SIFCO FORGE GROUP

AEROSPACE COMPONENT MANUFACTURING

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A Quick-Start Approach for JobshopLean (JSLean)

Company Overview

- SIFCO Forge Group is a specialized provider of forged components
  - Located in Cleveland, Ohio
- Capability to supply a broad range of services ranging from part drawing to on-the-shelf, ready-to-go, finish-machined components
- Some examples of products produced:
  - Compressor Discs
  - Turbine Discs
  - Helicopter Rotor Hubs
  - Aircraft Landing Gear

- Primary forging equipment:
  - Closed-die hammers ranging from 2000 lb. up to 40000 lb.
  - Hydraulic presses up to 2500 tons
  - 3500 ton precision hydraulic screw press
  - 4 inch mechanical upsetter
  - 5000 pound open frame hammer

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Scope of the Project

- Introduce JobshopLean to the executives and shopfloor personnel
- Provide training on using JobshopLean thought process in daily tasks
- Work with SIFCO team to improve current processes on the shop floor
- Show an example of the JobshopLean thought process in action for assessing the problems and generating solutions for those problems

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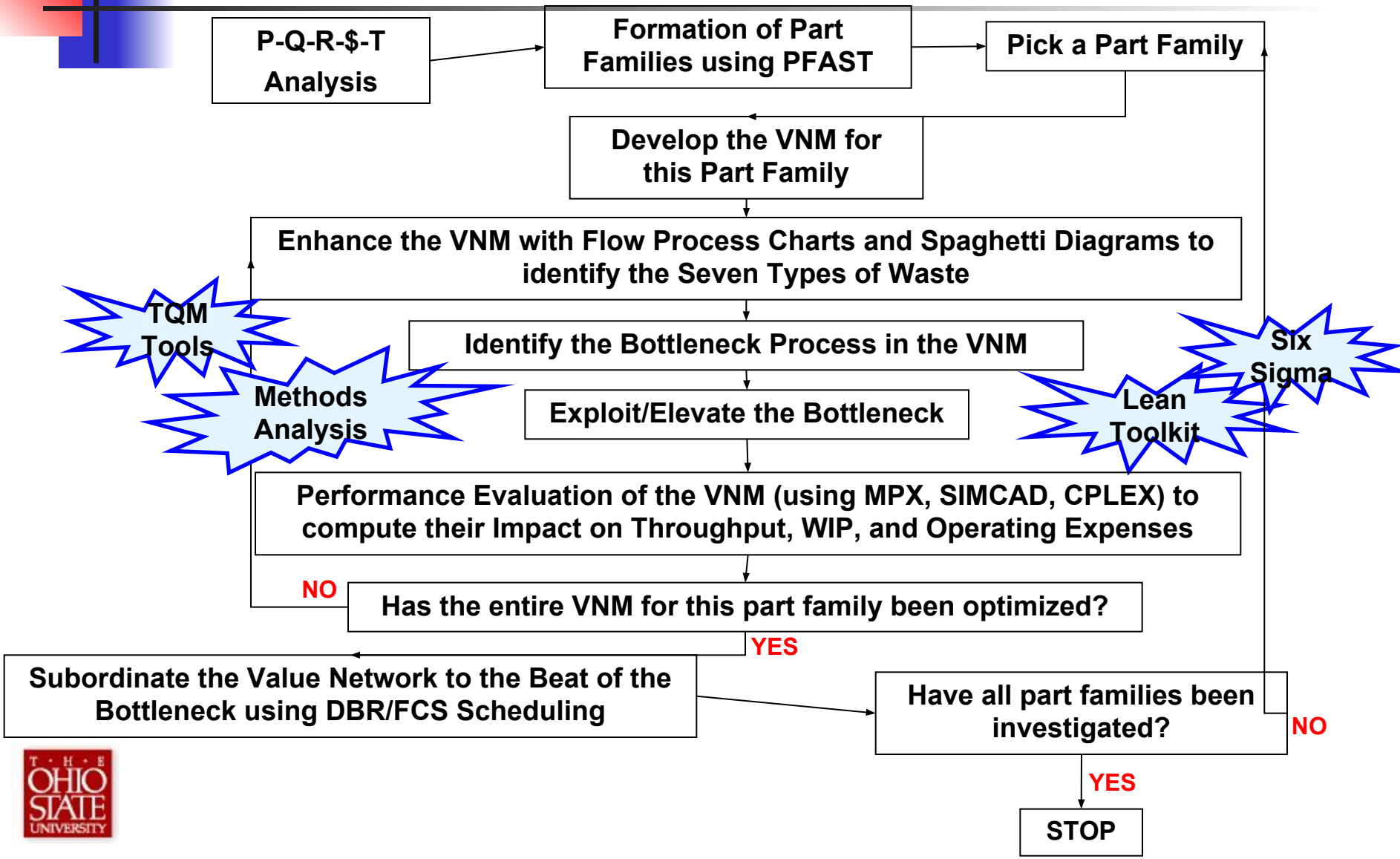
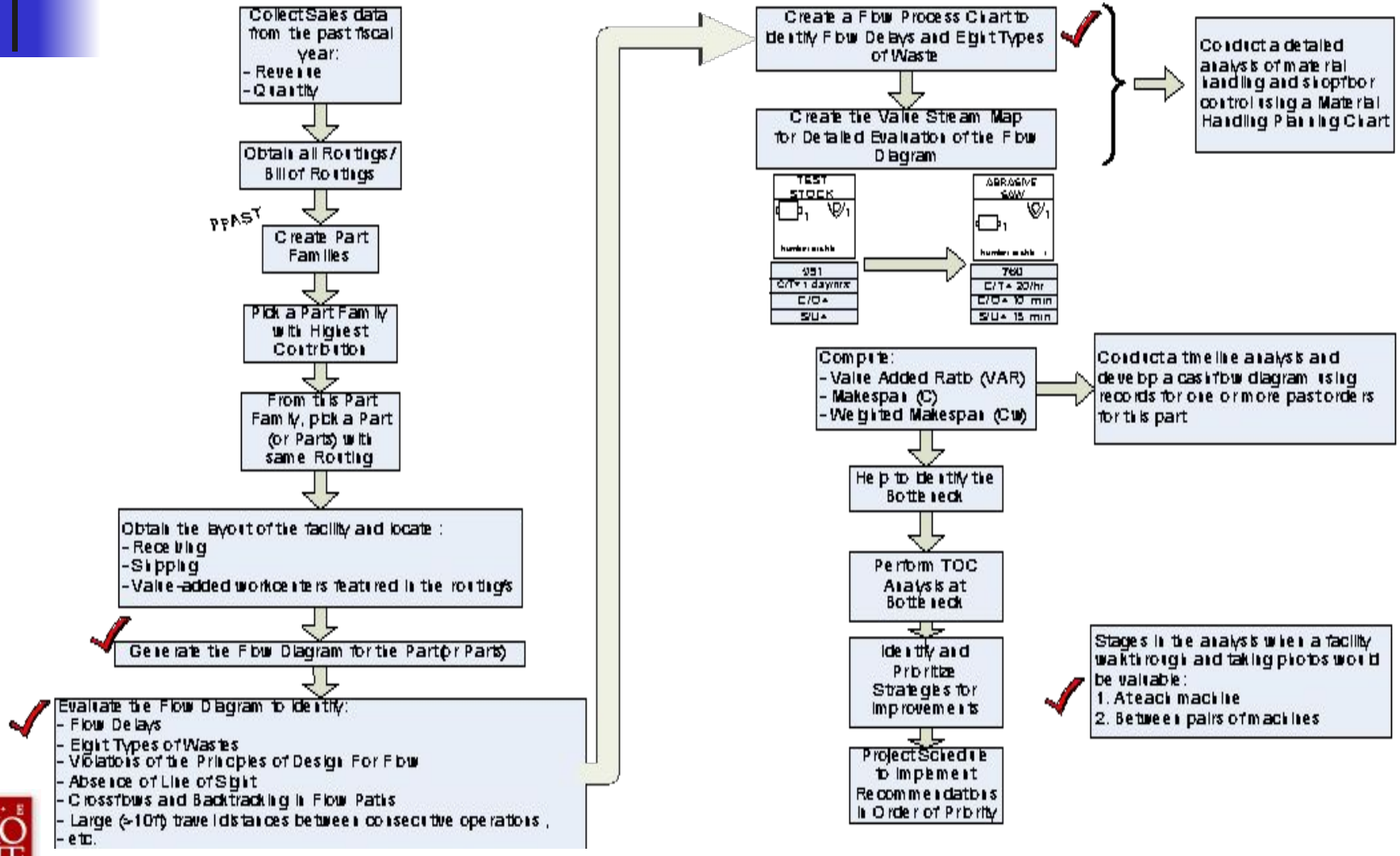
Comprehensive Approach for JobshopLean



