Bula Forge & Machine, Inc.

Quality Forging and
Machining Since 1973

Experiences and Results from a JobshopLean Pilot Project in a Custom Forge Shop

June 27, 2007

Company Profile

- Bula Forge & Machine, Inc produces forged, machined, and assembled products
- Located in Cleveland, OH
- ISO 9001:2000 Certified
- Number of Employees: 40
- Markets Served: Military Off-Road Equipment, OEM, Main Line Rail, Mining, Overhead Cranes, Other Specialty Hardware

Company Profile

Forging Capabilities:

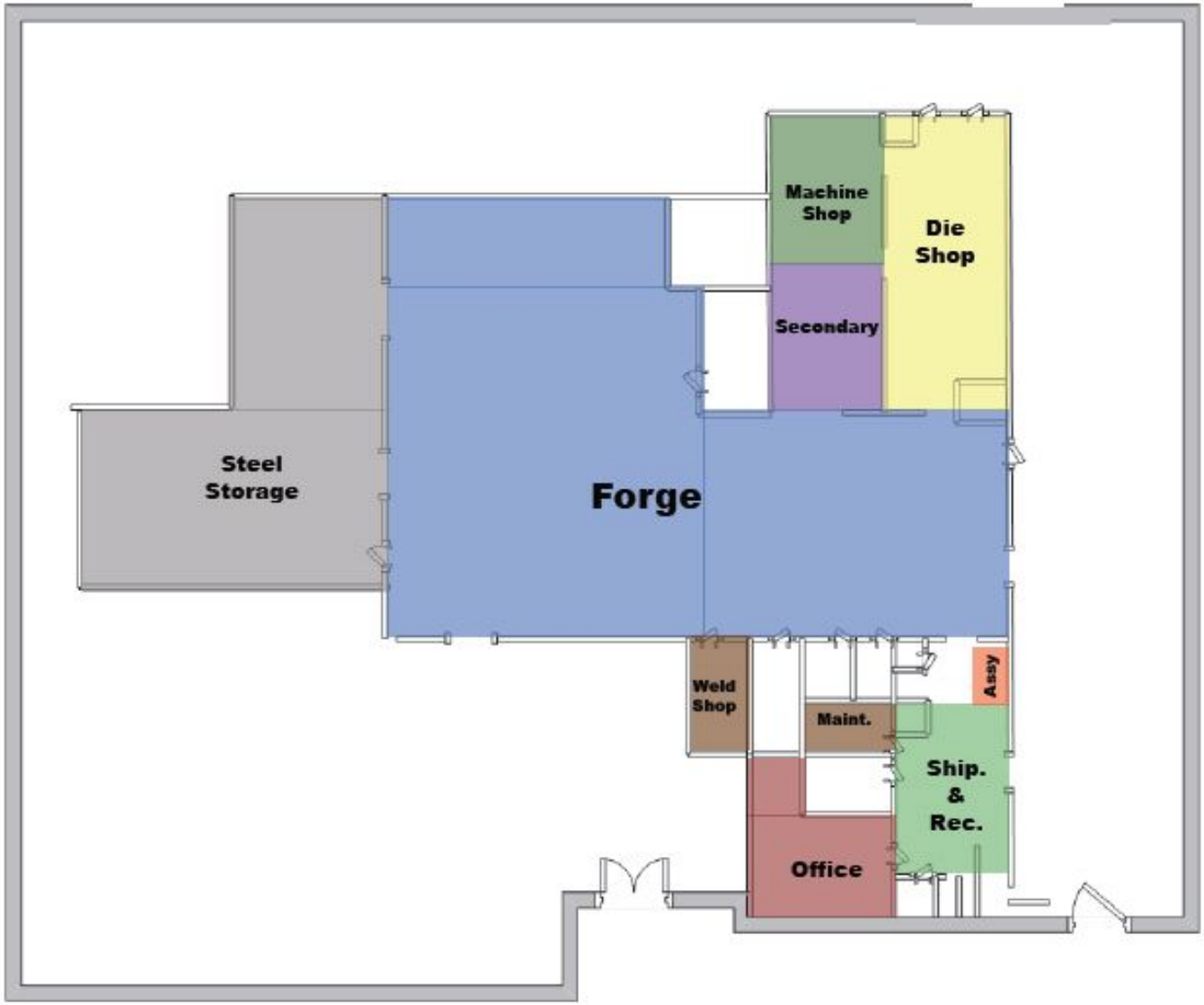
- Lot sizes range from 50-10000X
- Carbon, Alloy, Stainless Steel
- Forging weights range from 1# - 60#
- **Equipment:** Hammers, Presses, Upsetters

Precision Machining Capabilities

- Solid Modeling
- CAM
- CNC Machining with DNC Integration
- **Equipment:** Traditional Machining, CNC Precision Machining, Vertical Machining Centers, Horizontal Machining Centers, CNC Lathes

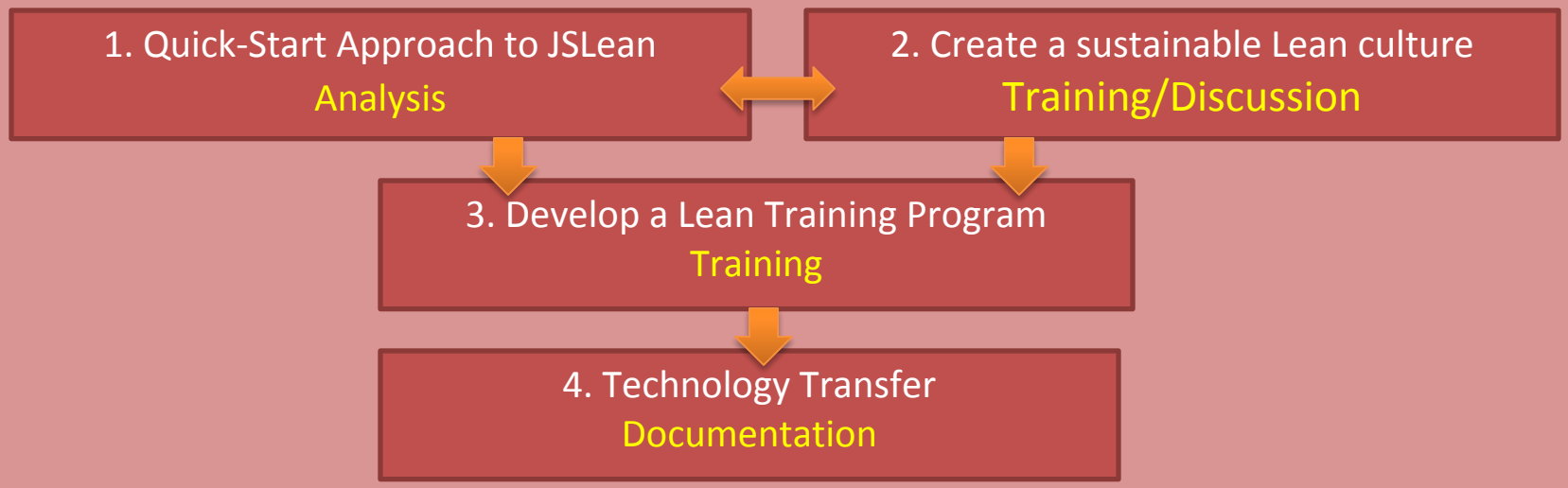
Assembly Fabrication

Layout (Key Departments)



Layout (Locations of Workcenters)

