The production L-31 Vicryl Regular and Plus are known as Heat Tipping.

- Apply the requirements and parameters for the tipping process using heat and cut for sutures Vicryl and Vicryl plus.
- Three different designs of machines used in L-31
    - VHTU: Vicryl Heat Tip and Cut
    - BHTU: Brazilian Heat Tip and Cut
    - EHTU: Expandable Heat Tip and Cut
- Currently Regular Vicryl has five machines and Vicryl Plus 4 machines

Machine VHTC (Vicryl)



Machine EHTC (Expandable)



Machine BHTC (Brazilian)

Main Technical Problem

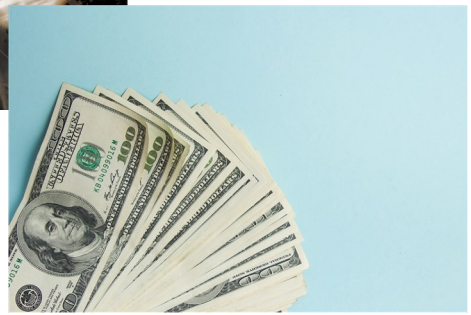
- Three new machines arriving
  - Two for Regular Vicryl and one for Vicryl plus
  - Actualize layout for both areas
  - Decide which machine is optimal for best production
  - Optimize layout with the three new machines included

Project Objective

1. Improve the layout of production line 31
2. Increase production from 1.8 million threads per week to 2.5 million threads.