Quick-Start Approach for JobshopLean



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Data Collection

- Collected data from October 2003 to August 2005
  - 4 basic items of data for analysis using PFAST:
    - Quantity
    - Sales
    - Profit Margin
    - Routing
  - Work center number and machine number
  - Workstation cycle times
  - Crew number

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Part Families

- Created an input file for PFAST
- PQ$ Analysis showed that 250 parts represent top 80% of product mix
- Based on the dendogram, the 720 parts could be split into many part families
- 2 part families were considered:
  - Part Family 1 consists of 229 part numbers
    - Total quantity of 41,710 (SIKORSKY: 43 part numbers with total quantity of 10,794)
    - Sales total of $ xx,xxx,xxx (SIKORSKY: $x,xxx,xxx)
  - Part Family 2 consists of 24 part numbers (demand will increase about 20% next year on the 20 parts which are "runners")
    - Total quantity of 12,631
    - Sales total of $ xx,xxx,xxx

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Part Family #2

	Parts	Revenue	Quantity	Projected QTY 2006
1	0Y889A	[redacted]	111	
2	11040B		714	564
3	11041B		675	636
4	11042D		708	864
5	11043B		672	900
6	11044D		666	852
7	11045B		684	636
8	11046B		251	216
9	11473B		1066	306
10	11567A		372	120
11	11570A		398	120
12	11568A		689	600
13	11569A		664	612
14	11569B		221	204
15	11571A		665	624
16	11572A		679	624
17	11573A		641	648
18	11574A		410	108
19	11049A		236	228
20	11575A		192	126
21	11576A		820	180
22	30324A		643	240
23	08315A		394	
24	11169B		60	

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Part Family #2 (contd.)

- Pick a few parts in Part Family #2 that have identical routings
- Parts chosen:
  - 11042D
  - 11043B
  - 11044D
- Parts are predicted to increase in sales volume in the following year (see Projected QTY 2006)
- Parts account for 15% of the revenue for the part family chosen

11043B before it is machined

Part #	NSN	Customer	Desc.	Program	Weapon System	Revenue	QTY	Projected QTY 2006	Batch Size
11042D	Unknown	Rolls Royce	Wheel-3rd-STG	AE2100	C-130J, C27J		708	864	48
11043B	Unknown	Rolls Royce	Wheel-4th-STG	AE2100/ T406	C-130J, C27J		672	900	48
11044D	Unknown	Rolls Royce	Wheel-5th-STG	AE2100/ T406	C-130J, C27J		666	852	48

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Part Routing

Operation No.	WC No.	Name of Work Center (WC)
1	951	TEST STOCK OR LAB RELEASE
2	760	SAW 36 IN ABRASIVE
3	510	BLAST - ROTO
4	810	COAT - DIP
5	80	20000 # HAMMER #2089 or #3585
6	510	BLAST - ROTO
7	310	MACHINING -CNC
8	673	SOLUTION TREAT 2
9	666	PRECIP TREAT 4/16
10	952	TEST FORGE
11	520	BLAST - TABLE
12	310	MACHINING -CNC
13	800	INSPECT
14	962	TO OUTSIDE WORK (going out)
15	974	FROM SONIC TEST (coming back)
16	570	PICKLE
17	958	NDT MICRO
18	952	TEST FORGE
19	820	STAMP

Workstation 80 includes a trim press and a furnace that will be dedicated to this hammer when these parts are being run

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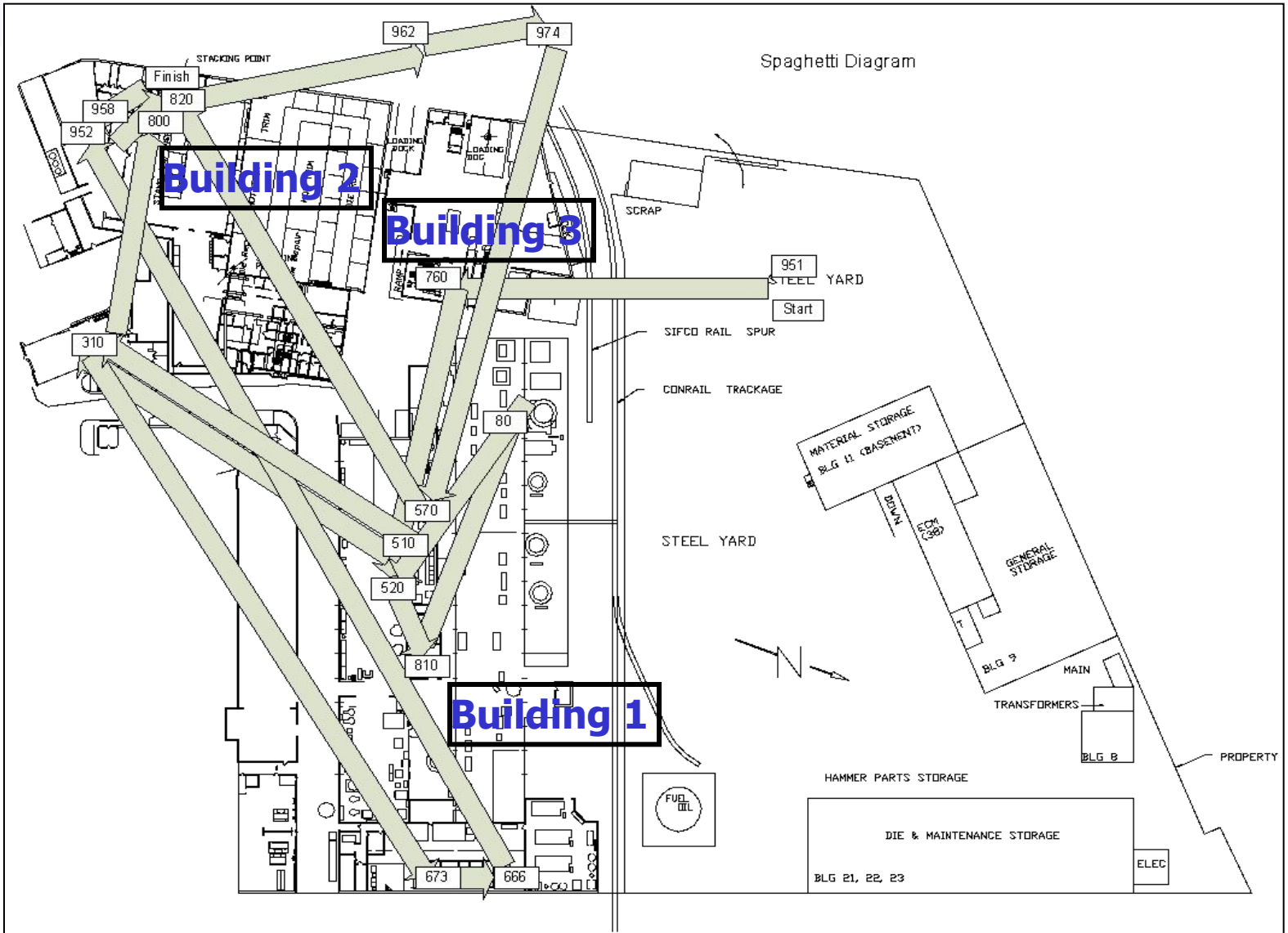
Flow Diagram



Analysis of Flow Diagram

- Analysis:
  - Parts have to travel a total distance of 7193 feet which results in significant batching
  - Large number of transportation steps
  - Poor LOS (Line Of Sight) because operations take place *in 3 different buildings* and, *within each building*, in different sections of the building that are separated by walls
  - Due to poor LOS, there is poor communication between departments and lack of signals to support JIT material flow and shopfloor control