Scope of the Project

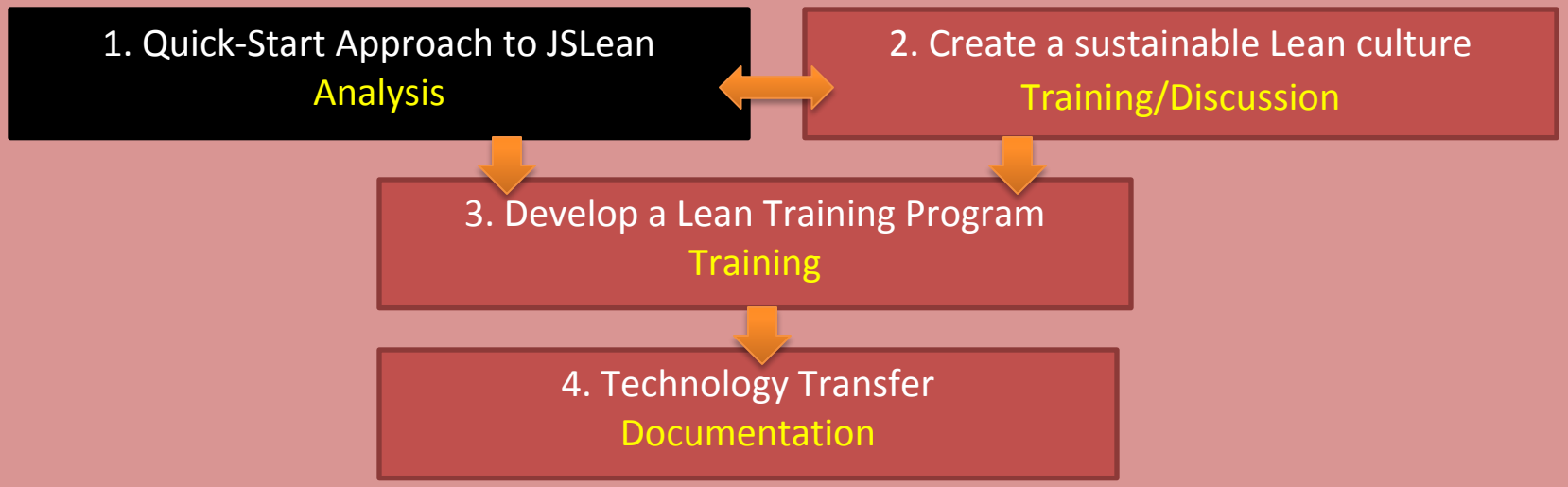


Scope of the Project

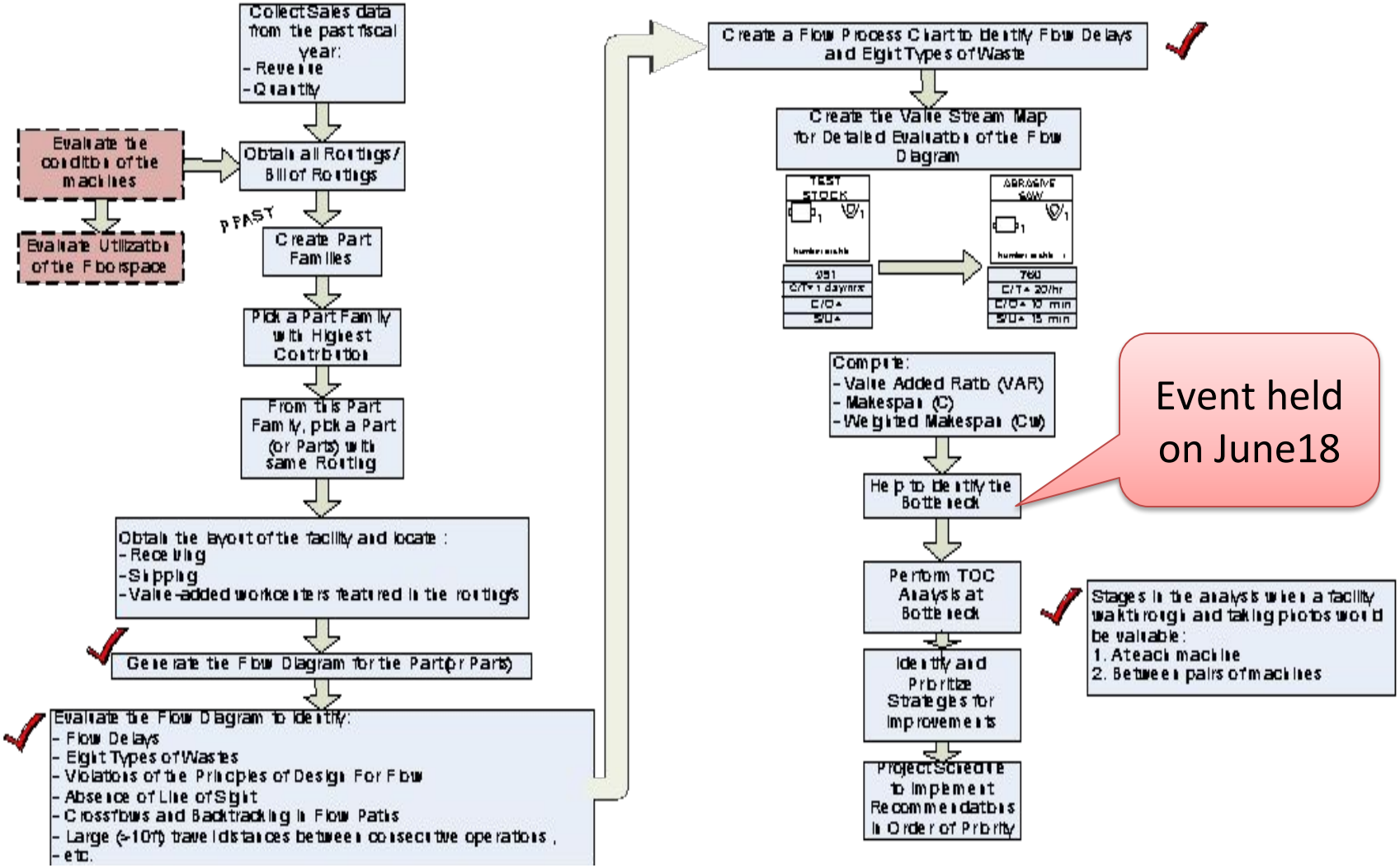
Task	1	2	3	4	5	6	7	8	9	10	11	12
1) Implement Quick-Start Approach to JSLean												
PFAST Analysis of Product Mix and Routings												
Flow Process Chart, VSM, Waste Identification												
Implementation of Improvement Ideas												
2) Create a Lean Culture												
Discussion Group												
Notice Board & Employee Suggestion Scheme												
3) Develop a Lean Training program												
Design & Develop the Program												
Train-the-Trainer												
4) Prepare Legacy Documentation for Tech Transfer												
Monthly Report												
Documentation												
Presentation at 2007 JSLean Conference												

Part I

Implement “Quick-Start Approach to JSLean“



Quick-Start Approach to JSLean



Data Collection for PFAST Analysis

- Data from 2004 to April 2007 was collected
  - 4 basic items of data for PFAST analysis:
    - Product
    - Quantity
    - Routing
    - Unit price
  - Because the information in the database is not up-to-date, a survey of the condition of the machines in the facility had to be conducted

Survey of the Machines

	A	B	C	E	F	G	H	I	J
1					Frequency	Condition			
2					often	Good			
3					sometimes	Not so good			
4					rarely	Broken			
5		2007/4/18 Machine Evaluation Form							
6	#	Item Number	Description	Location	Frequency	Condition	Suggestion/ Action/ Comment	Evaluator	List in Routing/EVO?
7	1	D400-WALKER DRL	DRILL PRESS	Die Shop	often	Good		JR.	
8	2	D403-BRIDGEPORT	MILL				Not exist	JR.	
9	3	D404-NASSOVIA	TOOL GRINDER	Die Shop	rarely	Not so good		JR.	
10	4	D405-DA BANDSAW	DO-ALL				Not exist	JR.	
11	5	D406-BS1JOHNSON	BANDSAW				Not exist	JR.	
12	6	D407-MATTISON	14X42 SURFACE GRINDER	Die Shop	sometimes	Not so good		JR.	
13	7	D409-HAMMOND	SURFACE GRINDER	Die Shop	sometimes	Not so good		JR.	
14	8	D412-#8MARVEL	BANDSAW	Forge Shop	rarely	Broken		JR.	YES
15	9	D415-UNIV.DIESK	3B UNIV.DIESINK	Secondary	sometimes	Not so good		JR.	YES
16	10	D416-UNIV.DIE#2	DIESK#2	Secondary	sometimes	Not so good		JR.	YES
17	11	D417-UNIV.DIE2B	DIE SINK	Storage			Don't Use	JR.	
18	12	D419-LB25 OKUMA	CNC LATHE	Die Shop	often	Good		JR.	YES
19	13	D420-FRGT&SETUP					Not exist	JR.	
20	14	D421-DELTA SAW		Die Shop	rarely	Not so good		JR.	
21	15	D422-ASOUTH DRL	RADIAL DRILL	Forge Shop	rarely	Not so good		JR.	
22	16	D423-CUMMINS	DRILL PRESS	Weld Shop	often	Good		JR.	
23	17	D424-LATHE OKUM	LATHE-OKUMA	Storage			Don't Use	JR.	
24	18	D426					Not exist	JR.	
25	19	D426 TOOLGRINDR	DARLEX 900 DRILL GRINDER	Die Shop	often	Good		JR.	
26	20	D427 3D PANTOGR	DEKEL GK-21 3D PANTOGRAPH				Not exist	JR.	
27	21	DA01-OKUMA MAN.	LATHE	Forge Shop			Don't Use	JR.	

Sheet1 Sheet2 Sheet3

編輯

P-Q-$ Analysis

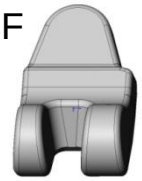
Part No	Description	Annual Quantity	Revenue	Q %	Accu Q%	Rev %	Accu Rev %
6503	7551067-18 CLEVIS	[redacted]		5.53%	5.53%	12.92%	12.92%
6504	7550983-18 CLEVIS			5.26%	10.79%	12.65%	25.57%
6502	7551061-18 EYE			2.62%	13.41%	11.50%	37.07%
3115	590 WHEELER MANUAL CUTTER			0.83%	14.24%	5.45%	42.52%
3114	490 RACHET OPERATED CUTTER			0.97%	15.21%	5.03%	47.55%
6501	7551071 BOLT EYE			0.97%	16.18%	5.03%	52.59%
9302	035284 FLANGE (CATERPILLAR)			6.06%	22.24%	2.41%	54.99%
20702	500020 HS/HSA TOP PLATE			8.47%	30.71%	2.28%	57.27%
3303	8000-1126 ROD EYE			0.36%	31.07%	1.64%	58.90%
8001	40F93-1 LUG FORGING			1.70%	32.77%	1.62%	60.52%
R146444	009190-0003 SLIDE BAR CAM			0.10%	32.87%	1.56%	62.08%
7501	ADJ. HANGER LATCH			1.34%	34.22%	1.53%	63.61%
9301	035287 FLANGE			6.21%	40.43%	1.49%	65.10%
M302731	009190-0110 MAIN CRANK			0.10%	40.53%	1.43%	66.53%
8802	67A248F8-2 KNUCKLE			0.51%	41.04%	1.31%	67.84%
9201	38850-00013-106 GRAB HOOK			1.11%	42.14%	1.19%	69.04%
8202	1005505/002 L.H. BRACKET			1.41%	43.55%	1.18%	70.22%
8201	1005505/001 R.H. BRACKET			1.41%	44.96%	1.18%	71.40%
M146441	009190-0003 OPERATING BAR			0.07%	45.03%	1.17%	72.57%
9206	11-1-3720-1 ARM CONNECTOR			1.53%	46.57%	1.11%	73.68%
20709	500005 WORKHORSE PLATE			4.58%	51.15%	1.05%	74.73%
9207	11-1-3719-1 CONNECTOR BODY			0.61%	51.76%	0.91%	75.64%
20703	500040			6.13%	57.90%	0.88%	76.52%
6904	59272450 PIN			2.26%	60.16%	0.87%	77.40%
20707	500100 AIR FLO RING			3.58%	63.73%	0.86%	78.26%
21610	1-17201-605 ROUGH WHEEL			0.46%	64.19%	0.77%	79.03%
8902	5419025 BODY PINTLE			0.04%	64.23%	0.77%	79.80%
20708	500220 TOP PLATE			1.96%	66.19%	0.77%	80.57%
20710	500010 WORKHORSE RING			4.57%	70.75%	0.73%	81.30%
9204	11-1-478 LOWER SUSPENSION LINK			0.19%	70.94%	0.69%	81.99%

Study a Value Stream

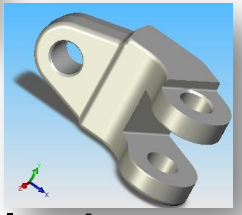
Part 6503F/6503 and Part 6504F/6504:

- Represent 25.57% of the Total Revenue
- Pulled by customer through a Kanban system
- Identical routings
- Parts 6504F/6504 were selected for preliminary analysis due to production schedule.