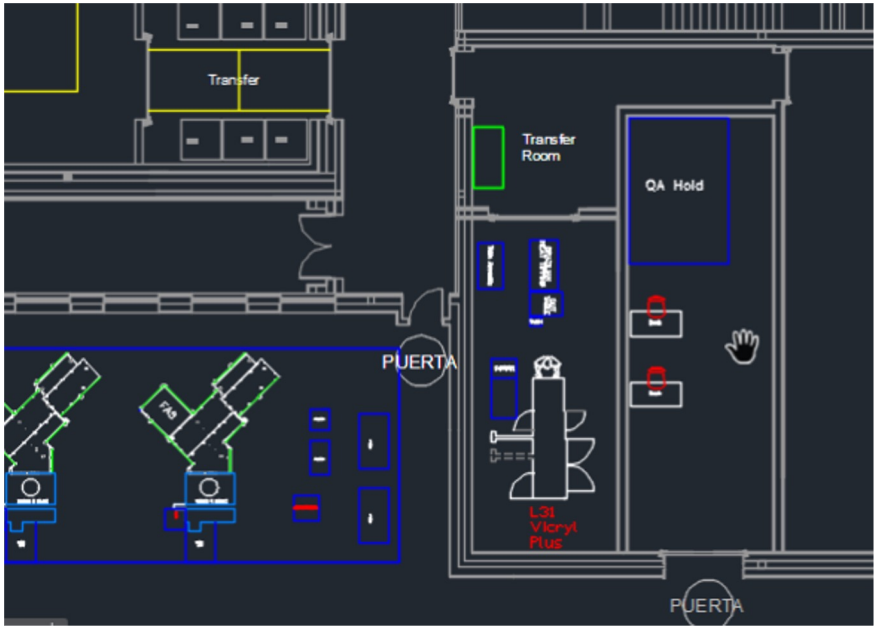
Project Constraints

1. Available space for the new machines.
2. Limit Time.
3. Unclear cost/budget.
4. Outdated layout

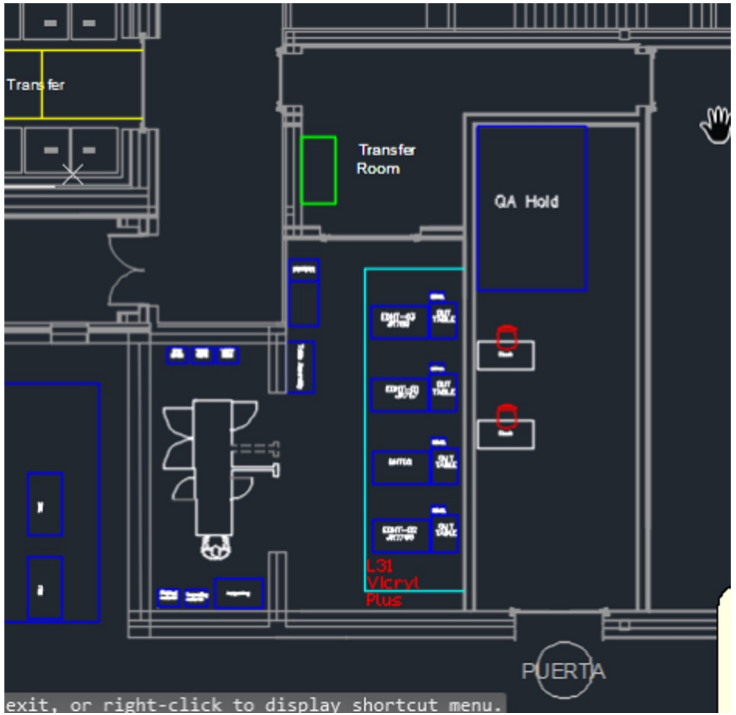


Updating the Layout

Before

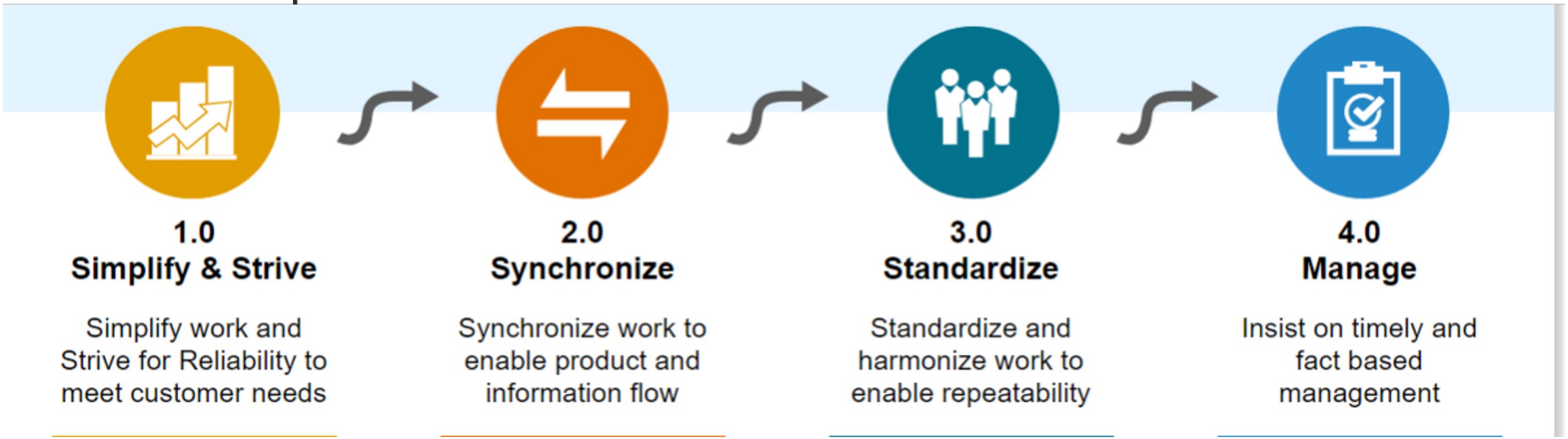


After



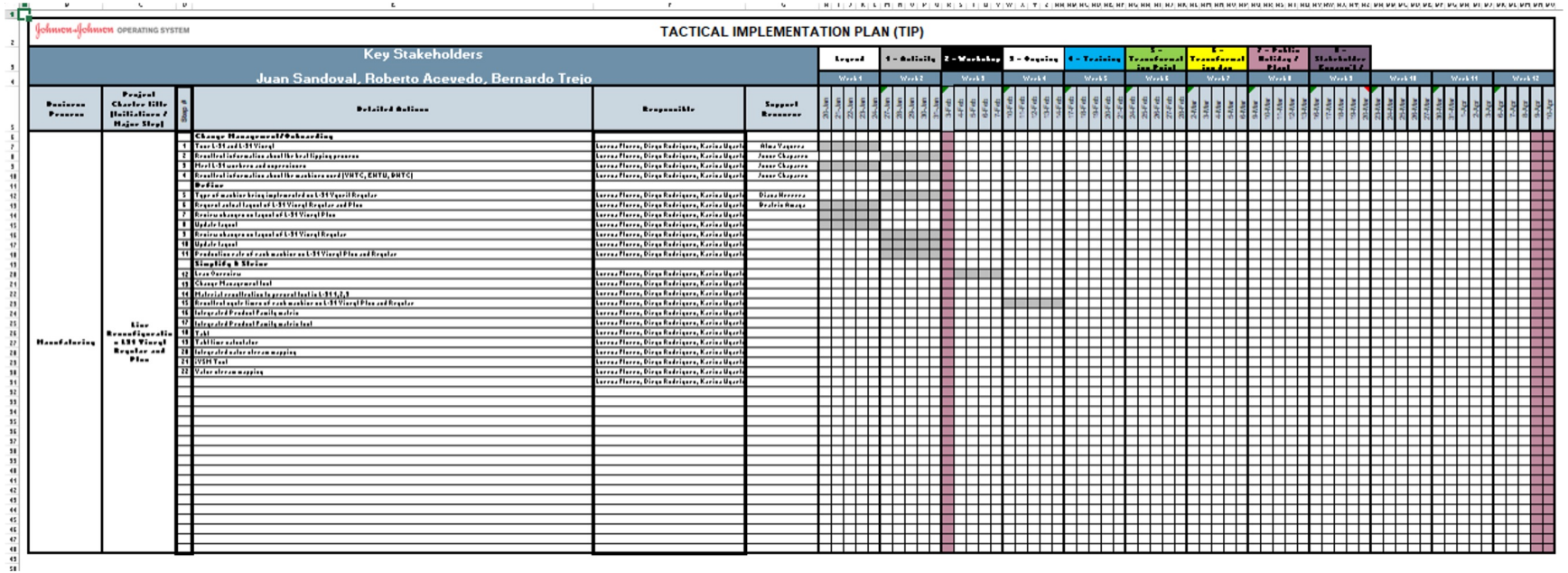
Methodology

Lean is a key foundational element for JJOS, and this knowledge center is centered around building those foundational capabilities.



Methodology

A Tactical Implementation Plan (TIP)



Johnson & Johnson OPERATING SYSTEM

TACTICAL IMPLEMENTATION PLAN (TIP)

Key Stakeholders

Juan Sandoval, Roberto Acevedo, Bernardo Trejo

Legend: 1 – Activity | 2 – Workshop | 3 – Ongoing | 4 – Training | 5 – Transformation Point | 6 – Transformation | 7 – Public Holiday / Break | 8 – Stakeholder Engagement

Business Process	Project Charter title Initiatives / Major Steps	Step #	Detailed Actions	Responsible	Support Resources
			Change Management/Onboarding		
		1	Train L-31 and L-31 Viscyl	Larrea Flores, Diego Rodriguez, Karina Ugarte	Alma Vazquez
		2	Broadcast information about the bed tipping process	Larrea Flores, Diego Rodriguez, Karina Ugarte	Juan Chaparro
		3	Meet L-31 members and supervisors	Larrea Flores, Diego Rodriguez, Karina Ugarte	Juan Chaparro
		4	Broadcast information about the machines used (VHTC, EHTU, DHTC)	Larrea Flores, Diego Rodriguez, Karina Ugarte	Juan Chaparro
			Define		
		5	Type of machine being implemented on L-31 Viscyl Regular	Larrea Flores, Diego Rodriguez, Karina Ugarte	Diana Herrera
		6	Request actual layout of L-31 Viscyl Regular and Plus	Larrea Flores, Diego Rodriguez, Karina Ugarte	Beatriz Nunez
		7	Receive changes on layout of L-31 Viscyl Plus	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		8	Update layout	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		9	Receive changes on layout of L-31 Viscyl Regular	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		10	Update layout	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		11	Production rate of each machine on L-31 Viscyl Plus and Regular	Larrea Flores, Diego Rodriguez, Karina Ugarte	
			Simplify & Shrink		
		12	Lean Overview	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		13	Change Management tool	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		14	Material reutilization by general tool in L-31 1,2,3	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		15	Broadcast cycle times of each machine on L-31 Viscyl Plus and Regular	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		16	Integrated Product Family matrix	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		17	Integrated Product Family matrix tool	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		18	TAKT	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		19	TAKT time calculator	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		20	Integrated value stream mapping	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		21	iVSM Tool	Larrea Flores, Diego Rodriguez, Karina Ugarte	
		22	Value stream mapping	Larrea Flores, Diego Rodriguez, Karina Ugarte	
Manufacturing	Line Reconfiguration L31 Viscyl Regular and Plus				