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Part Flow Tracking

Part:	11043B	Total QTY:	48	W/O number: 275 1412
Date	**Location**	**Quantity**	**Condition**	**Comments**
10/26/05	Saw Room	48	Cut	Cut at the savage saw and chamfered
10/26/05	Blast - Roto Staging	24	Not Blasted	
10/26/05	Coating staging area	24	Not coated	After chamfer & blasting
10/27/05	Forge Staging	48	Coated	Waiting for forge
10/31/05	Running in Forging	48	Forged	Run on Hammer from 6:00am to 9:30am
11/01/05	Blast - Roto Staging	48	Forged	30 minutes in Blast Roto. There's 1 tag with qty 24 but there are actually 48 because the 2 bins are combined into 1 bin
11/05/05	Blast - Roto	48	Blast - Roto	This was run on a Saturday(over time).There's 1 tag with qty 24 but there are actually 48 because the 2 bins are combined into 1 bin
11/08/05	CNC Staging area	48	Blast - Roto	Waiting for CNC machine
11/09/05	CNC Staging area	48	Blast - Roto	Waiting for CNC machine
11/12/05	CNC machine	48	Machining	30 pieces are done. CNC has been running on Saturdays for a few weeks.
11/14/04	Heat Treat	48	Machined	Waiting for furnace
11/15/05	Solution	48	Solutioned	Roughly (7:45pm-11:15pm) at 1775F then water quench while letting furnace cool to 1000F(11:15-1:30am)
11/16/05	Precip	48	Precip	1:30am-8:00am in age. Then cool for another 6 hours
11/16/05	Table Blast	48	Table Blasted	
11/23/05	CNC Staging area	48	Table Blasted	Waiting for CNC machine since 11/16/05
11/29/05	CNC machine	48	CNC machined	Only run on 1 CNC machine since 11/23/05 late morning

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Part Flow Tracking (contd.)

- Some wastes identified from following the flow of the parts:
  - Waiting for the next operation (11043B has been waiting for 4 days in front of the CNC machine; it was run in table blast in overtime on Saturday)
    - Reasons:
      - Scheduling
      - Machine breaks down
      - Cool down time (a few hours after forge but usually 1 day is given)
      - Employee is not available (absent)
      - Not identified as rush item (the need to get it done fast for the next operation was not emphasized)
      - Lack of communication, lack of signals, and poor Line Of Sight between departments (not aware that the products might be needed quickly in the next department unless told by scheduler)

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Part Flow Tracking (contd.)

- Sometimes the parts "go missing" because they have moved to the next operation but this is not indicated in the MRP system or sometimes parts are taken to the wrong operation/workstation (happened to Part# 11044D) → Human error (Forgot to enter into the computer)
- Overtime in many departments:
  - Saw: 5 days 10 hr/day
  - CNC: Run on Saturday
  - Grinding: Run on Saturday
- Some departments have multiple staging areas → this sometimes leads to a search for parts
- There is no rule which part should be run first unless they are indicated as rush (or hot) order or expedited by the scheduler

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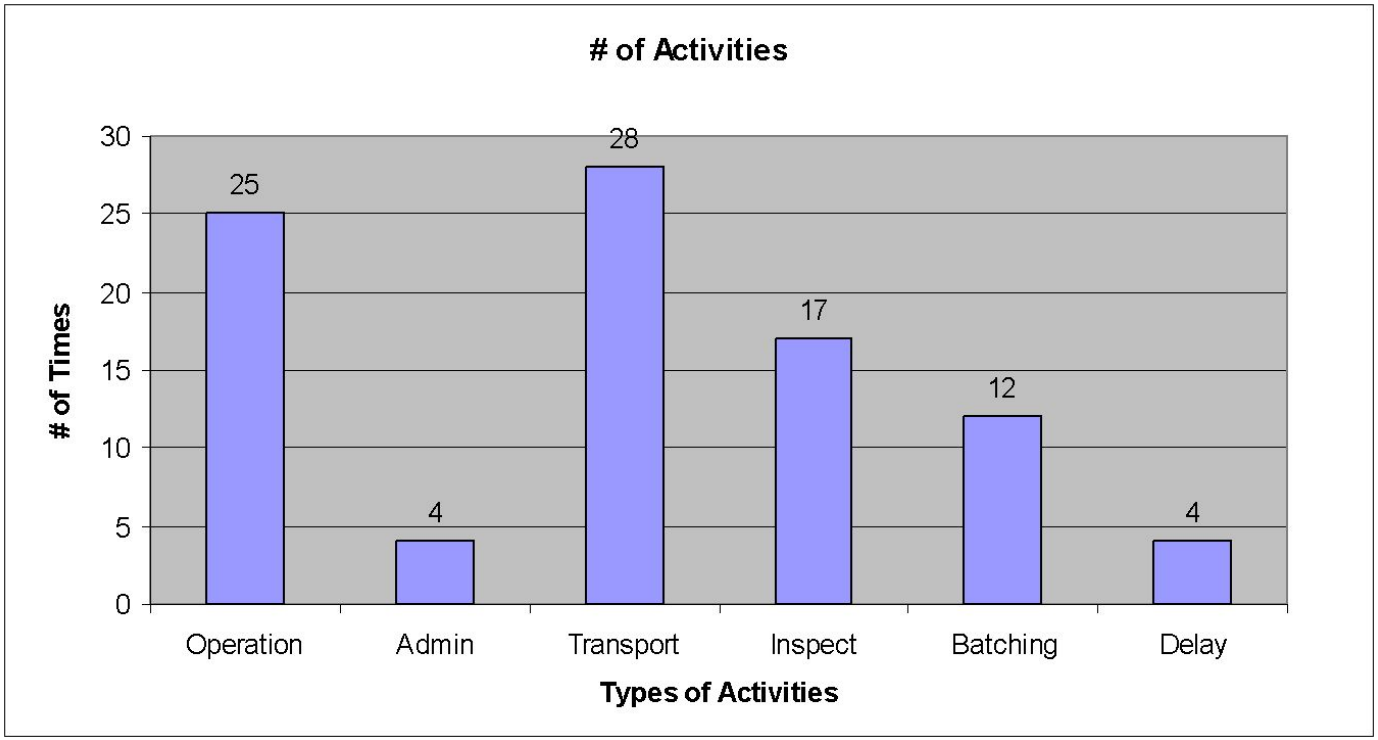
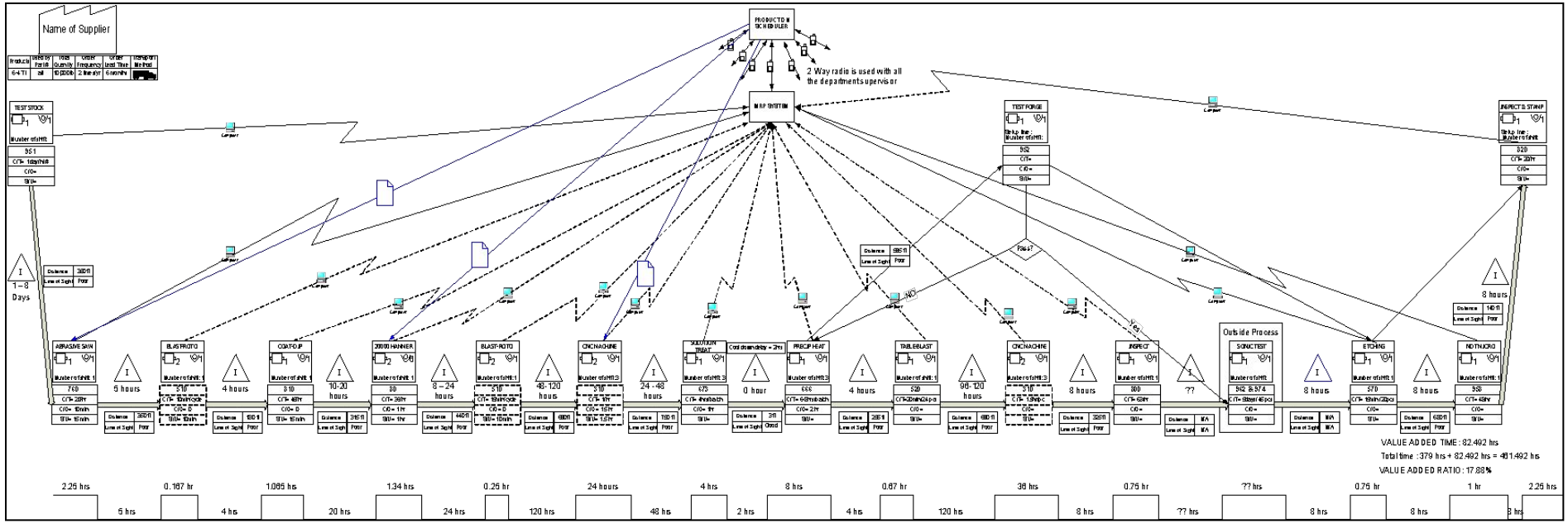
Flow Process Chart

- Flow Process Chart shows:
  - 28 transportation activities
  - 25 operation activities



Value Stream Map



Value Added Ratio ≈ 18% (does not include raw materials because they have minimum order of 10,000 pounds per order of 6-4 TI which lasts for almost 6 months)

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Value Stream Map (contd.)

