



Six Sigma DMAIC Improvement Story

Green Belt Project Objective:
To Improve Efficiencies of Bulky Trash Pick-Ups

Last Updated: 12-23-12

Team: *The Incredible Bulk*

Alejandro Martinez-Esteve (Co-Tm Ldr) Alonzo Kendrick (Co-Tm Ldr)

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Kathleen Woods-Richardson (Sponsor) Chris Rose (Sponsor) Ray Scher (Sponsor)



Lean Six Sigma Problem Solving Process

The team utilized the 5-Step DMAIC problem solving process.

DMAIC Performance Improvement Process

Process Step		Description of Team Activities
Number	Name	
1	DEFINE	<ul style="list-style-type: none"> • Select Problem • Identify Project Charter • Develop Project Timeline • Establish Method to Monitor Team Progress • Construct Process Flowchart • Develop Data Collection Plan • Display Indicator Performance “Gap”
2	MEASURE	<ul style="list-style-type: none"> • Stratify Problem (i.e. “Gap”) • Identify Problem Statement
3	ANALYZE	<ul style="list-style-type: none"> • Identify Potential Root Cause(s) • Verify Root Cause(s)
4	IMPROVE	<ul style="list-style-type: none"> • Identify and Select Improvement(s) • Identify Barriers and Aids • Develop and Implement Improvement Plan • Confirm Improvement Results
5	CONTROL	<ul style="list-style-type: none"> • Standardize Improvements within Operations • Implement Process Control System (PCS) • Document Lessons Learned • Identify Future Plans



Select Problem

Management reviewed many problems using a selection Matrix.

Project Selection Matrix					
Problem(s) <i>(where cause is unknown and knowing cause is desired)</i>	Customer (Internal or External)	Selection Criteria			C=A*B
		A Impact on Customer (Accuracy/ Cost /Timeliness)	B Need to Improve (Performance Gap)	Estim. Month for Project Ready and Prep'd	Overall
1 PWWM: Bulky Trash Collection Costs are too high	External	4	4	Oct '12	16.00
2 PWWM: Public Works Road & Bridge operations needs to be more efficient/effective (e.g. generalist vs specialist teams)	External	3	4	Oct '12	12.00
3 PWWM: Capital construction projects not getting done quickly enough (especially length of time to launch project)	External/Internal	3	3	Oct '12	9.00
4 PWWM: Costs of Chemical Collection are too high	External	3	3	Oct '12	9.00
5 PWWM: Carryover is too high in Special Taxing Districts	External	3	3	Oct '12	9.00
6 Internal Services Department: Procurement process is too long/cumbersome	Internal	4	4	Oct - Nov '12	16.00
7 WASD: It takes too long for Dept to effectively answer/handle customer service calls	External	4	4	Nov '12	16.00
8 Transit: Cost of bus service has risen more dramatically than expected	External	4	4	Nov '12	16.00
9 Fleet Maintenance Costs are too high	Internal	tbd	tbd	Nov '12	TBD
10 PROS (Parks, Recreation, and Open Spaces): tbd	tbd	tbd	tbd	Nov - Dec '12	TBD
Rating Scores:		5= Extreme 4= High	3= Moderate 2= Low 1=None		

The team was chartered by management to address Bulky Trash Pick-Up costs.



Identify Project Charter

The team developed a team Project Charter.

Project Charter	
Business Case	Project Name: To improve Efficiencies of Bulky Trash Pick-Ups
	Problem/Impact: Bulky Trash has not consistently met the 9 day Pick-up standard or Cost per Yard Targets. Also, constituent complaints and dissatisfaction result from late pick-ups.
	Expected Benefits: Improved Efficiencies and reduce cost
Objectives	Outcome Indicator(s) Q1- Bulky Trash Pick-Up Cost per Yard; Q4- % of Bulky Trash Pick-ups that were Late
	Proposed Target(s) Q1 Target= \$50 ; Q4 Target= 5%
	Time Frame: October 2012 thru March 2013
	Strategic Alignment: Supports the County's Business Plan
Scope	In Scope: Bulky Trash Requests
	Out-of-Scope: Other types of Requests
	Authorized by: Kathleen Woods-Richardson
Team	Sponsor: Kathleen Woods-Richardson, Chris Rose, Ray Scher
	Team Leader: Alejandro Martinez-Esteve; Alonzo Kendrick
	Team Members: Vivian Gonzalez-Cao, Rey Perez, Danny Diaz, Khanya Robinson, Darran Kinsey
	Process Owner(s): Alonzo Kendrick
	Mgmt Review Team: Ray Scher; Chris Rose; Kathleen Woods-Richardson
Schedule	Completion Date: 31-Mar-13
	Review Dates: Monthly and Final Review in Mach 2013
	Key Milestone Dates: See Action Plan