1.0 Simplify and Strive

- Lean Overview
- Change Management tool
- Material recollection to present tool in L-31 1,2,3
- Recollect cycle times of each machine on L-31 Vicryl Plus and Regular
- Integrated Product Family matrix
- Takt calculation
- Integrated value stream mapping

Integrated Product Family Matrix

Is a technique intended to group all activities in the value stream considering not only productivity (cost) but also safety and quality.

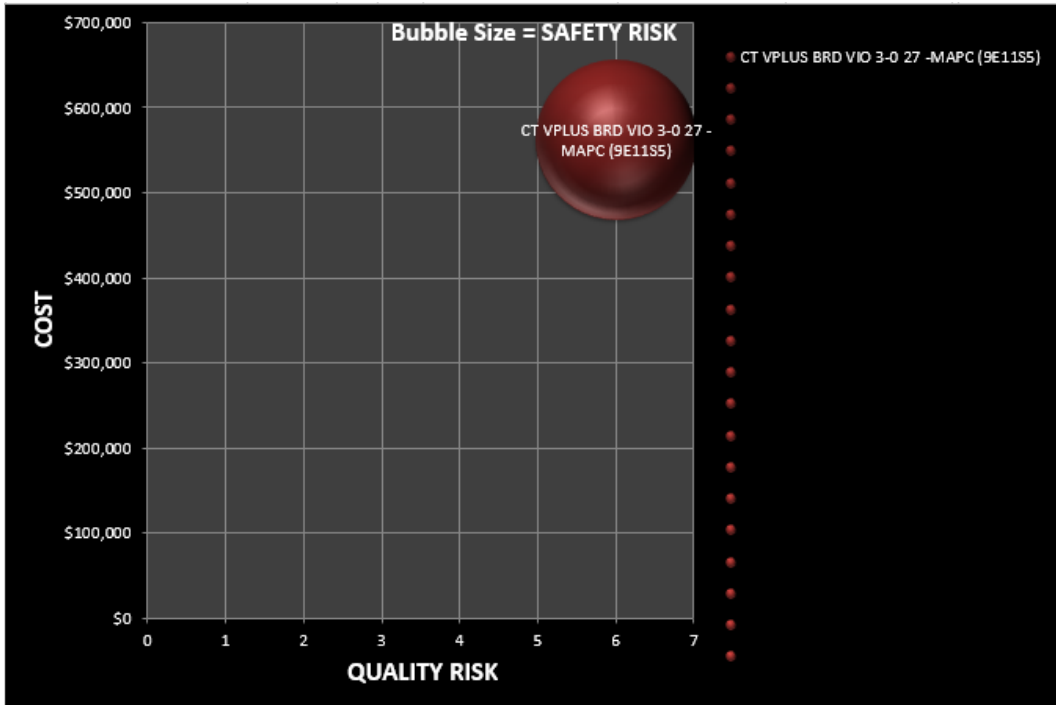
Value Streams		Manufacturing Process Information									SAFETY			
Site	Value Stream Name / Description	Description									18 Month Totals			
		Diameters							User Defined	User Defined	SIIC	LWD	Recordable Incident	First Aid Incident
		Process Number / Identifier												
		*0	*1	*2	*2-0	*3-0	*4-0		User Defined	User Defined				
9E3127	VCL+ CT UD USP0 27IN H/TIP S/E BRD SUT-MAPC	x												
9E1137A	VCL+ CT VIO USP0 36IN H/TIP S/E BRD SUT-ATHENS	x												
9E1247A	VCL+ CT VIO USP0 54IN H/TIP D/E BRD SUT-ATHENS	x												
9E1247	CT VPLUS BRD VIO 0 54 MAPC	x												
9E11G7A	VCL+ CT VIO USP0 43IN H/TIP S/E BRD SUT-ATHENS	x												
9E3247	CT VPLUS BRD UD 0 54 -MAPC	x												
9E1648	VCL+ CT VIO USP1 60IN H/TIP D/E BRD SUT		x											
9E3138	CT VPLUS BRD UD 1 36 -MAPC		x											
9E16L8	VCL+ CT VIO USP1 40IN H/TIP D/E BRD SUT		x											
9E3118	CT VPLUS BRD UD 1 18 -MAPC		x											
9E3128	VCL+ CT UD USP1 27IN H/TIP S/E BRD SUT-MAPC		x											
9E1248	CT VPLUS BRD VIO 1 54 -MAPC		x											
9E1118	CT VPLUS BRD VIO 1 18 -MAPC		x											
9E1628	VCL+ CT VIO USP1 48IN H/TIP D/E BRD SUT		x											
9E1138	CT VPLUS BRD VIO 1 36 -MAPC		x											
9E1128	VCL+ CT VIO USP1 27IN H/TIP S/E BRD SUT-MAPC		x											

Integrated Product Family Matrix (cont.)