- Captures the flow of information:
  - Between departments
  - Between the shop floor and scheduler
  - Between consecutive machines in the product flow path
- The wait times for the parts represent the amount of inventory in front of the workstations
- There is no direct communication between departments besides the MRP system printouts
- **Problem:** Once the parts are completed at any workstation, their status is input in the MRP system. The MRP system *assumes* that they will be taken to the next workstation.

Theory Of Constraints

- Identify the Bottleneck/Constraint
- Exploit the Constraint:
  - Improve utilization of available capacity on the bottleneck
- Elevate the Constraint:
  - Find new capacity sources or reduce the load on the bottleneck
- Subordinate the Constraint:
  - Schedule the remaining workstations and 'gate' the release of orders based on the capacity of the bottleneck
- Move to the next Constraint and repeat the process

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Identify the Constraint

- The theoretical bottleneck (based on cycle time) would be the outside processes (Sonic Testing)
- The in-house bottleneck (based on cycle time) will be the CNC machine
- However, in this project we will look at the **Forge Shop** since all parts that are produced in SIFCO go through this department! ☺
  - In particular, Hammers #2089 and #3585 because these are the hammers that are used to make this sample of parts and also most of the parts in Part Family #2.

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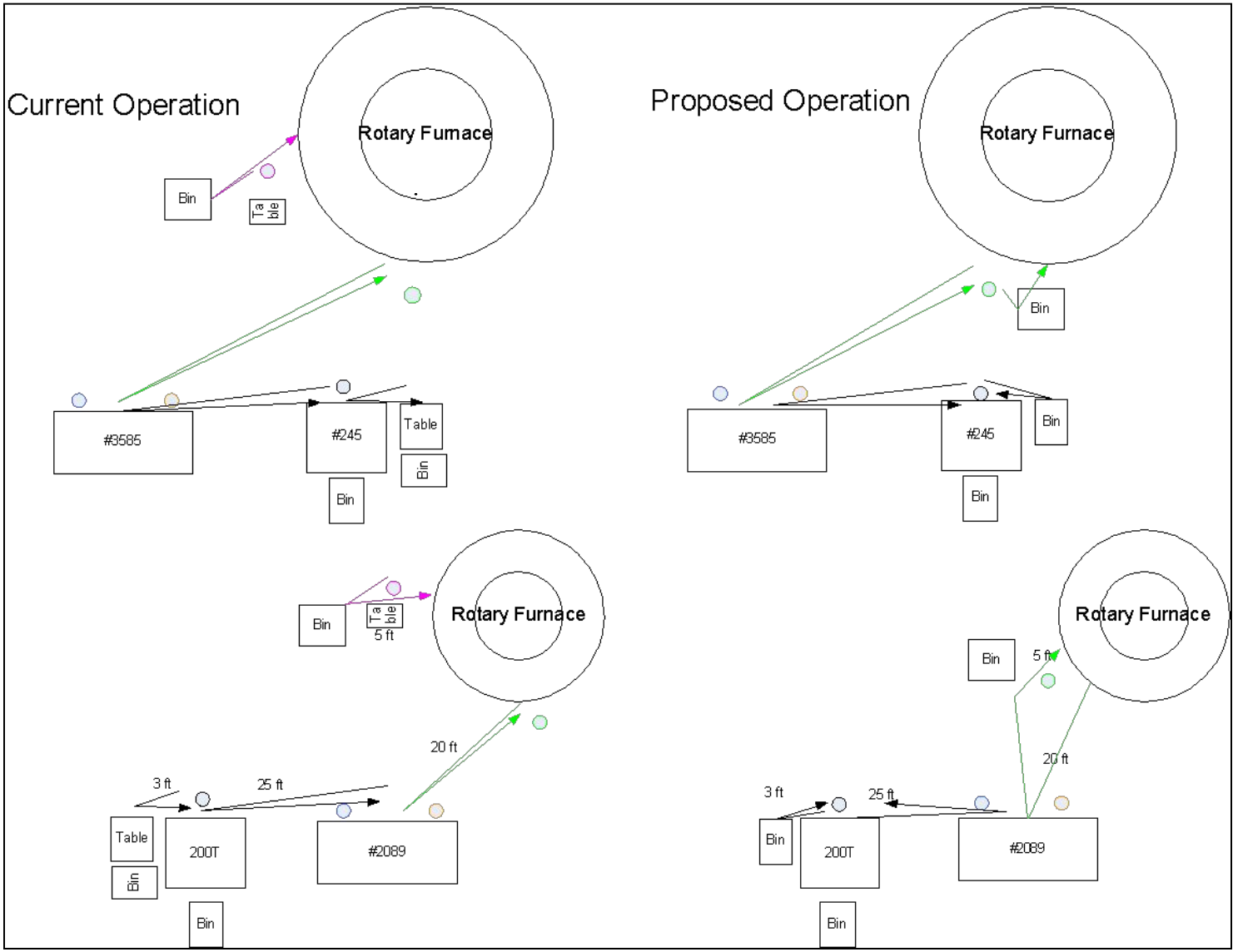
Exploit/Elevate the Constraint (1)

- Improving the work assignments in the shop which will lead to the following results:
  - Use a smaller crew each time the hammer is run
    - Let extra people help in prep/setup so the hammer can run continuously
    - Run extra hammers
  - Keep less people waiting for a job to run
- Currently:
  - The loader waits until the unloader finishes feeding a few pieces of bar stock before he starts putting bar stock in (may cause part to cool down if put too close to the heated stock)
  - The unloader waits from the time when the hammerman starts hammering until the trimmer-man picks up the part from the hammer

Exploit/Elevate the Constraint (1):
Improvements in Work Assignments

Forging Workstation



Exploit/Elevate the Constraint (1):
Results Predicted based on New Work Assignments

- Based on Part# 11042D that was run on 11/03/2005:
  - It took roughly 3.5 hrs. with 6 workers to finish 96 parts
- According to the time study with 4 workers
  - Value Added Time = 96 * 80 seconds = 128 minutes
    = 2 hours 8 minutes
- Therefore, the actual process took almost 1.5 hours more than the predicted Value Added Time and with 2 extra workers
- There were 6 workers at the workstation but usually there are only 5 workers
- The "extra" worker is now available to help in setting up the next hammer and loading the bar stock while the crew is working on a hammer

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Exploit/Elevate the Constraint (2)

- 5S (Sort, Systemize, Sweep, Standardize, and Self-Discipline) the Forge Shop which will help to reduce the time spent looking for tools or parts :
  - Next to Hammer #2089
    - Create a storage area close to the hammer for all the tools such as fans, tongs, sand, etc. that are needed when they are running the hammers

- Queue of jobs in staging area for hammers:
  - Create a separate area for re-strike, hold, and cancelled orders
  - Allocate an area at each hammer to queue active Work Orders that are scheduled to run within the next few days