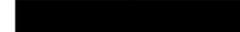
Develop Project Timeline Plan

The team developed a timeline plan to complete the Project.

4.

Legend:	
	= Actual
	= Proposed

WHAT: Complete DMAIC Story Project by March 31, 2013

DMAIC Story Process Step	WHEN					
	2012					
	Oct	Nov	Dec	Jan	Feb	Mar
1. Define	 		Completed 11/30/12			
2. Measure	 		Completed 11/30/12			
3. Analyze			 	Completed 12/12/12		
4. Improve			 		1/30/13	
5. Control			 			3/30/13

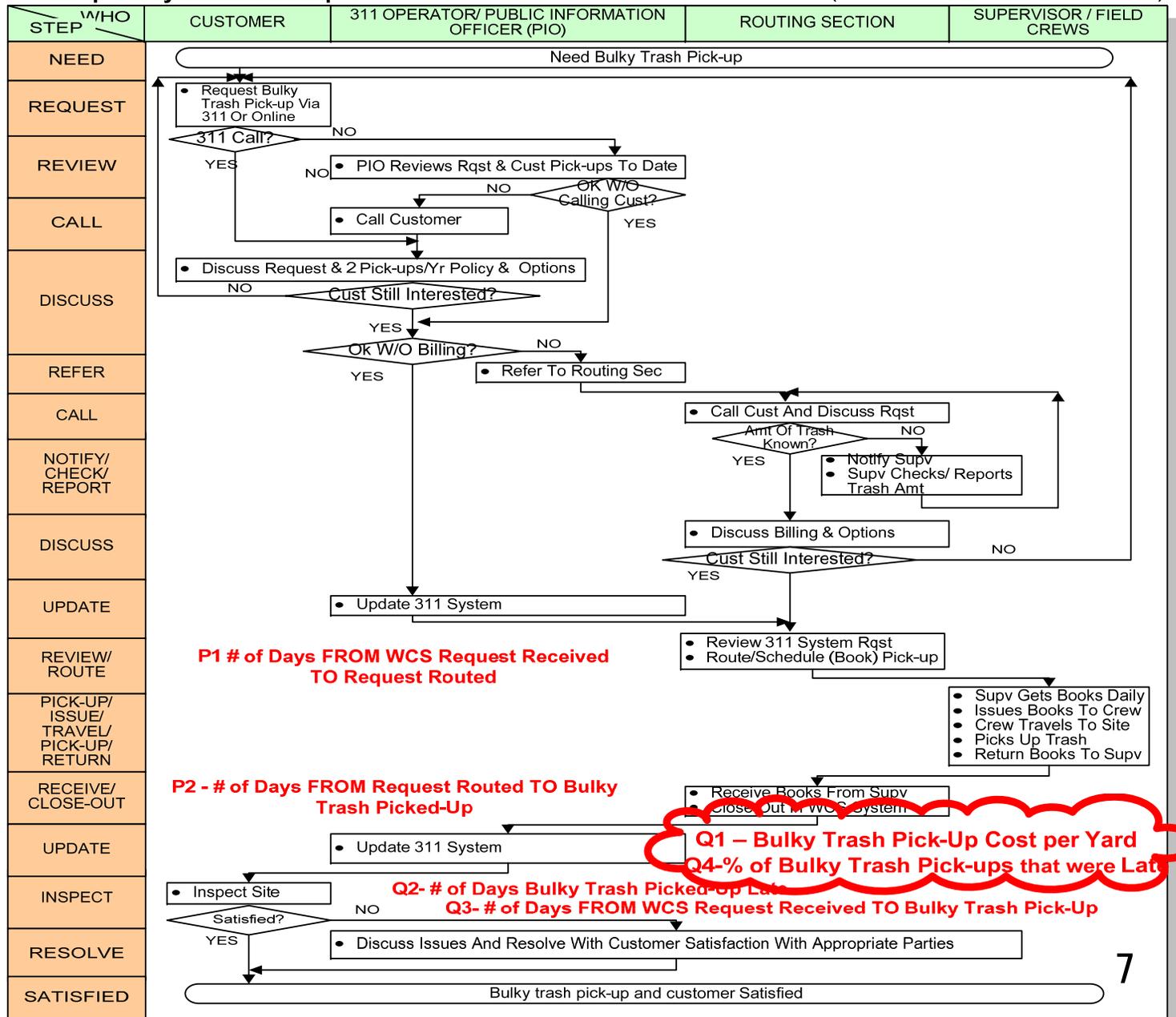


Review Process Flow Chart

The team constructed a Process flow chart describing the Process.

The team next looked closer how to capture indicator data.

Pick-up Bulky Trash on Request for Customers (Process Owner: Alonzo Kendrick)



Bulky Trash "Cost per Yard" Factors

The team identified Cost factors for Bulky Trash operations:

Pick-up Cost
per Yard = (Crew Costs/pick-up + Crew Transfer Fees/pick-up)/Pick-up Yards)

Where...

Crew Cost per Pick-up = (Truck cost/day)+[(Sum of Crew's Hrly Wage including Fringe Benefits)*(10 hrs per day)]/(Crew Pick-ups per day)

Crew Transfer Fees per Pick-up =(Avg Fee per crew Load)/(#Pick-ups per Load)