6504F



6504

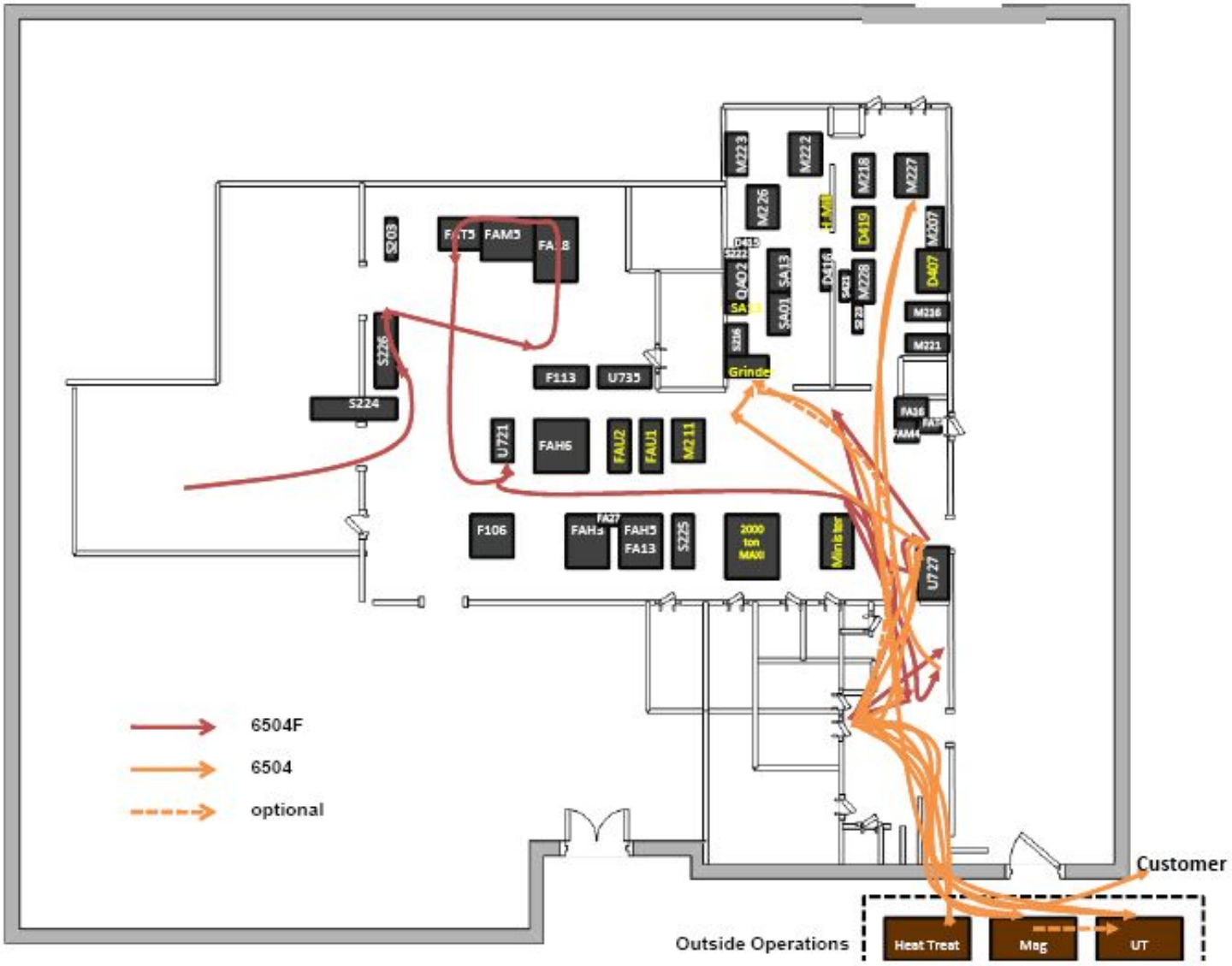


Tow bar for military vehicles

Routing of Part 6504F/6504

	Sequence	WC Number	Description
6504F	1	S224	SAW
6504F	2	FA18	HEAT
6504F	3	FAM5	FORGE
6504F	4	FAM5	SWAB
6504F	5	FAT5	HOT TRIM
6504F	6	U721	NORMALIZE
6504F	7	U727	WHEELABRATE
6504F	8	PACK	FINAL INSPECT/COUNT
6504	9	PACK	PULL PARTS
6504	10	M227	MILL 1 - 4
6504	11	(Outside)	HEAT TREAT
6504	12	U727	WHEELABRATE
6504	13	(Outside)	MAG
6504	14	GRIND	GRIND/MAG REWORK
6504	15	(Outside)	UT
6504	16	U727	WHEELABRATE
6504	17	PACK	GRIND/PKG

Flow Diagram to assess Product Flow



Flow Process Chart for Part 6504

45	6504															
46	Step	Date		Seq #	Event Description	Symbal	Parts/Hr.	Setup Time	Scrap rate	Uptime	# of staff	Time per piece (C/T)	Q	Machine/Location	Method	Distance
47	1				Storage	▼								Inventory		
48	2				To Stand	→						1	125		Forklift	70
49	3			40	Put 6504F into stand	■					1	1		Stand		
50	4		W	40	Count 125 pcs, put into a cart	■					1	15		Stand		
51	5			40	Put the leftover parts in another tub	■					1	0		Stand		
52	6				Tub to Storage	→						1	125		Forklift	70
53	7				Cart To Scale	→						1	125		Cart	20
54	8		W	40	Weigh the cart	■					1	1		Scale		
55	9				Cart to Storage Shelf in Shipping	→						1	125		Cart	30
56	10				Storage	▼							125	Storage Shelf		
57	11			40	To Mill							1	125		Cart	164
58	12				Delay/ Wait	D							125	M227		
59	13	3/28	Box	50	Mill 1-4	O	11.2	1 hr			1	10.43 (for 2 pcs)	125	M227		
60	14				Delay/ Wait	D							125	M227		
61	15				To Inspect	→						2	125		Cart	172
62	16				Delay/ Wait	D							125	Inspect		
63	17		I		Inspect	■					1	15 min	125	Inspect		
64	13				Consolidate carts into tubs	O					1		375	Inspect		
65	18				To Scale	→						1	375		Forklift	14
66	19	3/28	W		Weigh the tub	■					1	1	375	Scale		
67	20			60	To Heat Treat	→								Outside		
68	21		Box		Heat Treat	O								Outside		
69	22			61	100% Inspection	■								Outside		
70	23			70	From Heat Treat	→								Outside		
71	24				To Scale	→							375		Forklift	24
72	25		W		Weigh	■					1	1	375	Scale		
73	26				To wheelabrate	→							375		Forklift	50
74	27				Delay/ Wait	D							375	U727		
75	28		Box	90	wheelabrate	O					1 (load)		375	U727		
76	29				Delay/ Wait	D							375	U727		
77	30				To Scale	→							375		Forklift	50
78	31		W		Weigh	■					1	1	375	Scale		
79	32			100	To Mag	→								Outside		
80	33		Box		Mag	O								Outside		
81	34			101	From Mag	→								Outside		
82	35				To Grind	→							375		Forklift	52
83	36	3/29	(Box)	105	Grind/ Mag Rework	O	19.71				1		?			
84	37			110	To UT	→								Outside		
85	38				Operation at UT	O								Outside		
86	39			120	From UT	→								Outside		
87	40				To Scale	→							375		Forklift	44
88	41		W		Weigh	■					1	1	375	Scale		
89	42				To wheelabrate	→							375		Forklift	50
90	43				Delay/ Wait	D							375	U727		
91	44		Box	130	wheelabrate	O					1 (load)		375	U727		
92	45				Delay/ Wait	D							375	U727		
93	46				To WIP Storage	→							375		Forklift	48
94	47				Delay/ Wait	D							375	Grind		
95	48		Box	140	Grind/ Package	O	27.99				1		375	Grind		
96	49				Delay/ Wait	D							375	Grind		
97	50				To shipping	→							375		Forklift	52
98	51		W		Weigh	■					1	1	375	Scale		
99	52				Ship	→							375	Shipping		