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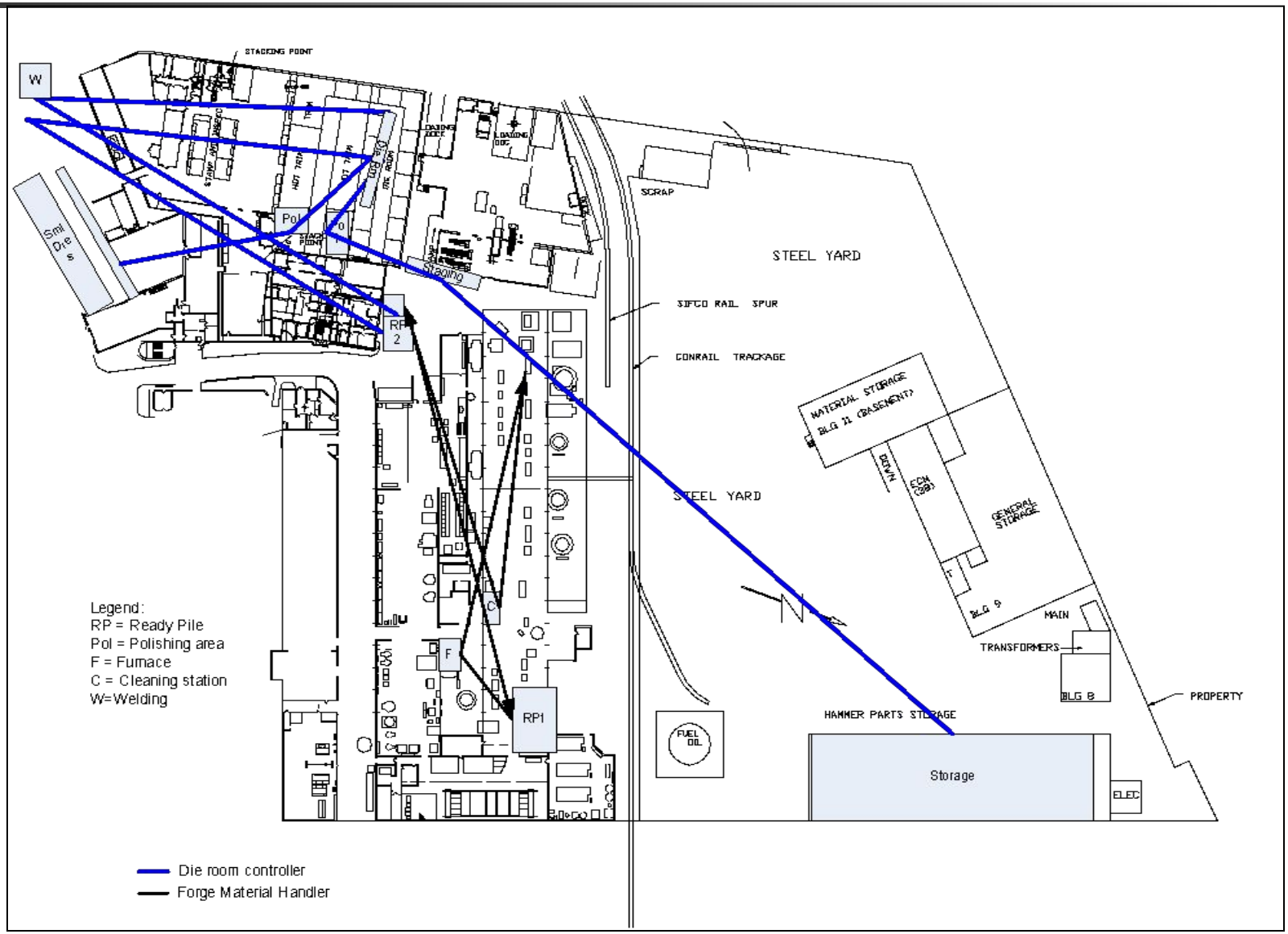
Exploit/Elevate the Constraint (2) (contd.)

- Ready pile area for dies:
  - Allocate different sections for a range of die numbers
  - Create aisles so it is easy to get to the dies

There is also a die "ready pile" outside the Forge Shop building because there is not enough space in the "ready pile" inside the building

Exploit/Elevate the Constraint (2):
Current Flow of Dies



Exploit/Elevate the Constraint (2): KAIZEN in Die Logistics and Storage

- Do 5S on dies:
  - Sort:
    - Purge the die ready pile (found 40 dies that are not needed within the next 6 months)
    - Received the whole list of part numbers and the last sales dates
    - Sort them by sales dates and segregate the ones that are older than 1996
    - The die room controller found some dies that are not in the MRP system
    - Sales administrator is looking at all the lists and making the decision on which one can be eliminated based on customer contract
- **Goal:** Improve the flow of dies to minimize handling and introduce systematic storage of dies to reduce delays due to retrieval, prep and availability of dies in Forge Shop

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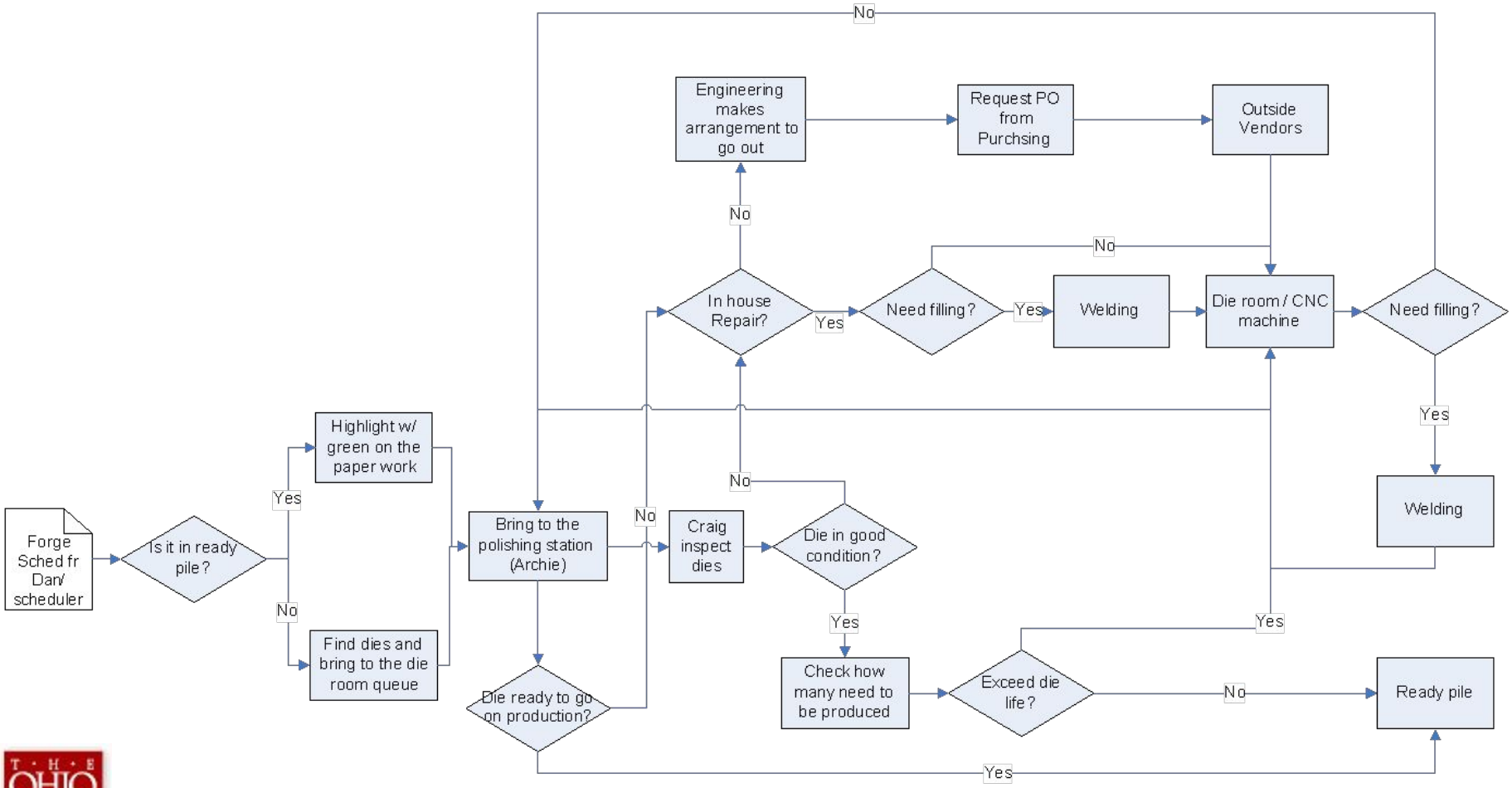
Exploit/Elevate the Constraint (3):
Flowchart for Die Prep



Exploit/Elevate the Constraint (3)

- Improve quality of dies that come into the Forge Shop because that results in following delays:
  - Rework and re-strike
  - Waiting for the dies to get fixed when materials are ready to go
  - Taking the materials out of the furnace to a staging area so another job can run in the hammer → this also results in waiting for the materials for the new job to reach a certain temperature before running the job

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Exploit/Elevate the Constraint (4)