Actual Calculations for Crews:

Scorpion Crew (*Scorpion Crane & two 32 yard capacity trucks; Crane Oper, 2 drivers, Waste Attendant*) =
 $[(\$696.35) + (\$101.26 * 10hr)] / 12 \text{pickups}$
 $+ (\$287.50) = \$429.91 \text{ per Pick-up}$



Hawk (One Man Show) Crew (*1 crane 25 yard capacity truck; Operator & Waste Attendant;*)= $[(\$264.33) + (\$50.50 * 10hr)] / 8 \text{pickups} + (\$168.46) = \$264.63 \text{ per Pick-up}$



Note: See Appendix for cost calculations



Identify Data Collection Needs

The team developed a data collection spreadsheet...

BCB	D E M O G R A P H I C S											
	Work Order Information											
Line #	B	C	D	E	F	G	H	I	J	K	L	M
	Work Order #	Reason Description	Address	Dist	# of Pick-ups Used	Book #	Div	Drop off Location	Crane Operator	Type Crew	Cost per Pick-up	Pick-up Yards
				% D8	% 2		% North	% NETS		%Scorpion	Average	
				23%	1%		39%	8%		63%	\$355	11.9
1	55351300	SCHED PICK	1275 NE 17	4	0	2	North	NETS	CHESTER	Scorpion	\$414.20	3
2	55362700	SCHED PICK	21800 SW 1	9	0	22	South	SDLF	DAVID WIL	Scorpion	\$414.20	12
3	55378000	SCHED PICK	9750 SW 66	7	0	15	South	WTS	JEFFREY	Scorpion	\$414.20	50