Value Streams		QUALITY						VOLUME (units)					
		18 Month Totals											
Site	Value Stream Name / Description	Field Actions	Complaints	CAPAs	Near		Quality Score	% Volume	Cum. % Volume	Annual Volume	Avg. Cost per piece (USD $)	% Cost	
9E3127	VCL+ CT UD USP0 27IN H/TIP S/E BRD SUT-MAPC						0	0.9%	0.9%	58,815	$ 0.30	0.9%	
9E1137A	VCL+ CT VIO USP0 36IN H/TIP S/E BRD SUT-ATHENS						0	0.2%	1.2%	14,213	$ 0.29	0.2%	
9E1247A	VCL+ CT VIO USP0 54IN H/TIP D/E BRD SUT-ATHENS						0	0.9%	2.1%	58,302	$ 0.29	0.9%	
9E1247	CT VPLUS BRD VIO 0 54 MAPC						0	0.0%	2.1%	-	$ 0.29	0.0%	
9E11G7A	VCL+ CT VIO USP0 43IN H/TIP S/E BRD SUT-ATHENS						0	0.1%	2.2%	4,650	$ 0.29	0.1%	
9E3247	CT VPLUS BRD UD 0 54 -MAPC						0	1.3%	3.4%	80,710	$ 0.30	1.2%	
9E1648	VCL+ CT VIO USP1 60IN H/TIP D/E BRD SUT						0	0.4%	3.8%	24,898	$ 0.38	0.5%	
9E3138	CT VPLUS BRD UD 1 36 -MAPC						0	7.5%	11.3%	469,640	$ 0.44	10.2%	
9E16L8	VCL+ CT VIO USP1 40IN H/TIP D/E BRD SUT						0	0.3%	11.6%	16,822	$ 0.26	0.2%	
9E3118	CT VPLUS BRD UD 1 18 -MAPC						0	1.3%	12.9%	82,538	$ 0.44	1.8%	
9E3128	VCL+ CT UD USP1 27IN H/TIP S/E BRD SUT-MAPC						0	5.9%	18.8%	370,404	$ 0.44	8.0%	
9E1248	CT VPLUS BRD VIO 1 54 -MAPC						0	0.6%	19.4%	36,097	$ 0.38	0.7%	
9E1118	CT VPLUS BRD VIO 1 18 -MAPC						0	1.0%	20.3%	60,259	$ 0.38	1.1%	
9E1628	VCL+ CT VIO USP1 48IN H/TIP D/E BRD SUT						0	0.0%	20.3%	1,967	$ 0.26	0.0%	
9E1138	CT VPLUS BRD VIO 1 36 -MAPC						0	12.7%	33.1%	799,052	$ 0.38	15.1%	
9E1128	VCL+ CT VIO USP1 27IN H/TIP S/E BRD SUT-MAPC						0	5.0%	38.0%	311,815	$ 0.38	5.9%	

Value Stream Matrix | Chart Data

Integrated Product Family Matrix (cont.)



The only riskful option to produce is 9E11S5

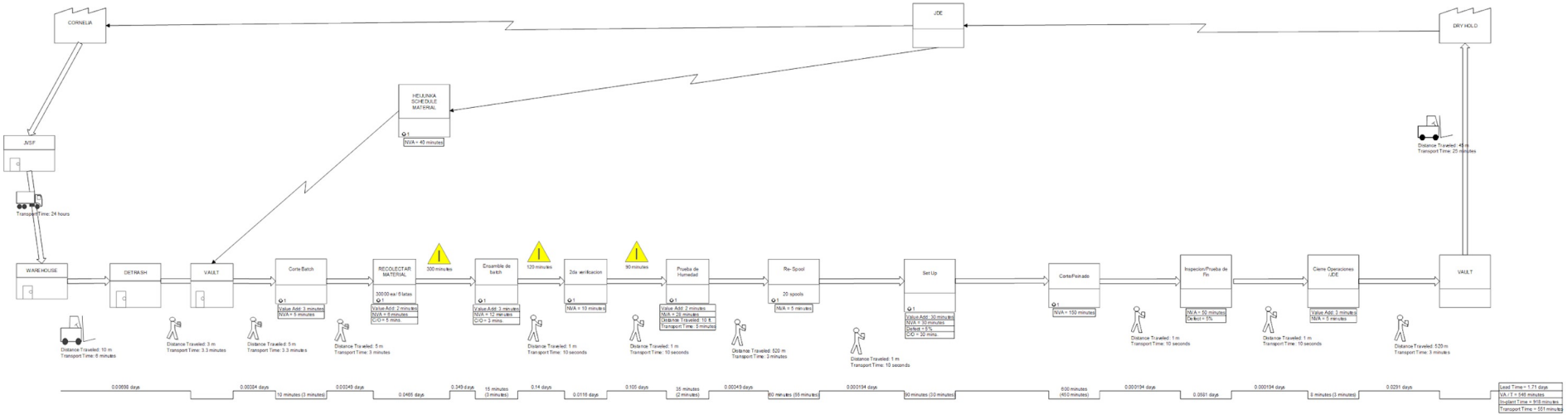
Takt Calculation

How often a piece must be produced to meet customer demand.

$$\text{takt} = \frac{\text{available time}}{\text{client demand}}$$

$$\text{takt} = \frac{17.75 \text{ hours per day}}{0.5 \text{ million threads per day}} = \frac{63900 \text{ seconds}}{500000 \text{ threads}} = 0.1278 \text{ seconds}$$

Integrated Value Stream Mapping



Machine Capacities Comparison

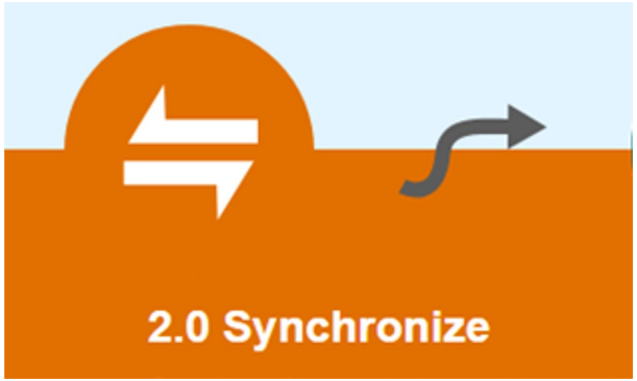
Shift	Time (hr)	Real Time for VHTC (hr)	Real Time for (EHTC)		Performance machine	
1	9.5	7	8		100%	
2	8.25	5.75	6.75			

	std per hr VHTC 3025	std per hr EHDT 5100
Total 1st shift	21175	40800
Total 2nd shift	17393	34425

Shift	Process	Machines	Prod x day	% Waste	Wk	
1st	VHTC	2	42350	10%	190575	
	EDHT	1	40800	5%	193800	EHDT is best
2nd	VHTC	2	34786	10%	156537	
	EDHT	1	34425	5%	163518	EHDT is best