- Smart Material Handler/Water Spider (Virtual Cell):
  - Responsible for knowing the forge schedule (for each hammer) so he can bring the right bar stock and dies to the right hammer at the right time
- Advantages:
  - Parts are ready at the location when needed
  - Parts are taken to the right place after they are completed
  - Less looking around for parts because only one person is moving parts and tools around
  - Eliminate some waiting due to material handling delays

Subordinate the Constraint

- Schedule the saw room, die room and the trim makers to the schedule of the Forge Shop
- The Forge Shop can never wait for anything from any previous workstation including die repair
- Limit the unexpected downtime in Forge Shop due to any reason especially if it is avoidable
- The work load between work centers should be leveled to the bottleneck

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Move to the Next Constraint

- Implement above recommendations and evaluate the results
- Once the Forge Shop is no longer a constraint then move to the next constraint

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8 Types of Wastes

- Explained to the scheduler and the manufacturing manager. Started analyzing from area to area individually (specifically related to the part family that has been chosen) and discuss possible solutions
  - Saw Area
  - Forge Shop
- Divided the jobs between the team and started from the largest impact and easiest to implement recommendation

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8 Types of Wastes in Saw Room

The 8 Wastes –	Finding	Why it happens?		How to solve?
Over-production	–Parts are cut even when the dies are not ready	Lack of communication	1	Train the foreman to follow the forge schedule
	– Parts are not cut when for the dies that are ready	Lack of communication	1	Train the foreman to follow the forge schedule
	– Extra parts are cut from the left over bar	Don't have good storage system & bad weather	2	Have racking system so short bars can be kept without loding them
Transportation	– Move the tow motor back and forth many times when bringing long bar into the saw area	Door too narrow	3	Widen the door?
	– Need a second person to open the door	Door doesn't open automatically	4	Add a rope/ remote that open and close the door
	– Lots of forklift movement to and from yard with empty load	Not trained/need better scheduling	5	There is an assigned incoming and outgoing material so ppl know what to bring. Pick a series of jobs not just one when traveling to the yard
	– Move extra bars to and from the yard	Comes in 1 bundle & bad weather	6	Unbundle and bundle on the spot when weather is good
	– Extra/left over bar stays in the saw area for a relatively long time	No sign that indicate that they need to go back to the yard	7	Better labeling of machines and areas

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8 Types of Wastes in Saw Room (contd.)

The 8 Wastes –	Finding	Why it happens?		How to solve?
Motion	-- Looking for bars that are not located/labelled properly	Unloading in a rush/ not enough training. Forgot where they put the materials	8	Improve communication, Have a shared material handler between grinding & saw. Have racking system that help in sorting and locating bars
	-- Poor machine layout	Too far from each other		
	-- Need to look for tools and carbide when changing the saw	No designated container and storage place for them	9	Create a kit for changeover
	-- Operator needs to walk to the weighing machine and back when checking the weight of the part	Weighing machine is already on a rolling table but plugged into the wall	10	Get battery operated weighing machine?
	-- To get into the pile/bin/anything that are inside, need to move all the things that are in front of it	Piles are stacked on top of each other. No racking or location allocation	11	Have racking system for bars, designated place for the different bin sizes, etc
	-- Move extra bars to and from the yard	Comes in 1 bundle & bad weather	11	Have racking system for bars, designated place for the different bin sizes, etc
	-- Must look for the appropriate size bins if not found	Discipline	12	Have all empty bins staged in front of saw area once any dept is finished using them
	-- Must get paperwork from the saw office		13	Distribute the job for the whole day to the respective operators at the beginning of the day
	-- Need lots of adjustment to the length sometimes	Uneven size of bar stock	14	Put tolerance requirement to the suppliers

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8 Types of Wastes in Saw Room (contd.)

The 8 Wastes –	Finding	Why it happens?		How to solve?
Waiting	-- Standing next to the band saw machine for the first piece before checking	Metalcut is too far for the operator to walk back and forth	15	Have a light/sound that will give signal once the bandsaw finish cutting
	-- Extra materials wait for months to get back to the yard–>sends false signal to procurement?	No sign that indicate that they need to go back to the yard	16	Better labeling of machines and areas
	-- Machine waits for the operator when they are not available	Unload and loading parts to/from trucks	17	Have materials handler responsible for Raw Mat'l, Saw and Grinding
	-- When changing the carbide	not expected	18	Have a record of what have run the machine so expect changes
	-- Waiting for paper work from the foreman	No copier in the Saw department	19	Give 2 copies to Saw dept initially
	-- Waiting for a tow motor when one is being used by the other operator		20	Should have a material handler for just saw and grinding
	-- Waiting for materials to be marked by Foreman		21	The unloader should mark the material and record the location. Schedule the incoming truck
	-- Waiting for someone to open the door when they are coming back from the yard	The door cannot open automatically	4	Add a rope/ remote that open and close the door

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8 Types of Wastes in Forge Shop

The 8 Wastes –	Finding	Cost/Waste	Why it happens?		How to solve?
Over-production	Produce stocks for a few months ahead	Inventory Cost	Long setup time	1	Sifco as a company set a standard lot size (sales & production agreement)
	There are some bars that are already cut when the order is on hold or cancelled	Inventory Cost	Lack of communication with sales or other reasoning		
	Produce to heat treat lot size	Inventory Cost	High cost in destructive testing		
	If there are a little left over from the bar stock; we will produce all	Inventory Cost	May have some defect, may lose the left over bar,		

Cut materials are covered with rust, it shows that they have been there for quite a while

Parts in Forge staging area that may need restrike or on hold

8 Types of Wastes in Forge Shop (contd.)

The 8 Wastes –	Finding	Cost/Waste	Why it happens?		How to solve?
Transportation	There are many dies in the ready piles that would not be used anytime soon	Time moving dies	Not returning the already used dies to the storage if they don't need it anymore	1a	Purge the ready pile
	Multiple handling of dies, about 4 different stations before reaching the hammer	Time, Trans cost		2	Choose dies that are commonly used, arrange in some logical order
	Long distances between the staging area and the hammer thus poor line of sight(can't see which hammer is about to finish).Sometimes parts are taken to the wrong station after forge	Time, Trans cost	No communication between the material handler & hammerman	3	Smart Material handler - water spider => Mike will train material handler to use the forge schedule to bring the needed items to the hammer
				4	Bring the dies according to the die room schedule and not just bring all the dies as it appears in the list
				5	Store dies that have not been used in 10 years in the storage building
	Material handling equipment often breaks down	Time, Maint. cost	Using without care	6	In the process of buying new MH. Should take better care of them(not bang anything with it)

Small aisle,rough driving, and dirty work condition would contribute to the break down of material handling equipments

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8 Types of Wastes in Forge Shop (contd.)

The 8 Wastes –	Finding	Cost/Waste	Why it happens?		How to solve?
Motion	Pick up fans, torch/lighter, cloth,tools, etc when moving from 1 hammer to the next	Productive time	No storage place in each area	7	Do 5 S in 2089 and check on the 5S in 2222 and blacksmith area
	Pick up parts from the bin to the table before feeding it to the furnace	Productive time	Too low to pick the part directly from bin to the furnace	8	design a container that will eliminate the transfering to table
	Looking for dies, trimmers, key knocker, etc	Productive time	No designated place	9	5S the dies and tools then create a map for their location
	Move all the dies around to get to the dies that are inside.Dies are stacked and lined up in rows so need to move the dies on top to get to the bottom dies	Productive time	Limited space	10	5S the area. There may be addditional area for dies in the precision forge for the extra dies --> only if needed..to support #2
	Must go down from forklift to be able to identify the parts	Productive time	tag too small	11	Have a bigger tag??put board #
	Look for the bin of parts that will run next because there are many other bins that are not needed immediately	Productive time		12	Assign a specific area for the queue of specific hammer for cut stocks
	Look for the other bin of parts(don't know there is another bin until they look at paper work)	Productive time	Not located together	13	Locate bins that contain the same part number together

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8 Types of Wastes in Forge Shop (contd.)