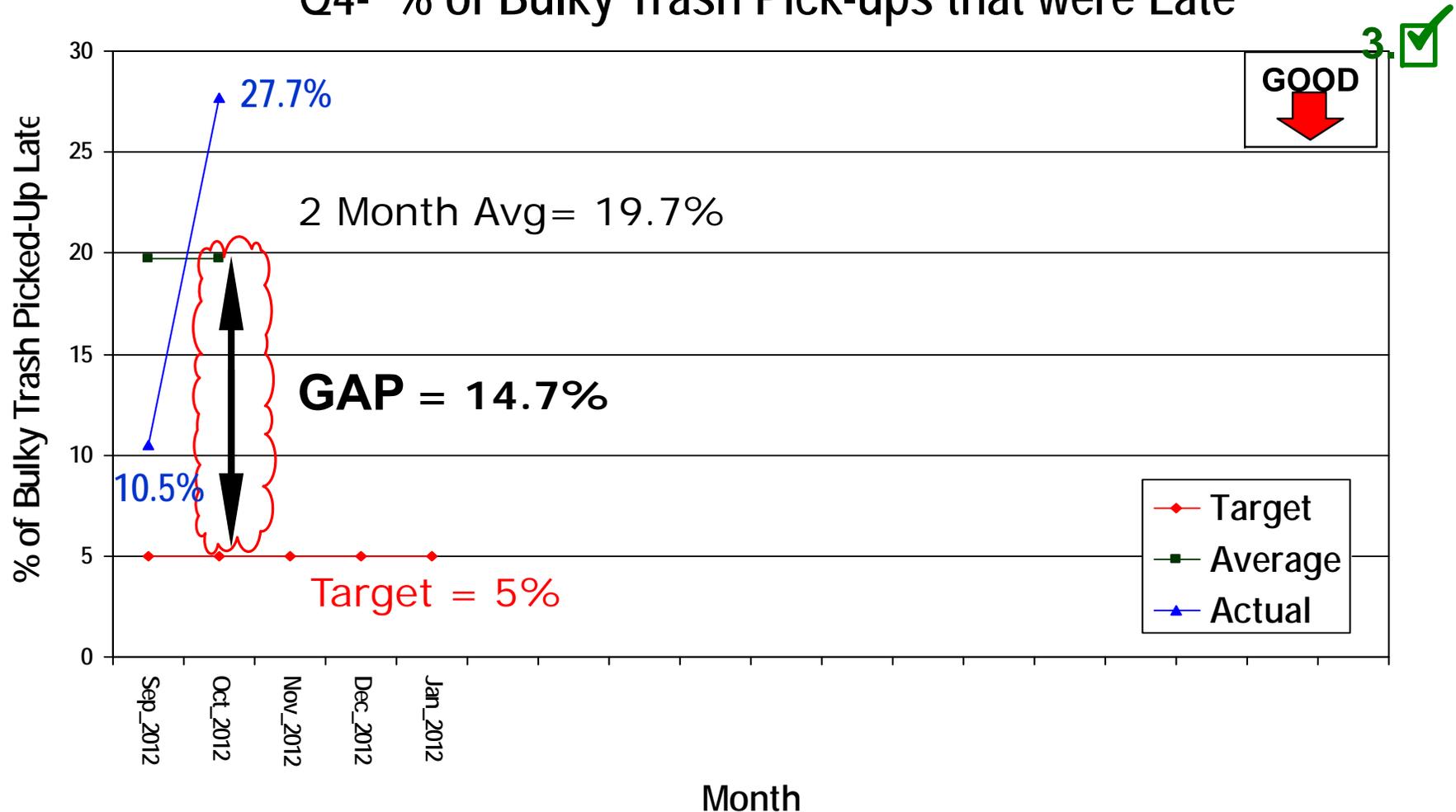
MILESTONE DATES						DURATION			OUTCOMES			BB
N	O	P	Q	AA	AB	P-N	AA-P	AA-N	AI-90	AI<=9	BA = L/M	
1- WCS Order Date		2- Request Routed Date		3- Pick-up Date		WCS Rec'd TO Rqst Routed	Rqst Routed TO Pick-Up	WCS Rc'd TO Pick-Up	# of Days Pick-up was Late	Pick-Up Late?	Pick-Up Cost per Yard	
Day	Day	Day	Day	Day	Day							
%Mo	%Mo	%Mo	%Mo	Avg # of Days			%Y	Avg				
25.8		26.9		22.2	2.1	6.6	8.7	-0.3	31.8	\$56.26		
P1		P2		Q3		Q2		Q4		Q1		
10/11/12	Th	10/15/12	Mo	10/18/12	Th	4	3	7	-2	N	\$138.07	
10/11/12	Th	10/12/12	Fr	10/18/12	Th	1	6	7	-2	N	\$34.52	
10/12/12	Fr	10/15/12	Mo	10/18/12	Th	3	3	6	-3	N	\$8.28	