2.0 Synchronize

- Create product Flow
- Product process flow improvement
- Create a draft layout
- Activity of Operator
- Critical Zone Map
- Start preparation on changeover process
- Implement machines in L-31 Regular
- Make necessary adjustments
- Do some trial runs and compare production



Activity of Operator

Activity of Operator - Data Collection

Site	0				Seconds (Op)	Seconds (Mch)	Seconds (NLNM)		Improve / Eliminate	Future Time
Value Stream	0	Target Takt								
Product Family	0	#¡DIV/0!	sec							
Assessor	0									
Package Rev.	0									
Operator	Restart	Work Element	End	Code	Secs	Mach	NLNM			
	16:00:00	Inspection	16:00:10	I	10				Improve	
	16:00:10	Walk	16:00:14	WK	4					
	16:00:15	Inspection	16:00:40	I	25					
	16:00:40	Walk	16:00:42	WK	2					
	16:00:42	Walk	16:00:52	WK	10					
	16:00:52	LazerMike	16:01:04	P	12					
	16:01:04	Walk	16:01:18	WK	14					
	16:01:18	Getting Material	16:01:46	MH	28					
	16:01:46	Set-Up	16:03:42	O	116					
	16:03:42	Reespool	16:54:10	O	###				Improve	

Activity of Operator cont.

Seq	Work Element (smallest increment of work that could be moved to another person)		Separate observations of the same process										Cycle Time		
			1	2	3	4	5	6	7	8	9	10	Min	Max	Avg
1	Inspection	Start Time	14:00:00	14:00:30	14:01:00	14:02:00	14:02:40	14:03:20	14:04:10	14:05:40	14:06:30	14:07:30			
		End Time	14:00:10	14:00:40	14:01:10	14:02:10	14:02:50	14:03:30	14:04:20	14:05:50	14:06:40	14:07:40			
		Elapsed Time	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10
2	Walk	Start Time	14:00:10	14:00:40	14:01:10	14:02:10	14:02:50	14:03:30	14:04:20	14:05:50	14:06:40	14:07:40			
		End Time	14:00:14	14:00:44	14:01:14	14:02:14	14:02:54	14:03:34	14:04:24	14:05:54	14:06:44	14:07:44			
		Elapsed Time	0:00:04	0:00:04	0:00:04	0:00:04	0:00:04	0:00:04	0:00:04	0:00:04	0:00:04	0:00:04	0:00:04	0:00:04	0:00:04
3	Inspection	Start Time	14:00:14	14:00:44	14:01:14	14:02:14	14:02:54	14:03:34	14:04:24	14:05:54	14:06:44	14:07:44			
		End Time	14:00:39	14:01:09	14:01:39	14:02:39	14:03:19	14:03:59	14:04:49	14:06:19	14:07:09	14:08:09			
		Elapsed Time	0:00:25	0:00:25	0:00:25	0:00:25	0:00:25	0:00:25	0:00:25	0:00:25	0:00:25	0:00:25	0:00:25	0:00:25	0:00:25
4	Walk	Start Time	14:00:39	14:01:09	14:01:39	14:02:39	14:03:19	14:03:59	14:04:49	14:06:19	14:07:09	14:08:09			
		End Time	14:00:49	14:01:19	14:01:49	14:02:49	14:03:29	14:04:09	14:04:59	14:06:29	14:07:19	14:08:19			
		Elapsed Time	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10
5	Walk	Start Time	14:00:49	14:01:19	14:01:49	14:02:49	14:03:29	14:04:09	14:04:59	14:06:29	14:07:19	14:08:19			
		End Time	14:00:59	14:01:29	14:01:59	14:02:59	14:03:39	14:04:19	14:05:09	14:06:39	14:07:29	14:08:29			
		Elapsed Time	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10
6	LazerMike	Start Time	14:00:59	14:01:29	14:01:59	14:02:59	14:03:39	14:04:19	14:05:09	14:06:39	14:07:29	14:08:29			
		End Time	14:01:09	14:01:39	14:02:09	14:03:09	14:03:49	14:04:29	14:05:10	14:06:49	14:07:39	14:08:39			
		Elapsed Time	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:10	0:00:01	0:00:10	0:00:10	0:00:10	0:00:01	0:00:10	0:00:09

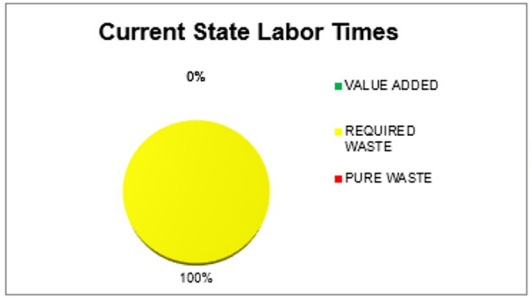
Activity of Operator cont.

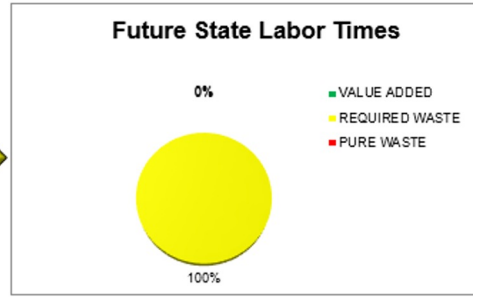
Activity of Operator Summary

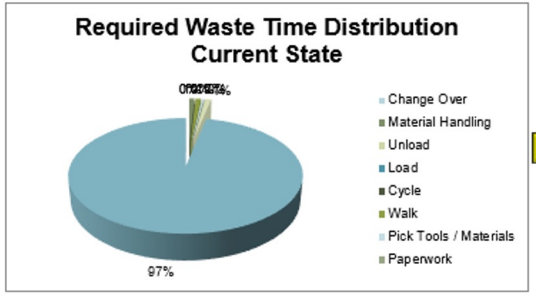
		Labor Times				
		CURRENT		FUTURE		
		TIME	PERCENT	TIME	PERCENT	T CHANGE
LABOR	VALUE ADDED		0%		0%	
	REQUIRED WASTE	48735	100%	1425	100%	97%
	PURE WASTE		0%		0%	
	TOTAL in seconds	48735		1425		
	TOTAL in hours	14		0		
	TOTAL in days	1		0		