The 8 Wastes –	Finding	Cost/Waste	Why it happens?		How to solve?
Waiting	Crews waiting for the bar stocks to get hot	Productive time	need a few hours to heat up	14	May be have the hot inspector helps in loading the stock into the furnace
	Crews waiting for the dies to get hot because the die just come from the die room	Productive time	sometimes just done from die room	15	Schedule the die room to the forge schedule not just the whole list of dies
	Waiting for the tong to get hot so it can be bent to the shape that they want before continuing on the next job/part	Productive time	only have 1 tong that they work with	16	Have a spare tong that has the same shape as the one that they are using ->Rather difficult because they have to adjust according to the stock size
	Parts are completed partially before the forge thus they have to wait for the rest of them before they can run on the hammer	Productive time	Not processed together. Do the blasting 2 times, etc	17	Schedule person from grinding who helps in coating to utilize the die furnace when it is not being used(while doing some grinding if there's
	Wait for trimmers to be set up	Productive time		18	Schedule the trimmer makers based on the forge schedule/die room schedule so they can be there once the die is there
	Waiting after 3pm because they cannot start on a new job	Productive time	It is too late in the day to start a new job	19	Improve performance on cleanup
	The hammer breaks down; wait for it to get fixed (black smith only has 1)	Productive time	Preventive Maintenance does not keep the machineries in good working condition	20	Improve preventive maintenance quality of work and scheduling
	The helper sometimes have to wait because the hammerman is still hammering after they are done trimming etc	Productive time	No clear work assignment	21	New work assigment-> have 4 crews instead of 5

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8 Types of Wastes in Forge Shop (contd.)

The 8 Wastes –	Finding	Cost/Waste	Why it happens?		How to solve?
Over Processing	After the dies are heated in the furnace, it gets heated again the the hammer as it cools down when waiting for the removal of the current die and other things that needs done before they can start production	Productive time		22	Not take the die out of the furnace until the die in the hammer is removed.
	Reheat and restrike	Productive time	The die is not in good condition, does not fill the cavity well	23	Better inspection of dies before going into the forge shop
	Double labeling (the stamp of serial number)	Productive time	Afraid it does not read well on some numbers	24	Better inspection of dies before going into the forge shop
	Sometimes "Ready die" may not be ready for production. This cause unnecessary process such as the heated parts have to be taken out of the furnace(may be reblast,rewrap etc)	Productive time	impression is not good, lack of stamping dies. Not ready for the particular part number that will run	25	The die checker that finalize the "Ready" status must check the specification requirement of the specific part number(A,B,C,etc) that will run. Must make sure the die is really ready
Inventory	The are many bins with different part numbers in the staging area	Productive time	most of these are there for restrike(waiting for the next order of the same part to run)	26	Allocate an area for restrike jobs
	There are stocks to be run for the hammers to that are mixed with the restrike parts (can't differentiate)	Productive time	No allocated area	27	Split the inventory area by the queue for each hammer (have specific area for each hammer)

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8 Types of Wastes in Forge Shop (contd.)

The 8 Wastes –	Finding	Cost/Waste	Why it happens?		How to solve?
Defects	Sometimes "Ready die" may not be ready for production and cause defect and rework	Productive time, scrap parts	impression is not good, lack of stamping dies. Not ready for the particular part number that will run	28	Make sure it meets the specs for the parts that are going to run before going to the ready pile
	Sometimes parts stick to the die	Productive time	not well oiled	29	proper training
	Relatively high rework and defect rate	Productive time	many different causes	30	Defect reduction teams who looks at the different causes of defect and try to solve them
Inteligence	Material handler not well informed about where to take what and when	Parts taken to the wrong place	because the person who has the paper work does not tell him	31	Train the material handler to be the water spider
	hammerman driving a tow truck	Productive time	Material handler did not handle the die the way the hammerman wants it. Too long	32	Train material handler to be able to handle the dies properly

Recommendations for Improvement

Action #	Difficulties	Impact	Action	Person in Charge	12/7/2005
1	4	-2	Sifco as a company set a standard lot size (sales & production agreement)		
1a	-4	2	Purge the ready pile	Dan	Done
2	3	4	Choose dies that are commonly used, arrange in some logical order	Mike	Will meet on thurs
3	-1	1	Smart Material handler - water spider => Mike will train material handler to use the forge schedule to bring the needed items to the hammer	Mike	Done-trial period
6	-4	3	In the process of buying new MH. Should take better care of them(not bang anything with it)		
7	-4	3	Do 5 S in 2089 and check on the 5S in 2222 and blacksmith area	Mike	Will start 12/15/05
8	0	3	design a container that will eliminate the transferring to table	Mike	Have not started
9	-4	2	5S the dies and tools then create a map for their location	Dan	
10	3	4	5S the area. There may be additional area for dies in the precision forge for the extra dies --> only if needed. to support #2		
11	-4	-1	Have a bigger tag??put board #		
12	-4	2	Assign a specific area for the queue of specific hammer for cut stocks	Dan	
13	0	-4	Locate bins that contain the same part number together		
14	3	-1	May be have the hot inspector helps in loading the stock into the furnace		
15	-3	2	Schedule the die room to the forge schedule not just the whole list of dies	Erin with Craig	Discuss about the paper work
16	0	-4	Have a spare tong that has the same shape as the one that they are using ->Rather difficult because they have to adjust according to the stock size		
17	-3	3	Schedule person from grinding who helps in coating to utilize the die furnace when it is not being used(while doing some grinding if there's no cutting work to be done) or buy build new furnace	Greg	Spoke to Doug a little bit
18	-1	0	Schedule the trimmer makers based on the forge schedule/die room schedule so they can be there once the die is there	Craig	
19	-2	3	Improve performance on cleanup	Mike	In Progress
20	0	4	Improve preventive maintenance quality of work and scheduling	Greg	
21	0	3	New work assignment-> have 4 crews instead of 5	Mike	Have not started
22	-1	1	Not take the die out of the furnace until the die in the hammer is removed.	Mike	Done-trial period
24	-3	2	Better inspection of dies before going into the forge shop	Craig	
25	-3	2	The die checker that finalize the "Ready" status must check the specification requirement of the specific part number(A,B,C,etc) that will run. Must make sure the die is really ready	Craig	
26	-2	0	Allocate an area for restrike jobs	Dan	
27	4	2	Split the inventory area by the queue for each hammer (have specific area for each hammer)	Dan	
28	-3	2	Make sure it meets the specs for the parts that are going to run before going to the ready pile		
29	4	-3	proper training		
30	-2	4	Defect reduction teams who looks at the different causes of defect and try to solve them		
31	-1	1	Train the material handler to be the water spider	Mike	Done-trial period
32	-1	1	Train material handler to be able to handle the dies properly	Mike	Done-trial period

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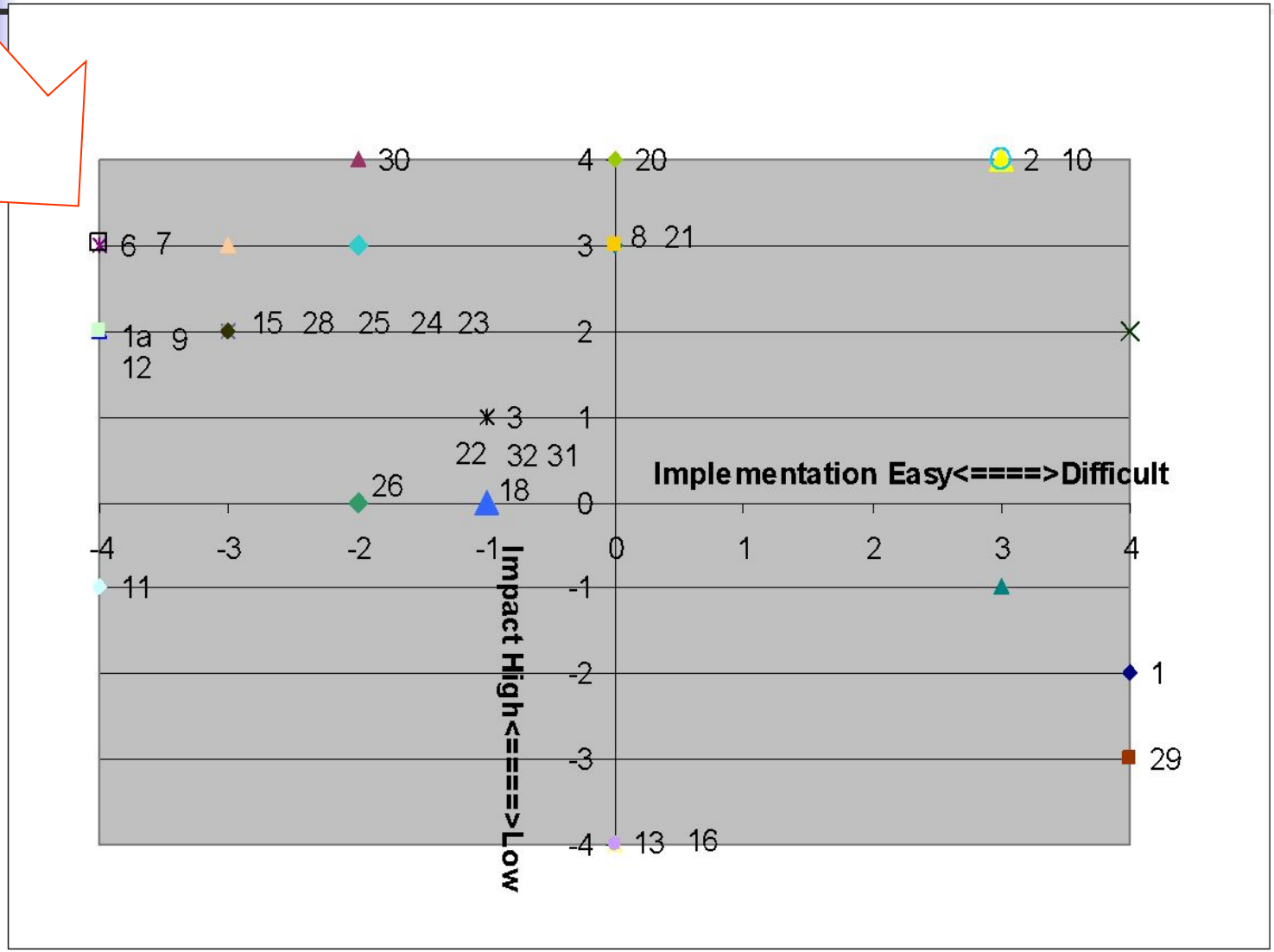
Ranking of Recommendations