Flow Process Chart for Part 6504F

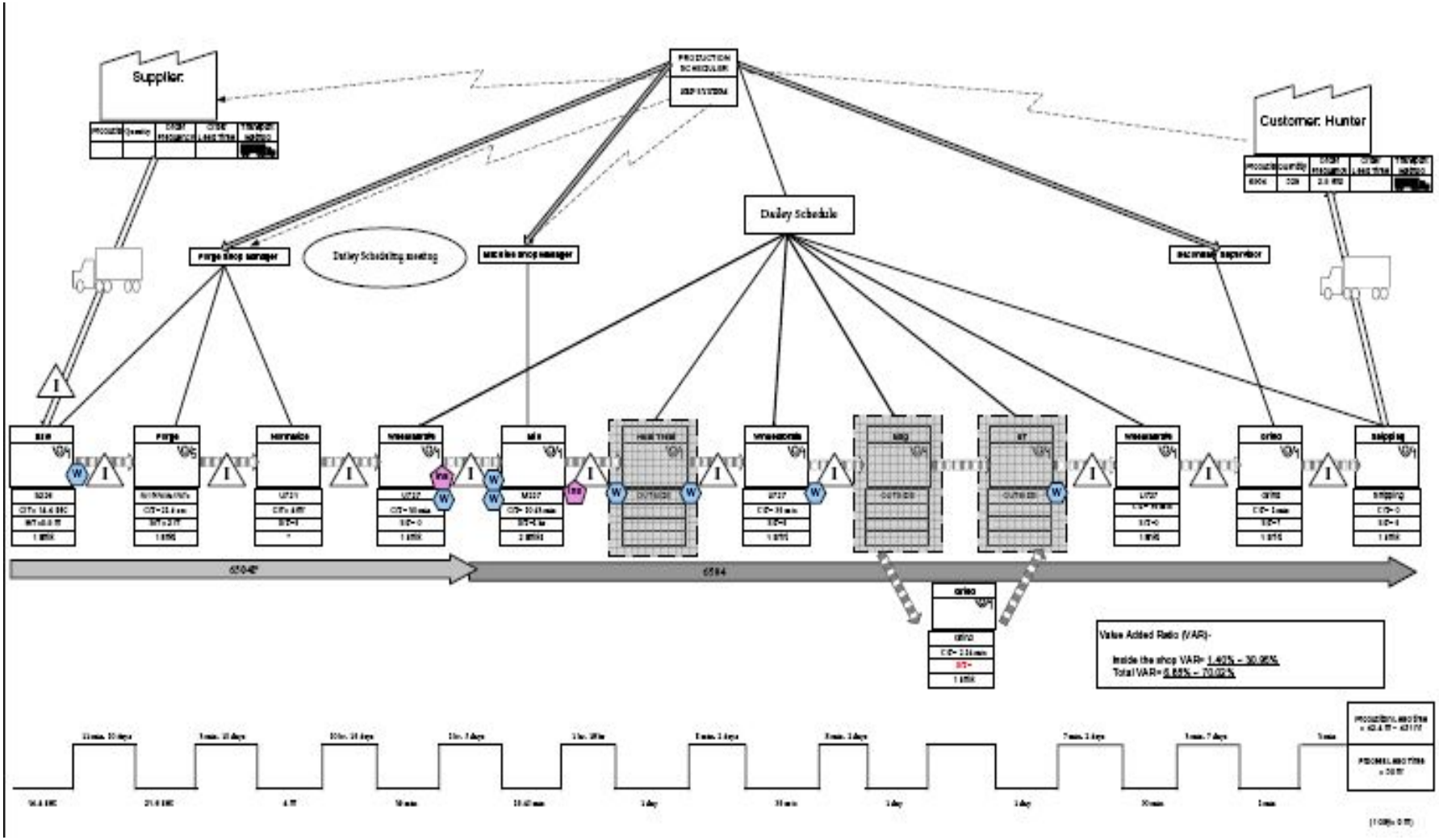
	Storage	▼
	Transportation	→
	Operation	O
	Inspection/ Count/ Weigh	■
	Delay/ Wait	D

6504F

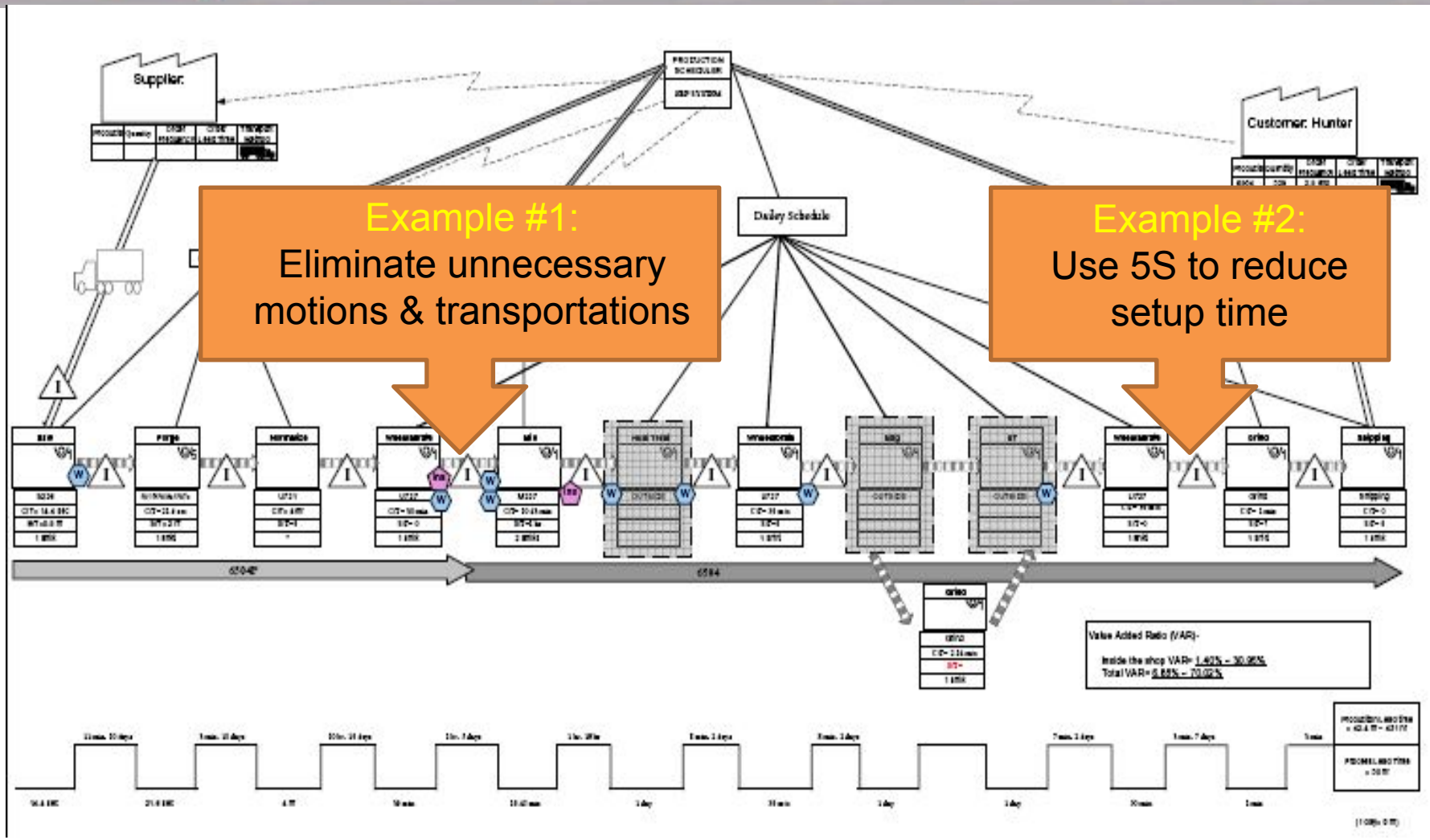
Step	Date	VSM	Seq #	Event Description	Symbal	Parts/Hr.	Setup Time	Scrap rate	Uptime	# of staff	Time per piece (C/T)	Q	Machine/Location	Method	Distance
1				Raw Material Storage	▼								Steel Storage		
2	2/26			To Saw	→									Crane+Fork	100
3	2/26	Box	10	Saw	O	250	0.5 hr			1 (load)	14.4 Sec	1931	S226		
4		W	10	Weigh the billets	■					1	1		Scale next to saw		
5	2/26			To Forge Storage	→						1			Forklift	40
6	2/26-3/7			Forge Storage	▼								Forge Storage		
7	3/7			To Heat	→						1			Forklift	26
8	3/7	Box	22	Heat	O	165	0			1	21 sec	1931	FA18		
9	3/7		20	Forge	O	165	2			1	21 sec	1931	FAM5		
10	3/7		23	Swab	O	165	0			1	21 sec	1931	FAM5		
11	3/7		21	Hot Trim	O	165	2			1	21 sec	1931	FAT5		
12	3/7			Delay/ Wait	D								FAT5		
13	3/7			To Normalize	→						1			Forklift	62
14	3/7			Delay/ Wait	D								U721		
15	3/7	Box	30	Normalize	O					1 (load)	4Hrs.	200	U721		
16	3/7			Delay/ Wait (cooling)	D								U721		
17	3/7			To wheelabrate	→						2			Forklift	170
18	3/7			Delay/ Wait	D								U727		
19	3/7	Box	40	wheelabrate	O	1615				1 (load)			U727		
20	3/7			Delay/ Wait	D								U727		
21	3/7			To Final Count Storage	→						1			Forklift	30
22	3/7			Final Count Storage	▼								Final Count Storage		
23	3/7			To Stand	→						1			Forklift	76
24			50	Put into the stand	■					1	1		Stand		
25			50	Inspection & Sort	■					1	15		Stand		
26			50	Put into another tub	■					1	0		Stand		
27				To Scale	→						1			Forklift	20
28		W	50	Weigh the tub	■					1	1		Scale		
29				To Storage	→						1			Forklift	88
30				Storage	▼								Inventory		

Sheet1 Sheet2 Sheet3

Value Stream Map



Waste Identification using VSM



Example #1
(Initial Problem Statement)

Below is how the product maneuvers just for supplying product to the machine shop:

1) All 6504F forgings, approximately 2000 parts per run (about four tubs), are put in a stand, sorted for defects, and put into another tub.
2) Tubs of sorted parts are weighed and put into inventory
3) A tub gets pulled from inventory and put into a stand
4) 125 parts are put into a cart, balance of forgings are shoveled into another tub
5) The cart of parts are weighed and put under the inventory shelf in shipping
6) The tub of leftover parts is delivered back into inventory in the forge shop
7) Step 3-6 are repeated daily

A cart of 125 pcs supplies the machine shop with one day's worth of production.