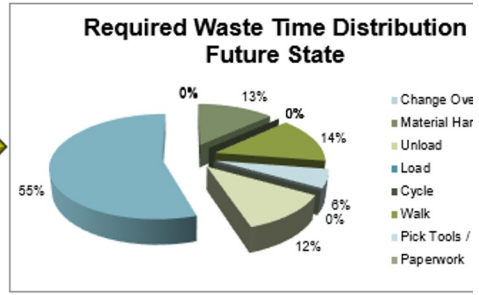
		CURRENT		FUTURE		
		TIME	PERCENT	TIME	PERCENT	PERCENT
REQUIRED WASTE	Change Over		0%		0%	
	Material Handling	420	1%	420	13%	0%
	Unload		0%		0%	
	Load		0%		0%	
	Cycle		0%		0%	
	Walk	450	1%	450	14%	0%
	Pick Tools / Materi	180	0%	180	6%	0%
	Paperwork		0%		0%	
	Inspection	525	1%	375	12%	29%
	Other	47160	97%	1740	55%	96%
	Waste		0%		0%	
	TOTAL	48735		3165		

Select Work Station:
Entire Process









Activity of Operator cont.

Activity of Operator - Current State

Site	0
Value Stream	0
Product Famil	0
Assessor	0
Package Rev.	0

Seq	WS	Work Element	Time					Comments & Ideas	Op	Incidental										
			V	RW	IT	Mach	NLNM			CO	MW	C	PW	L	U	I	WK	P	O	W
		Totals		###							28					35	38	12	3144	
1		Inspection		10												10				
2		Walk		4													4			
3		Inspection		25												25				
4		Walk		2													2			
5		Walk		10													10			
6		LaserMike		12														12		
7		Walk		14													14			
8		Getting Material		28							28									
9		Set-Up		116															116	
10		Reespool		##															#	
11																				
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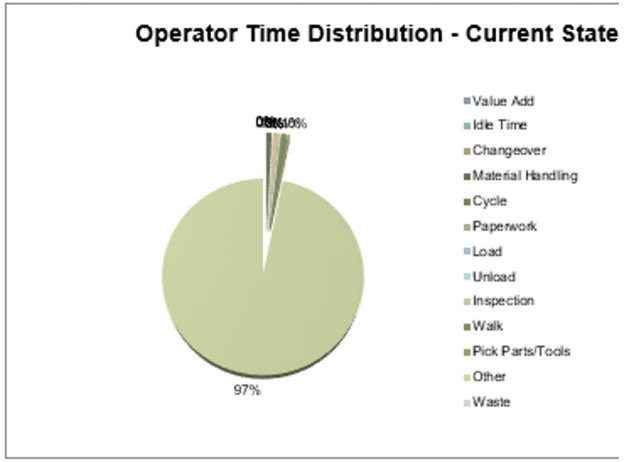

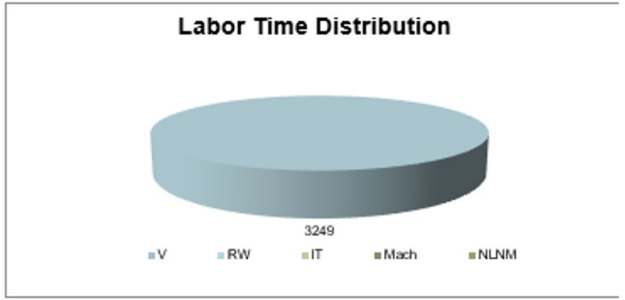

Activity of Operator cont.

Value Stream	0
Product Fami	0
Assessor	0
Package Rev	0

Seq	WS	Work Element	Time: V	Time: RW	Time: IT	Time: Mach	Time: NLNM	Comments & Ideas	Operator: Op	Required Waste: Changeover CO	Material Han MH	Cycle C	Paperwork PW	Load L	Unload U	Inspection I	Walk WK	Pick Parts/Tc P	Other O	Waste W
		Totals		95							28					25	30	12	116	
1		Inspection																		
2		Walk		4													4			
3		Inspection		25												25				
4		Walk		2													2			
5		Walk		10													10			
6		LazerMike		12														12		
7		Walk		14													14			
8		Getting Material		28							28									
9		Set-Up																	116	
10		Reespool																		
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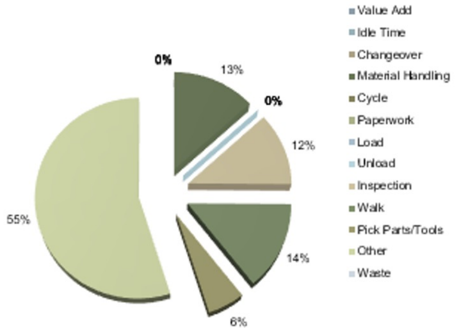
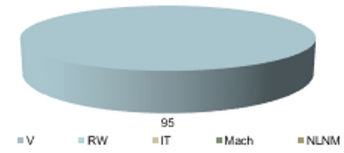


Labor Time Distribution



3.0 Standardize

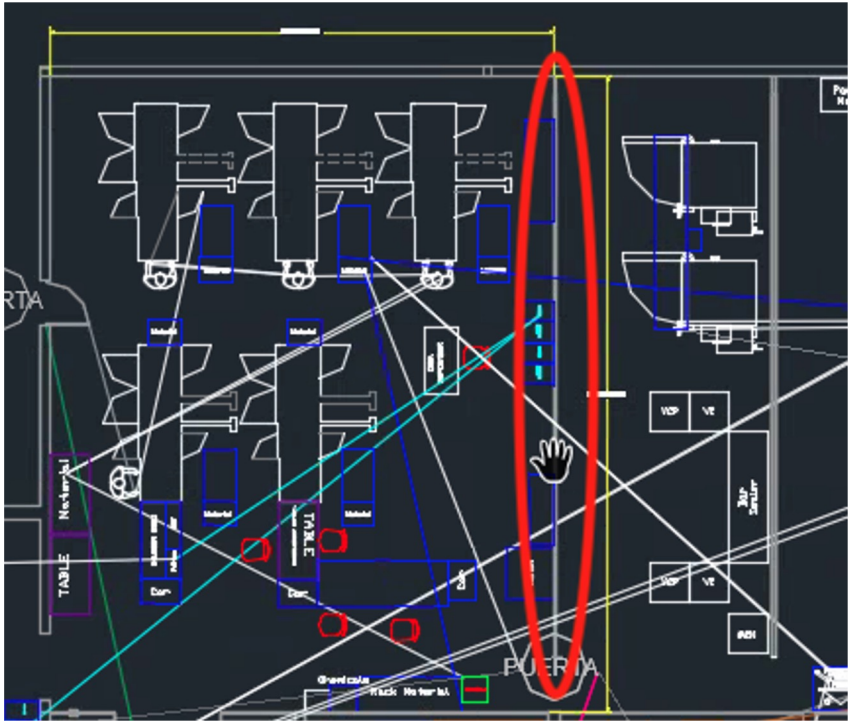
- Pilot initial proposals
- Validations
- Implement Proposals