Review Selected Indicator

The team collected Q4 indicator data and reviewed performance trends:

Q4- % of Bulky Trash Pick-ups that were Late



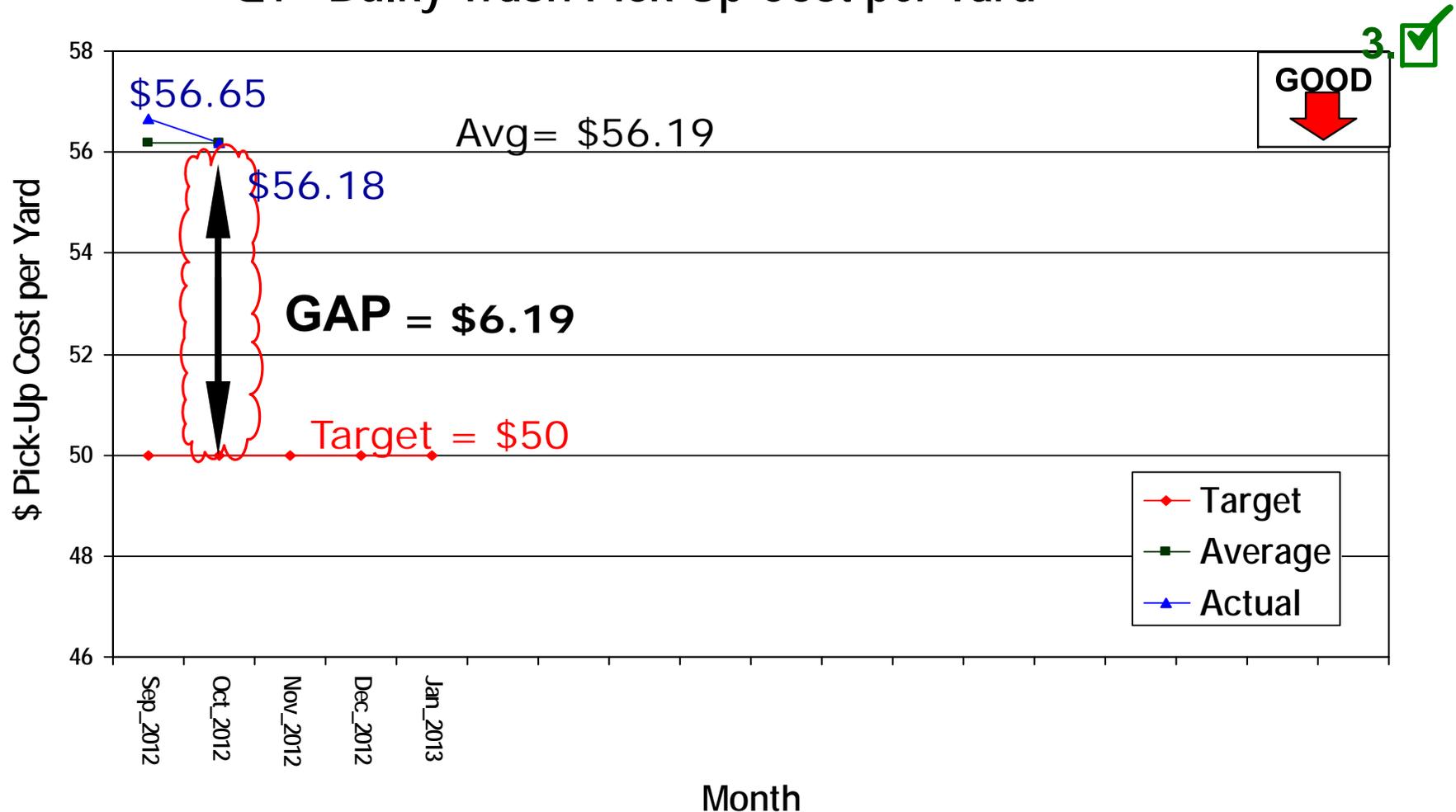
The team next looked at the Q1 Indicator Performance.