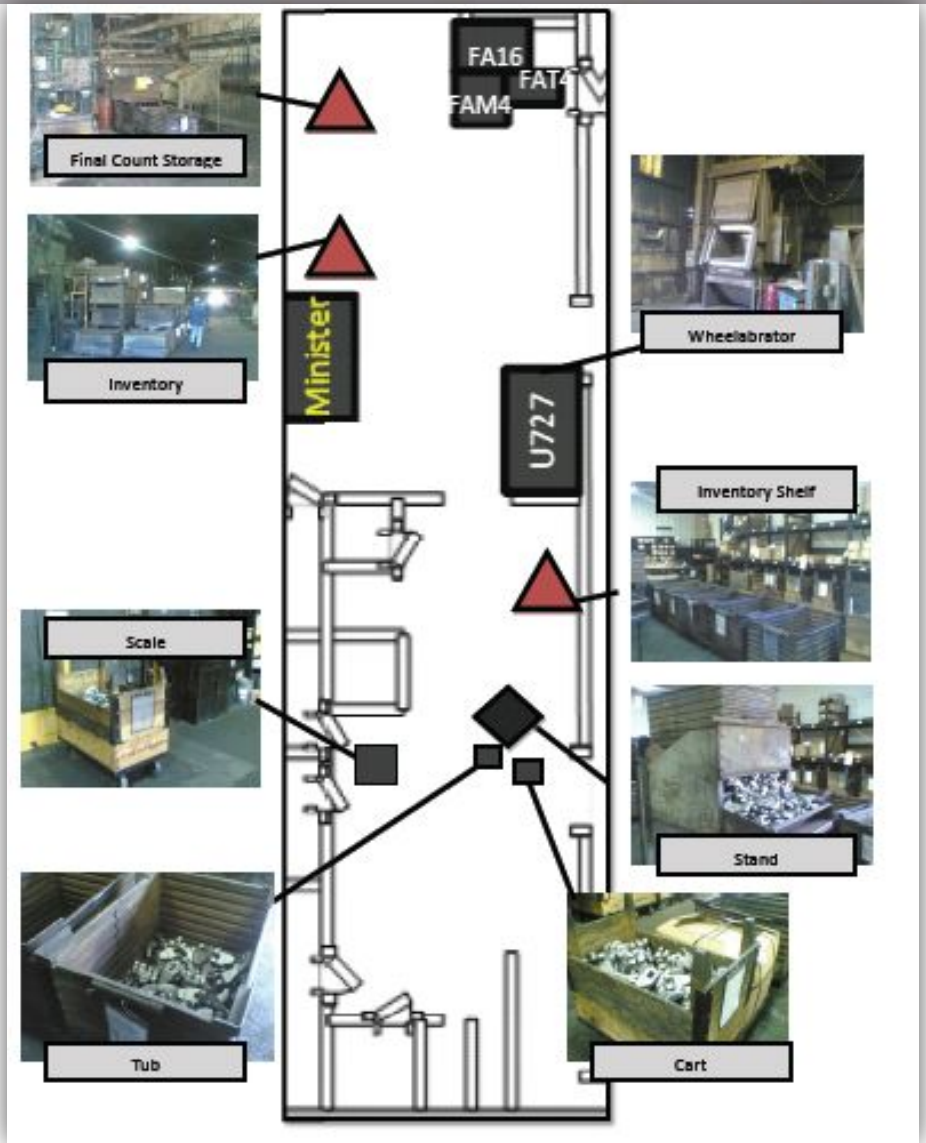
Example #1
(Analysis of Flow Process Chart)

Step	Seq #	Event Description	Symbal	Parts/Hr.	Setup Time	Scrap rate	Uptime	# of staff	Time per piece (C/T)	Q	Machine/Location	Method	Distance
19	40	wheelabrate	O	1615				1 (load)			U727		
20		Delay/ Wait	D								U727		
21		To Final Count Storage	→						1			Forklift	30
22		Final Count Storage	▼								Final Count Storage		
23		To Stand	→						1			Forklift	76
24	50	Put into the stand	■					1	1		Stand		
25	50	Inspection & Sort	■					1	15		Stand		
26	50	Put into another tub	■					1	0		Stand		
27		To Scale	→						1			Forklift	20
28	50	Weigh the tub	■					1	1		Scale		
29		To Storage	→						1			Forklift	88
30		Storage	▼								Inventory		

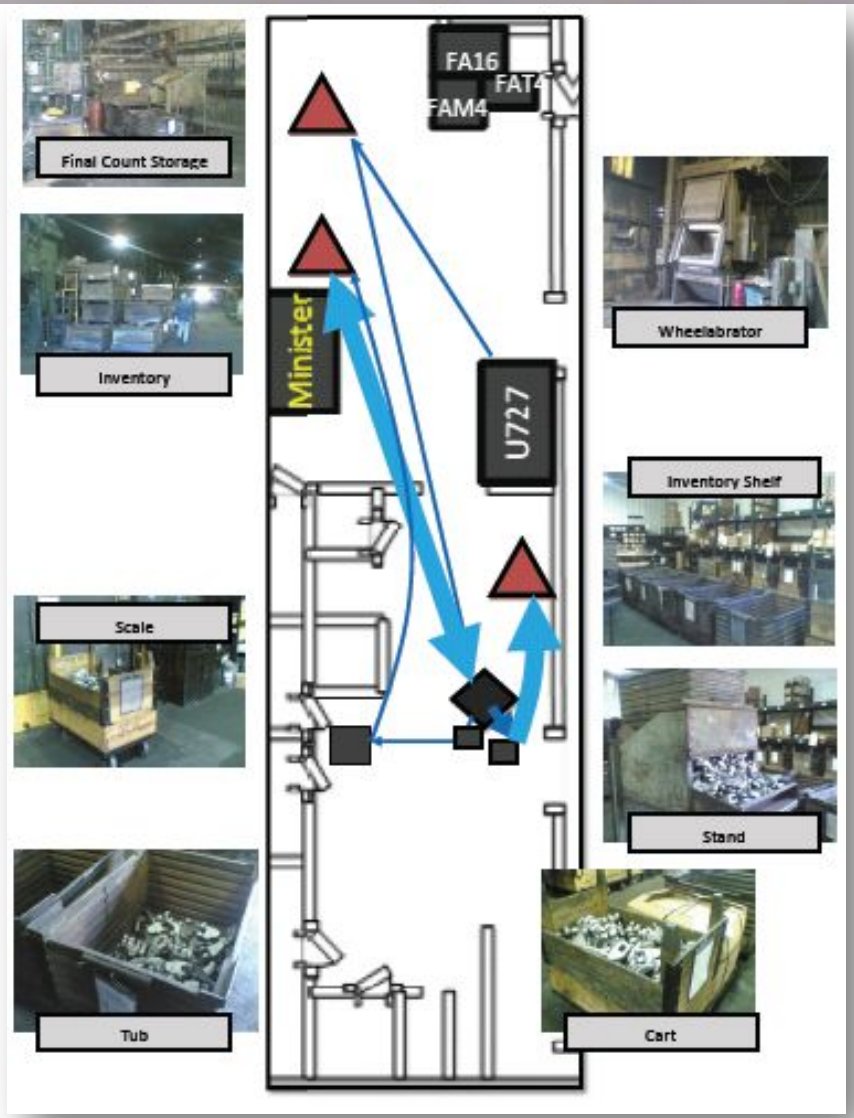
Step	Seq #	Event Description	Symbal	Parts/Hr.	Setup Time	Scrap rate	Uptime	# of staff	Time per piece (C/T)	Q	Machine/Location	Method	Distance
1		Storage	▼								Inventory		
2		To Stand	→						1	125		Forklift	70
3	40	Put 6504F into stand	■					1	1		Stand		
4	40	Count 125 pcs, put into a cart	■					1	15		Stand		
5	40	Put the leftover parts in another tub	■					1	0		Stand		
6		Tub to Storage	→						1	125		Forklift	70
7		Cart To Scale	→						1	125		Cart	20
8	40	Weigh the cart						1	1		Scale		
9		Cart to Storage Shelf in Shipping	→						1	125		Cart	30
10		Storage	▼							125	Storage Shelf		
11	40	To Mill							1	125		Cart	164

For a batch of 2,000 pieces, the parts are transported back and forth 16 times!

Visualize the Problem



Visualize the Problem (contd.)

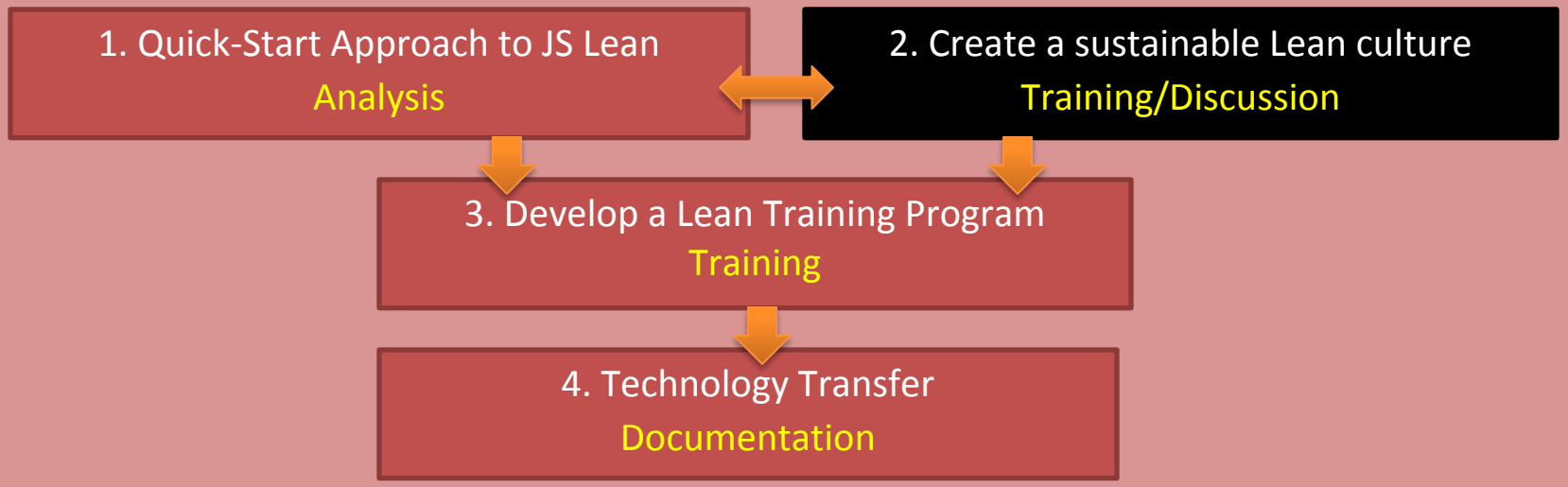


Example #2

Video: Use of 5S to reduce setup time

Part II

Create a sustainable Lean culture



Lean Discussion Group

- Goal: Create a ***sustainable*** Lean culture.
- A group of 11, including president, vice president, shop managers, sales manager, and department of scheduling, human resource, purchasing, and engineering meet 1 hour per week for the first 8 weeks, and ***3*** hours in the following 4 weeks.
- Readings followed by discussion: *The Goal, Lean Thinking, The Toyota Way*, and some additional readings such as chapters from *Learning to See*.
- Presentation by intern: Concepts & tools of Lean Thinking.
- Individual & Group Assignments: Waste Assessment, Flow Diagram, Flow Process Chart, and Value Stream Map.
- The group selected one value stream, identified the wastes in it, and worked as a team to brainstorm for solutions.