Proposals

1. Remove aluminum wall in L-31 Regular.
2. Eliminate unnecessary materials in L-31 Regular
3. Replace Vicryl machine for 3 Expandable in L-31 Plus
4. Repositioning tables and materials in L-31 Regular.

Proposal 1

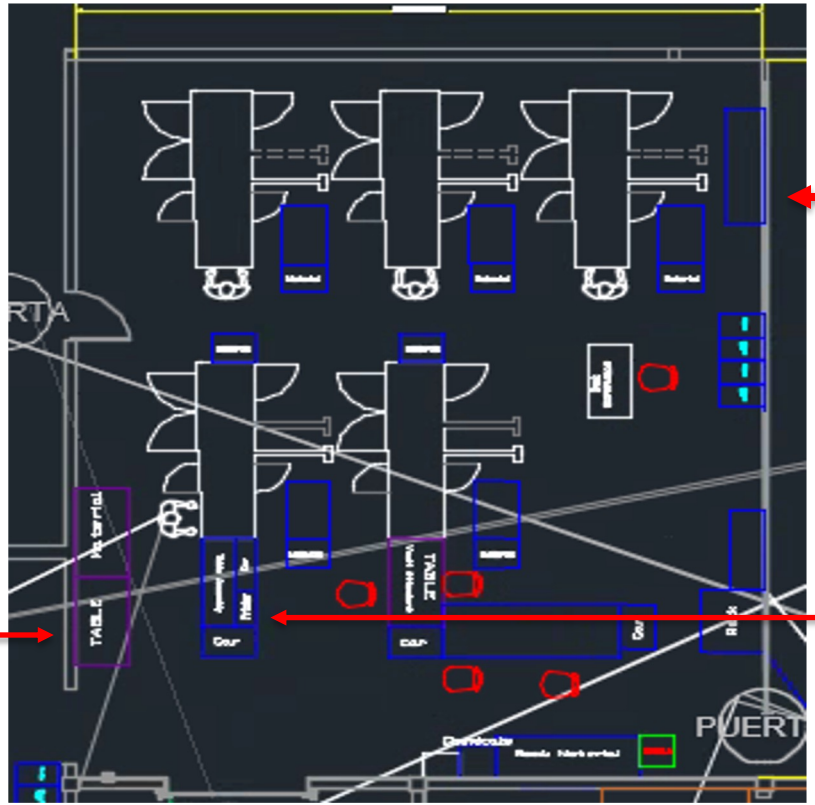
Line 31 - Regular



The aluminum wall is highlighted by the red circle.