Small Cost, Big Impact



Implementation of Recommendations

- **Items #1a, #2, #10:** In-process
  - Will reduce die handling time by 20%
- **Item #3:** Implemented
  - Increased awareness of forge shop requirements; less reliance on supervisor
- **Item #11:** In-process
  - Targeted for First Quarter 2007
- **Items #15, #18:** Implemented
  - Launch schedule created for having tooling ready on time and in prime condition in die room based on demand for tooling in Forge Shop; has drastically improved the Forge Shop schedule
- **Item #17:** Implemented
  - Alternative schedules for coating using die furnace when available

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Source: Greg Muniak, Lean Champion, SIFCO Forge Group (DLA Supplier)

Implementation (contd.)

- **Item #19:** In-process
  - Improved awareness of condition of facility and personal responsibility for maintaining their work area
- **Item #20:** Implemented
  - Reduced downtime in Forge Shop by doing repairs in p.m. and off shifts; reduced number of shutdown projects by working around production schedules during year
- **Item #21:** In-process
  - Hiring a full-time Lean Manufacturing Manager to evaluate all areas of operation and to drive Lean throughout the organization; payback will be immediate

Source: Greg Muniak, Lean Champion, SIFCO Forge Group (DLA Supplier)

Implementation (contd.)

"…..Much of the initial work we have done is hard to $ quantify but we know there have been cost benefits, both in pure time and $ savings *but also in the mindset installed in the workers about looking for ways to improve processes*. *With the hiring of a Lean Manager, we expect to see large, quantifiable cost savings.* We should have the new person on board within the next 4 weeks…."

Source: Greg Muniak, SIFCO Forge Group (DLA Supplier), 9-21-2006

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General Findings & Suggestions

- Finding: Communication issues
  - No direct communications between departments thus:
    - Some departments are unaware of what job is coming up without instruction from the scheduler
    - Unaware of the work load of the next workstation
  - Each department is trying to finish any jobs that are in front of them as fast as possible without knowing the priority
  - There is no indication as to how many bins does a work order have besides the paper work that informs them about the total number of parts.

    - Show the total number of bins used by the parts on the metal tag.
      - For example: 1 of 2
    - Standardize the number of parts per bin for different part numbers
  - Different machine numbers are used in the office and on the shopfloor

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General Findings & Suggestions

- Suggestions: Improve communication between departments
  - Use some signals like Andon light
  - Use MRP (that the scheduler can adjust anytime) to list the jobs instead of having to ask through the 2-way radio each time a job is done
  - Put the queue in some order of production (water spider could help with this)
  - A list that connects the management number and the shop floor number has been created
  - Use the same work center/machine number for any department in the company to avoid confusion and miscommunication
  - Better labeling on the shop floor
    - Machine numbers
    - Boundaries of various areas (departments, incoming, outgoing, etc)

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General Findings & Suggestions

- Finding: Large travel distances between workstations and multiple handling
  - Total travel distance of 7193 feet for sample part
  - Distance between Heat Treat to CNC machine is 750 feet
  - The Cold Inspection area (pack any products that will leave SIFCO Property) is about 200 feet away from the shipping docks
  - The staging areas are not arranged in any logical order of production which results in considerable movement of products
- Suggestions:
  - The Cold Inspection area can be separated to different areas because these are "green" (easy to move) equipment
  - Have the products arranged in the staging area

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General Findings & Suggestions

- Finding: Significant movement of material handling equipment
  - Operation cost
  - Maintenance cost
  - Time lost looking for items
  - Some examples of activities:
    - In Forge (1 person tight down to run the forklift when running big parts) – try another solution
    - Just to get around or to look for items, lots of Golf carts are used etc (should have a designated place & usage log)
- Suggestions: Water striders (Smart material handler) instead of having everyone going around with forklift delivering parts
  - Advantages:
    - Eliminate communication breakdown between departments
    - Eliminate confusion
    - Operators can concentrate on what they are doing
    - Better maintenance of the material handling equipment

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General Findings & Suggestions

- Finding: Outdated/under-utilized standards
  - There are standard instructions on the responsibilities of each worker but they are not well applied
  - Some standards in the MRP systems are outdated or inaccurate
- Suggestions:
  - Use the standard work instructions for each area and possibly improve the procedures
    - Some areas are susceptible to accidents
  - Revise standards for the MRP system
    - The Saw department still uses the old standards which were based on the machines that do not exist anymore
    - The standards on the CNC machine for finishing off the sample parts need to be revised

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General Findings & Suggestions

- Finding: No allocation strategy for matching a furnace with type of heat treatment for a job
  - There are many furnaces that can perform multiple heat treatment processes but they are not clearly specified
- Suggestion:
  - Create a matrix to match each furnace with a planned set of HT methods → this will help to assign specific furnaces to a limited range of HT methods, thereby reducing changeover losses (idle time, energy, throughput, etc.)

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General Findings & Suggestions

Heat Treatment/Furnace #	Materials	Preheat	Deep Freeze	Normalize	Austenitize	Sub-critical Anneal	Anneal	Solution	Temper	Age/ Precipitate	Stabilize	Water Quench	Polymer Quench	Oil Quench	Stress Relieve	Embrittlement Relieve
168	Carbon/low alloy Steel	X		X	X									X		
380	Carbon/low alloy Steel	X			X									X		
534	Carbon/low alloy Steel	X		X		X										
2157	Carbon & low alloy Steel,titanium,nickel base alloy such as 718 & PH Steel	X				X			X	X						
2063	Carbon & low alloy Steel,titanium,nickel base alloy such as 718 & PH Steel	X				X			X	X						
3543	Cryogenics		X													
3555	Carbon & low alloy Steel,titanium,nickel base alloy such as 718, berryllium copper & PH Steel	X		X	X	X	X	X	X	X	X	X	X		X	
5781	Carbon & low alloy Steel,titanium,nickel base alloy such as 718 & PH Steel	X		X		X	X		X	X					X	
5782	Carbon/low alloy Steel,alloy such as 718 & PH Steel	X					X		X	X					X	X
5823	Carbon/low alloy Steel,alloy such as 718 & PH Steel	X				X			X	X						
8001	Carbon/low alloy Steel,alloy such as 718 & PH Steel	X		X		X	X		X	X					X	

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Preferred Furnace-Process Assignment

Future Work

- Systematic Handling Analysis
- Process Rationalization:
  - Reassign some operations to positively impact the majority of routings
- "Plus one" i.e. having the next job available in the "hot spot" in case something goes wrong

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