Waste Assessment

Wastes	Examples in Bula	Causes	Possible solutions
Over-production			
Inventory			
Transportation			
Waiting			
Motion			
Over-processing			
Rework			
Not utilizing HR			

Everyone in the discussion group is required to identify at least 3 wastes in his/her work area. This completed form must be turned in as part of the individual assignments.

Waste Assessment (Examples)

Bryan:

Below are the three wastes I identified in the Engineering Department.

Example 1: Waiting, Motion, and Rework
The document management system (PDM) contains data that is not up to date and concurrent within each job (CAD, CAM, CNC Programs and Fixtures). A great deal of time and is lost as machines are idle as these jobs must be reversed engineered and expedited. This means the cnc program is manually written and still not concurrent with remaining data.
Causes:
Previous employees were not following procedures.
Possible Solution:
Analyze and rework all data in all software packages along with fixtures to be concurrent and up to date.

Example 2: Waiting and Not utilizing HR
The surfcam software has only one qualified operator. This means that any program that needs to be made in surfcam must pass thru this operator. Any programs that are created by others will take additional time or must wait to be programmed.
Causes:
No time to train
Possible Solution:
Find a way to create time and train three or more qualified employees.

Example 3: Waiting and Not utilizing HR
There is not enough time to train or cross train people so that when a task is required it can be completed by more than just one or two people. There are times that one task must wait so that another can be preformed. Training and cross training would allow for a task to be performed with an idle worker or assigned to a worker with a lower priority task.
Causes:
No time to train
Possible Solution:
Find a way to create time to train and cross train as many employees will be required to keep tasks flowing.

Dennis Wisen
Engineering

From: Wayne Phelps, Jr. [mailto:wphelpsjr@bulaforge.com]
Sent: Tuesday, April 17, 2007 6:11 PM
To: snaticchioni@bulaforge.com
Subject: homework
Discussion for Session 2:

1. What is value? What is waste?
   Value is necessary work to a product, what the customer is will to pay for.
   Waste is unnecessary work done to a product, activities that do not add value.

2. According to your observation during the week, fill-in the blanks (at least 3 wastes or 3 examples)

Wastes	Examples in Bula	Causes	Possible solutions
Over-production	All continuous running jobs	Long set-up times	Quick change tooling.
Inventory	The repercussions of over-producing.	Long set-up times.	Quick change tooling.
Transportation	Storing and picking of inventory.	Over-producing	Run only what we need.
Waiting	Finishing the job that we don't need at that time so we have to what we need now	Over-producing	Quick change tooling
Motion	Carting parts form one area to the next	One area does one task were the other does the next	Work cells.
Over-processing	Doing more to a part than it actually needs.	Not looking further into your process.	Kaizan
Rework	Work done to a part because it wasn't done right the first time.	Repetiveness Mistakes	Rotation Poka-yoke
Not utilizing HR	Training	Convenience	Schooling, training programs

(This form is also attached as a word document)

Waste Identification using VSM

6503 & 6504 - Message (HTML)

File Edit View Insert Format Tools Actions Help

Reply | Reply to All | Forward

You forwarded this message on 5/15/2007 3:30 PM.

From: Tori Phelps [tphelps@bulaforge.com] Sent: Tue 5/15/2007 1:02 PM
To: bwang@bulaforge.com
Cc:
Subject: 6503 & 6504

Bryan,

Since you are analyzing the value stream of P/N 6504, I see an immediate opportunity for improvement that has come to my attention. Below is how the product maneuvers just for supplying product to the machine shop:

1) All 6504F forgings, approximately 2000 parts per run (about four tubs), are put in a stand, sorted for defects, a ut into another tub.
2) Tubs of sorted parts are weighed and put into inventory
3) A tub gets pulled from inventory and put into a stand
4) 125 parts are put into a cart, balance of forgings are shoveled into another tub
5) The cart of parts are weighed and put under the inventory shelf in shipping
6) The tub of leftover parts is delivered back into inventory in the forge shop
7) Step 3-6 are repeated daily

This is over handling of product in the most wasteful way! When I asked why we do it, the bottom line comes s and space to store carts. A cart of 125 pcs supplies the machine shop with one day's worth of production.

This may be something we can come up with a solution as a group.....????

Thank you,

Tori Phelps
Sales Manager
Bula Forge & Machine, Inc.
3001 W.121St. St.
Cleveland, OH 44111
Phone: (216) 252-7600
Fax: (216) 252-7601
E-mail: tphelps@bulaforge.com

"I see an immediate opportunity for improvement that has come to my attention…"

- Tori, Sales Manager

Feedback from Lean Discussion Group

Response Rate= 70%; 7 out of 10

Feedback for Lean Manufacturing Discussion Group

May. 16 2007

1. **How much have you finished the readings (%)**
   - The Goal 90 %
   - Lean Thinking 100 %
   - The Toyota Way 85 %
   - Other Readings 29 %

2. **The amount of readings are reasonable**
   - 2 ☐ Strongly Agree
   - 4 ☐ Agree
   - 0 ☐ Disagree
   - 0 ☐ Strongly Disagree

3. **The assigned readings are useful to my work**
   - 4 ☐ Strongly Agree
   - 3 ☐ Agree
   - 0 ☐ Disagree
   - 0 ☐ Strongly Disagree

4. **The discussion during the sessions are useful to my work**
   - 5 ☐ Strongly Agree
   - 2 ☐ Agree
   - 0 ☐ Disagree
   - 0 ☐ Strongly Disagree

5. **The time I spent on this discussion group is worthy**
   - 5 ☐ Strongly Agree
   - 2 ☐ Agree
   - 0 ☐ Disagree
   - 0 ☐ Strongly Disagree

6. **This Lean program will improve Bula Forge's performance**
   - 6 ☐ Strongly Agree
   - 1 ☐ Agree
   - 0 ☐ Disagree
   - 0 ☐ Strongly Disagree

7. **Things we've done well:**
   - * work together
   - * Group works well together

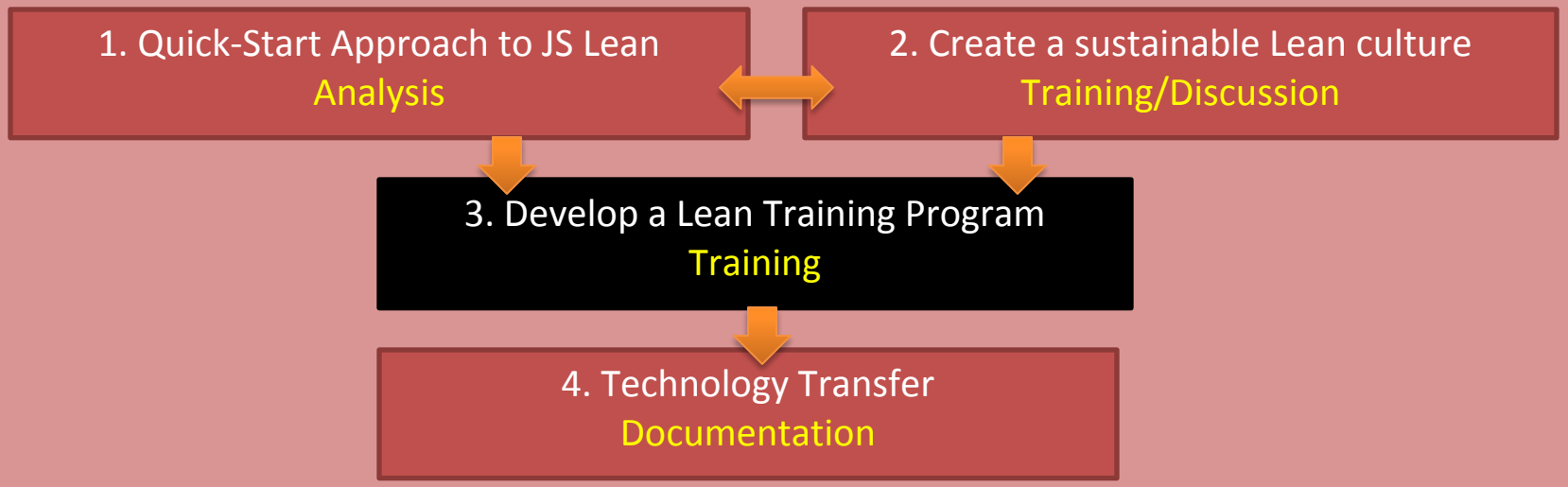
8. **Things we can improve:**
   - * We get started on projects but need to finish them
   - * communication

9. **Other Comments:**

Thank you for your response!