Proposal 2

Re-spool Table

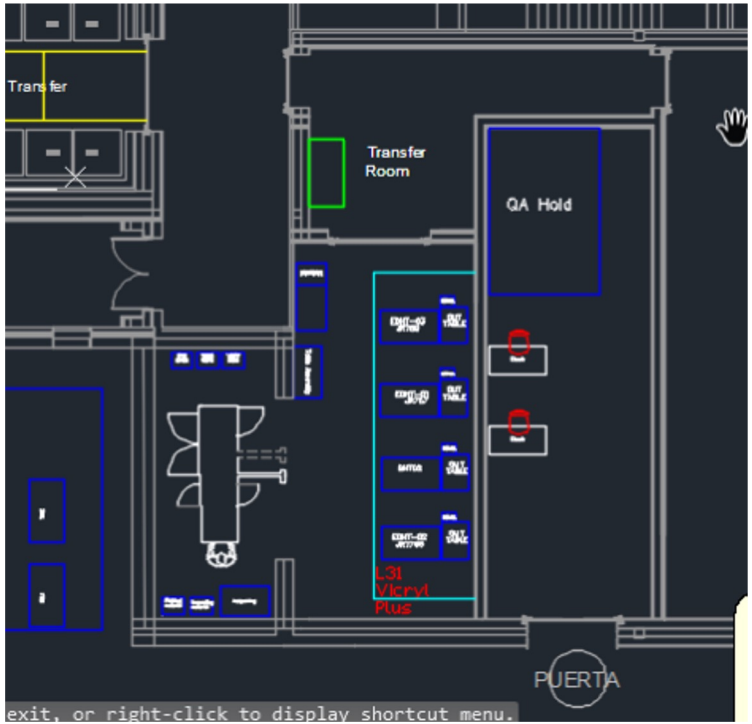


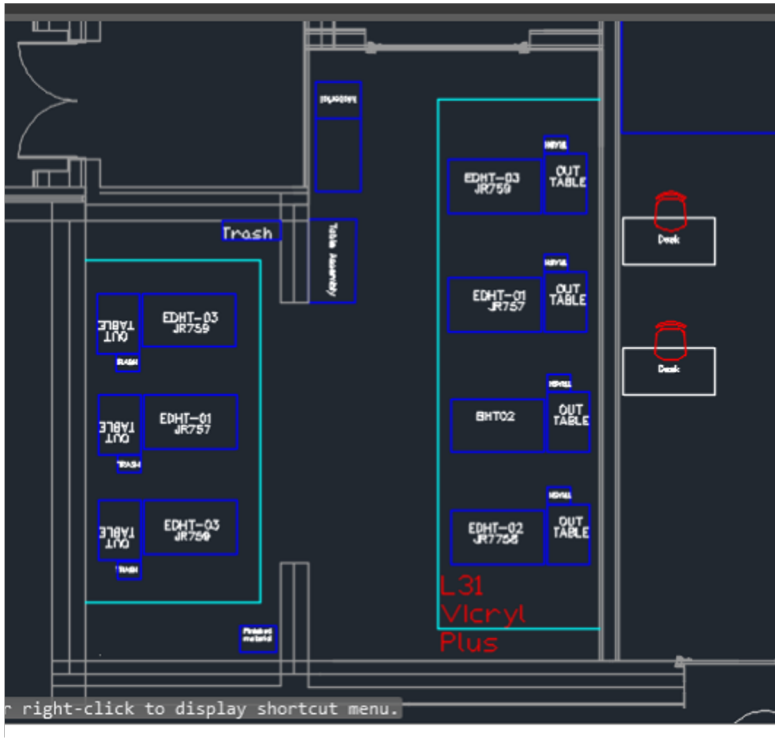
Mechanics tool

Can opener unused

Proposal 3

Line 31 - Plus

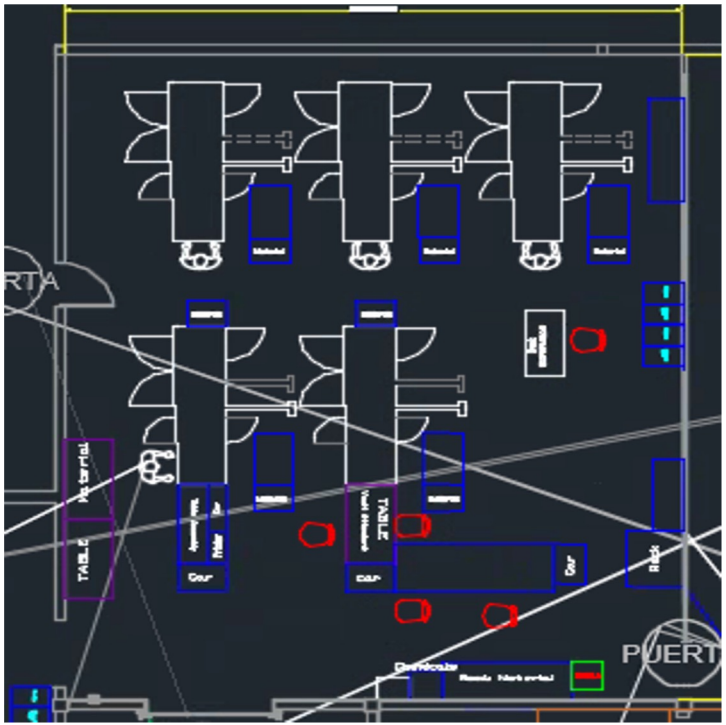




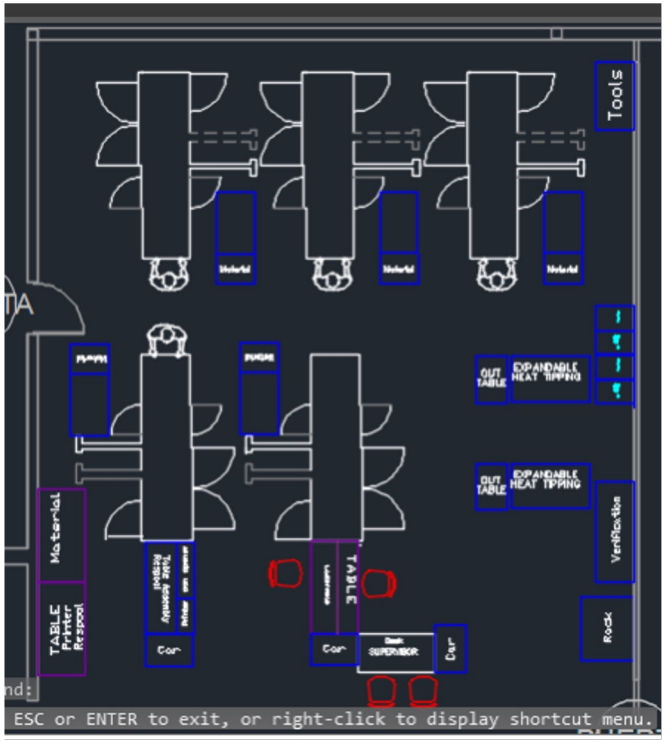
Proposal 4
Selected Proposal

Line 31 - Regular

Now



Desired



Implementation

Current Production

Total of 1,185,440 threads per week approx.

CURRENT PRODUCTION PLAN

Shift	Real Time (hr)
1st	7.91
2nd	6.84
3rd	5

Performance machine
100%

Cycle time EDHT (min): 3.25

Production per cycle: 300

Cycle time BHTC (min): 3.25

	std per hr VHTC 3025
Total 1er turno	23928
Total 2do turno	20691
Total 3er turno	15125
Total R. por M. 1ero	23928
Total R. por M. 2do	20691
Total R. por M. 3ero	15125

Shift	# Machines	Prod x dia	WK
1st	5	119640	598200
2nd	3	62073	310365
3rd	3	45375	226875
		TOTAL	1135440

Implementation

With new machines

Total of 2,229,200 threads per week approx.

WITH NEW MACHINES IMPLEMENTED

Shift	Real Time (hr)
1st	7.91
2nd	6.84
3rd	5

Performance machine VHTC
95%

Performance machine EHTC
100%

	std per hr VHTC 3025	std per hr EHDT 5538
Total 1er turno	23928	43806
Total 2do turno	20691	37880
Total 3er turno	15125	27690
Total R. por M. 1ero	22731.6	43806
Total R. por M. 2do	19656.45	37880
Total R. por M. 3ero	14368.75	27690

Turno	Machine	# Machines	Prod x dia	Wk
1st	VHTC	5	119640	598200
	EDHT	2	87612	438060
2nd	VHTC	3	62073	310365
	EDHT	2	75760	378800
3rd	VHTC	3	45375	226875
	EDHT	2	55380	276900
			TOTAL	2229200

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- Lilia K. Ugarte (EHTC and BHTC machines)
- Diego Rodriguez (VHTC machine)

Johnson & Johnson