Part III

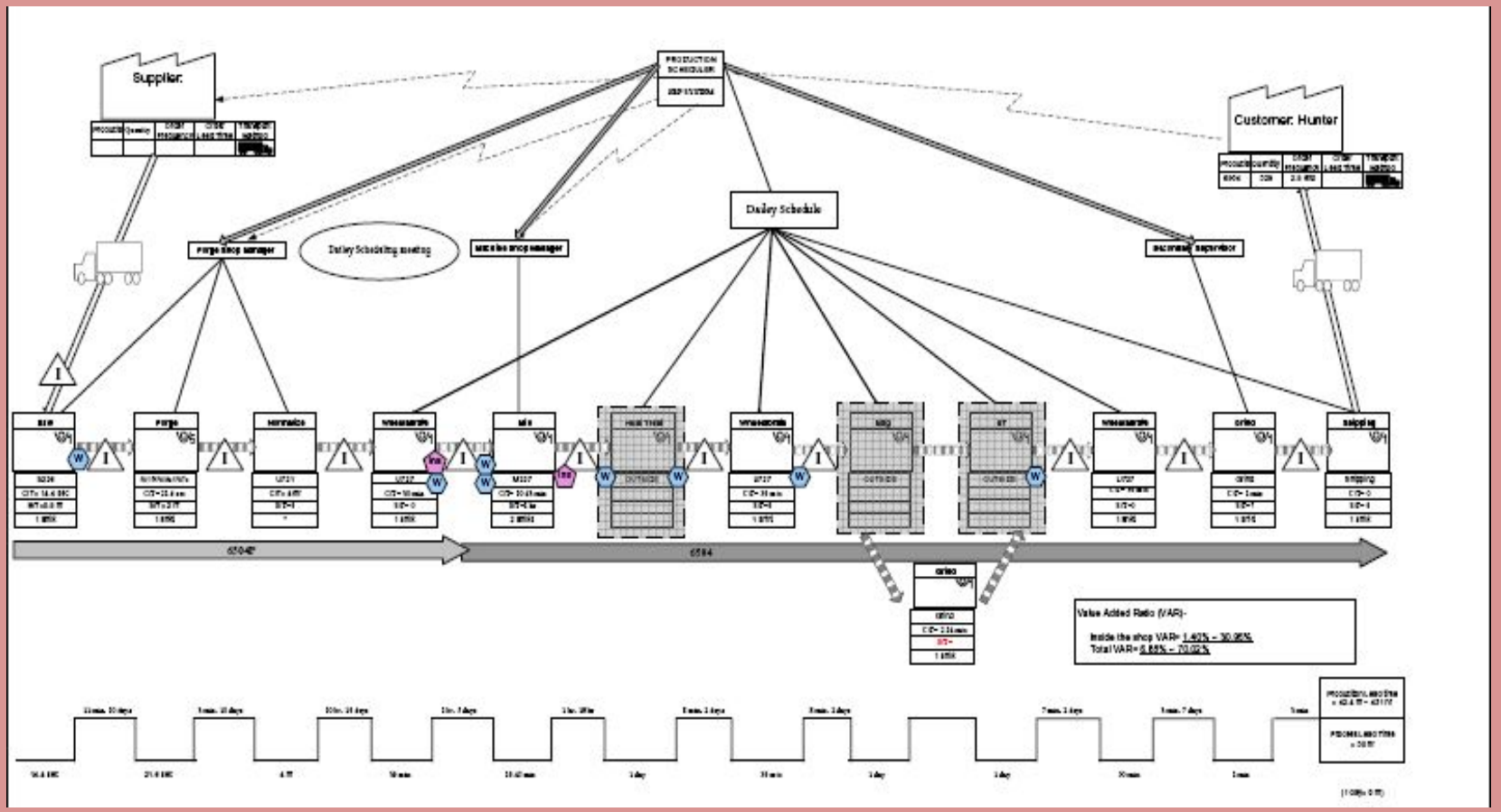
Develop a Lean Training Program



Lean Training Program

- Several modules for training the workforce in the fundamentals of Lean Thinking have been (or are being) developed, based on the outputs of the Lean Discussion Group & improvement activities executed as per the Statement Of Work
- Lean 101: What is Lean?
- Lean 102: Identifying the Eight Types of Waste
- Lean 103: Learning to See (Flow Diagram, Flow Process Chart, Value Stream Map)

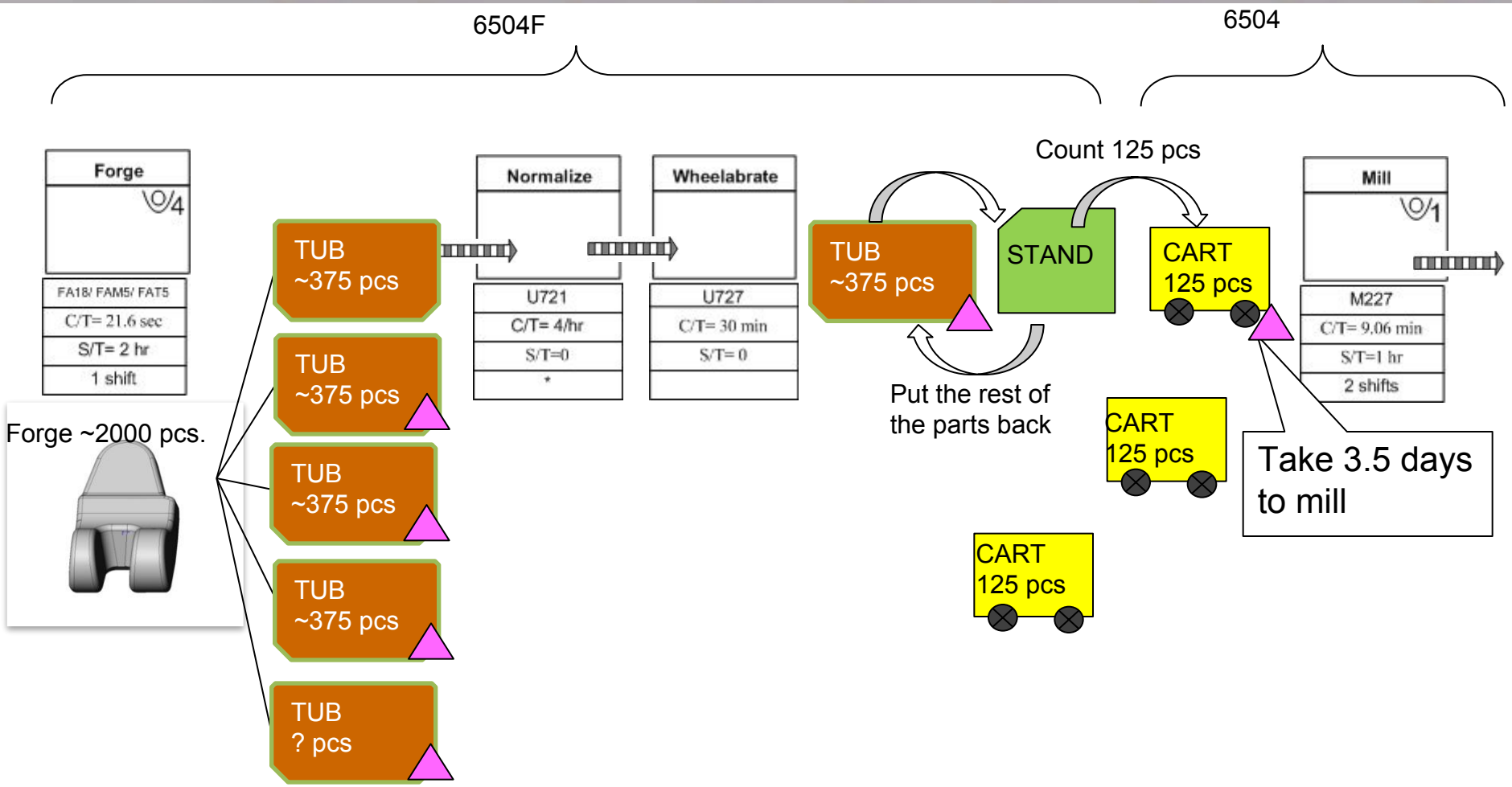
Future Work


Supplier
Customer: Hunter
Daley Schedule
Daley Scheduling meeting
Value Added Ratio (VAR)-
Inside the shop VAR= 1.40% - 30.96%
Total VAR= 8.88% - 70.02%

Issues/Concerns

- Current lot size for Part 6504 is confusing, and the management lose control of the parts easily (e.g. unaccounted scrap)
- Current production schedule causes inventory, waiting, unnecessary transportations and motions
- Part flow time vary significantly due to the large batch size

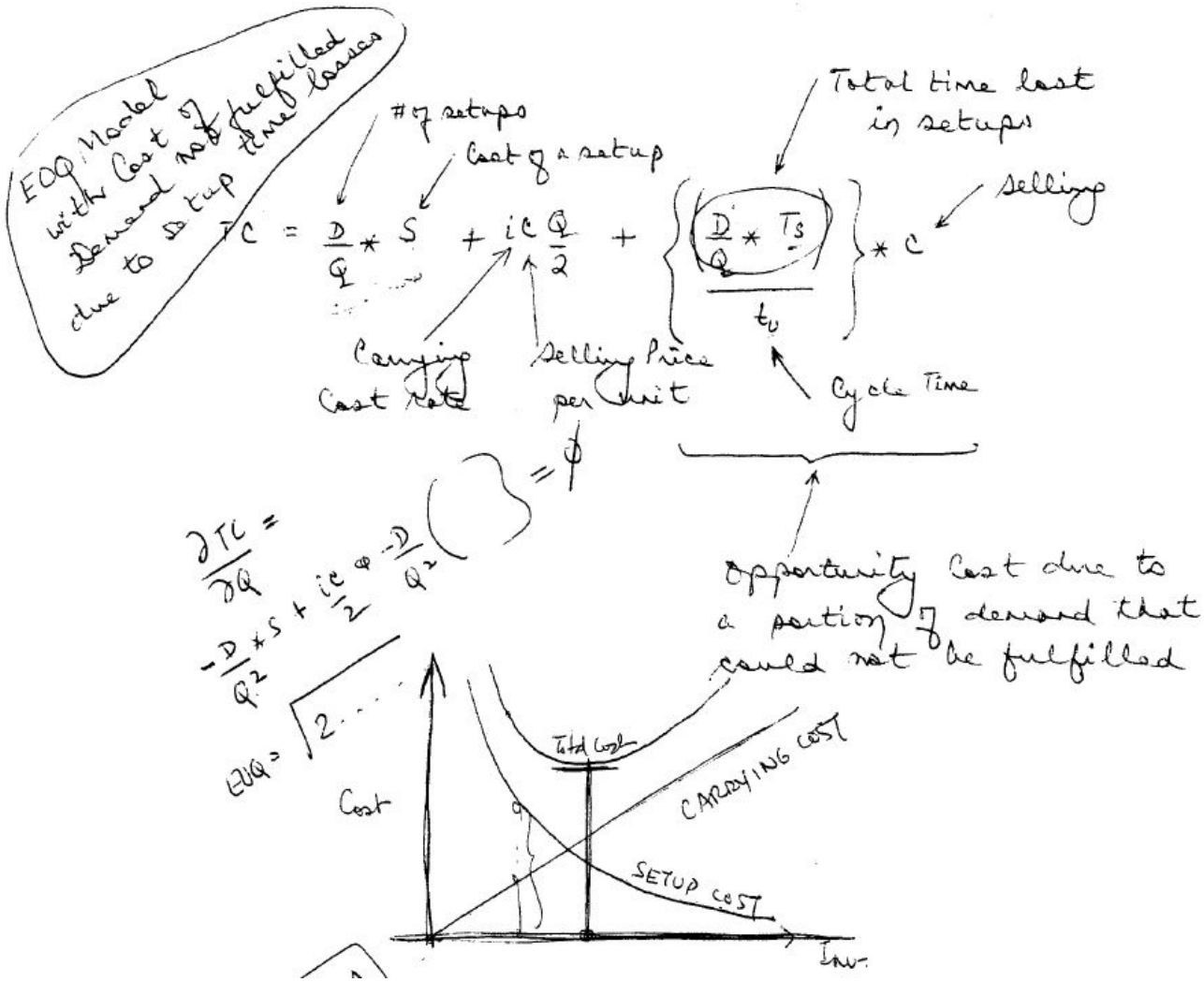
Current State Map



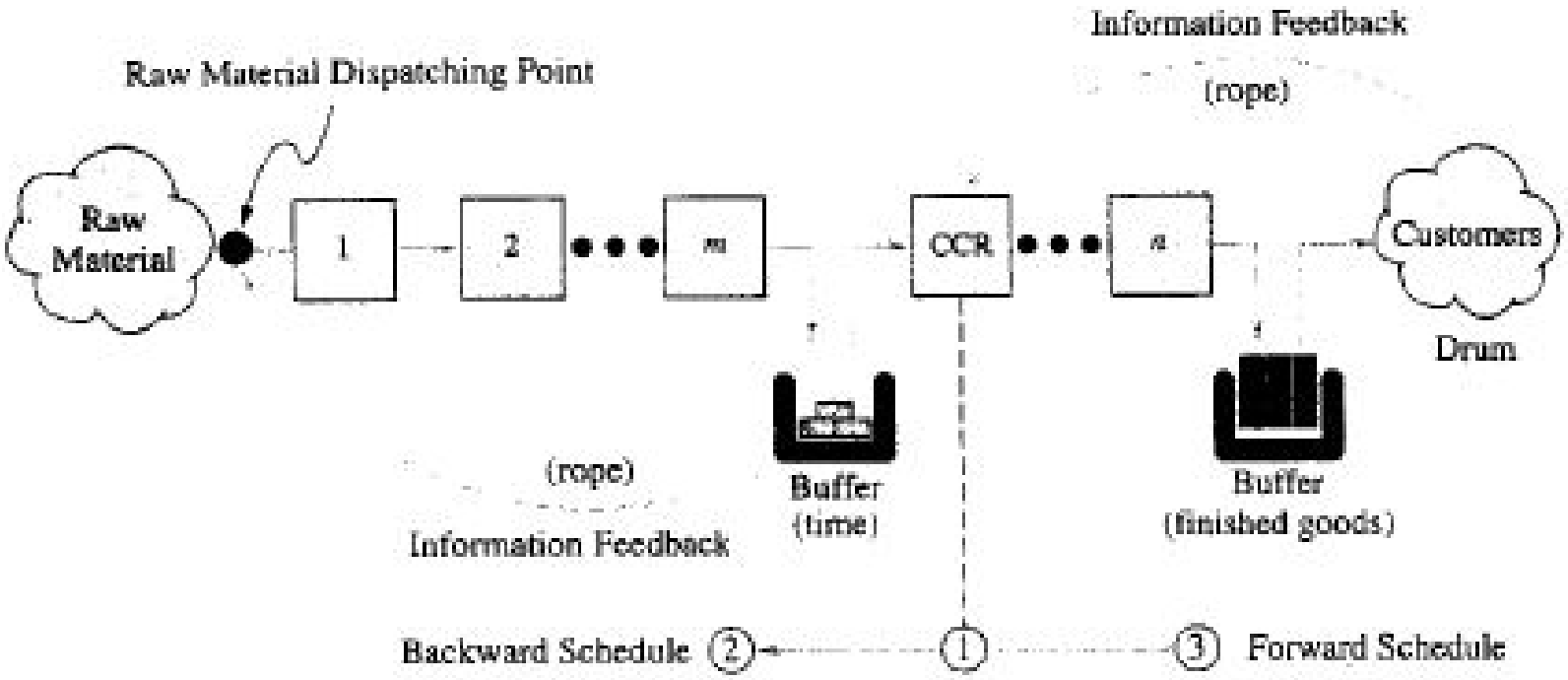
Questions

- What is the optimal batch size for Forging since Machining is the constraint ex. allow more setups on the Forging Press?
  - ***Modified*** Economic Order Quantity (EOQ)
  - Pull using Drum-Buffer-Rope
- What is the optimal transfer batch size between Forging and Machining?
- What is the best way for the departments and material handlers to communicate with each other to support JIT transfers of small batches?

Model for Modified EOQ Batch Size



Pull using Drum-Buffer-Rope



Scheduling Procedure:

(1) Schedule CCR.

(2) Backward schedule to raw material dispatching point.

(3) Forward schedule to finished goods buffer.

Summary of Benefits

- Performance Improvement Metrics for 6504F/6504

Metric	Current State	Future State	Improvement (%)
Part flow time (days)			
Inventory ($)			
On time delivery (% of orders)			
Unaccounted scrap rate (%)			

Recommendations

1. Keep updating the data in ERP system (eg. cycle time, setup time)
2. Adjust the lot size of 6504F/6504 and 6503F/6503 and start a pull system
3. Persuade the customer have leveled demand
4. Map other value streams and start to identify problems
5. Adopt more visual management tools
6. Clean up the unutilized floor space
7. TWI (Training Within Industry) training for shop managers
8. Establish a training management system, i.e. ISO 10015

Future Plans

Department	Category	Plan	Date
Forge Shop	Quick Changeover	Cut set-up times on the presses down to 1 hr and the hammers down to 2 hrs Work on dies immediately after production is completed	12/31/2007 End of 3rd quarter
Forge Shop	Standardization	Establish production rates for each job on an ongoing basis and write standard operating procedure (SOP)	06/30/2007
Forge Shop	Training & Education	Retain well educated forge shop personnel by starting an internal education program that will be in place: Manager will develop a 10 to 20 minute class on a specific subject at the rate of one per month (07/01/2007) Sessions will be scheduled during the first week of each month (starting Jan. 2008)	12/31/2007
Forge Shop	Workplace organization	Transform the forge shop into a showcase: The clean-up will consist of clean sweep and organization. Manager will pick one to two areas per month with personnel input. All forge shop personnel are responsible for executing the project. All outside areas will be complete by (8/31/2007). Inside will begin after outside is complete (9/01/2007)	12/31/2007
Machine Shop	Quick Changeover	Quick Change completed -US&S (12/2007) -Wheeler (06/2008)	12/31/2008
Machine Shop	Training & Education	Educate employees through classes, seminars, in house training/cross training	continuous
Machine Shop	Workplace organization	Clean and organize storage shelves	12/2007

Future Plans (contd.)

Engineering	Recruitment	Hire up to three people for a position to assist the following areas: engineering, manual machining and CNC program/setup/operator	08/01/2007
Engineering	Training & Education	Seek out information through vendors, educational institutions, books, trade journals, white papers and trade groups	now
Engineering	Quick Changeover	Incorporate the Quick Change system, PDM, Surfcam, programming, Solidworks and document updates concurrently with completion to be	12/2008
Maintenance	Maintenance	Replace FAU1 furnace, FAT trim press and Rebuild FAH6	10/2007
Maintenance	Recruitment	Hire another skilled maintenance person	07/2007
Administrative	Office Lean	Define clear guidelines for maintenance and storage of electronic files; email invoice, order acknowledgements, & purchase orders for customer & vendors	The end of 2007
Scheduling	Scheduling	Establish inventory goals for each part# or category by end of May, and meet them through re-establish lot size Update MRP planning parameters for each item Overhaul routing information Routing updates; time studies, routing changes provided by production managers Implement finite scheduling	End of August
Quality	Standardization	Develop S.O.P. for first, mid, and last piece inspection by June 30, 2007. Implement with each department head as products flow through each operation. (Address other shifts). Review, write, or revise one each week, per department, beginning first week in June. Eliminate weaknesses in the QMS before third party assessment audit in October through quarterly audits and one full audit.	06-30-2007
Quality	Training & Education	Develop and implement Q.A. Training Program for new employees, existing employees, and audit training before full internal audit in August.	Before August
HR	Training & Education	Work with supervisors to set up training program and records to ensure employees have the skills to do their work and have a vision and direction that commits them to working smarter.	by 9-30-07