Review Selected Indicator

The team collected Q1 indicator data and reviewed performance trends:

Q1- Bulky Trash Pick-Up Cost per Yard



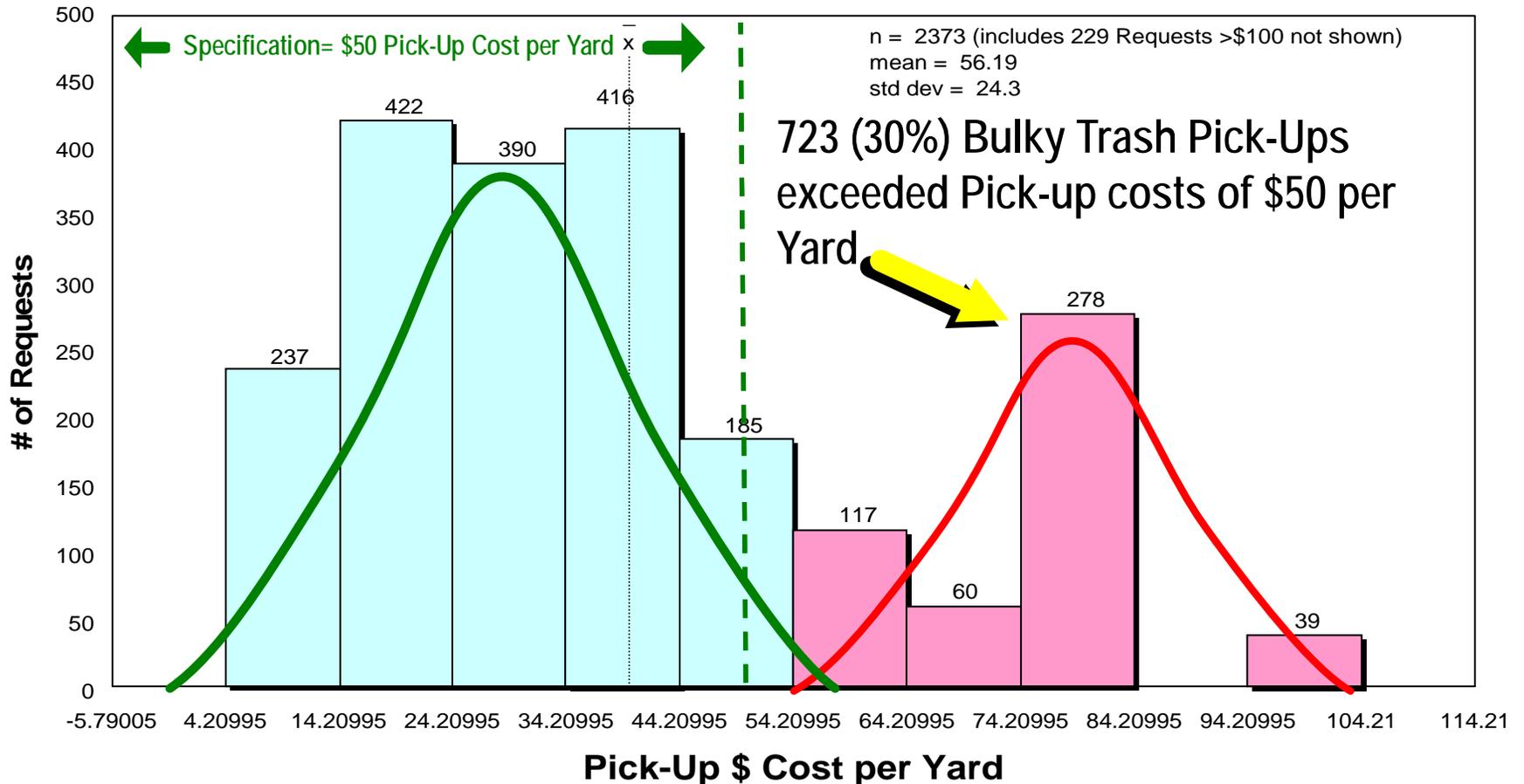
The team next looked closer Sep and Oct Pick-up Cost per Yard Data.



Stratify the Problem

The team sampled 2373 October Bulky Trash Pick-ups and constructed a histogram:

**Bulky Trash Pick-Up Requests Completed
from Oct 18 through Oct 31, 2012**



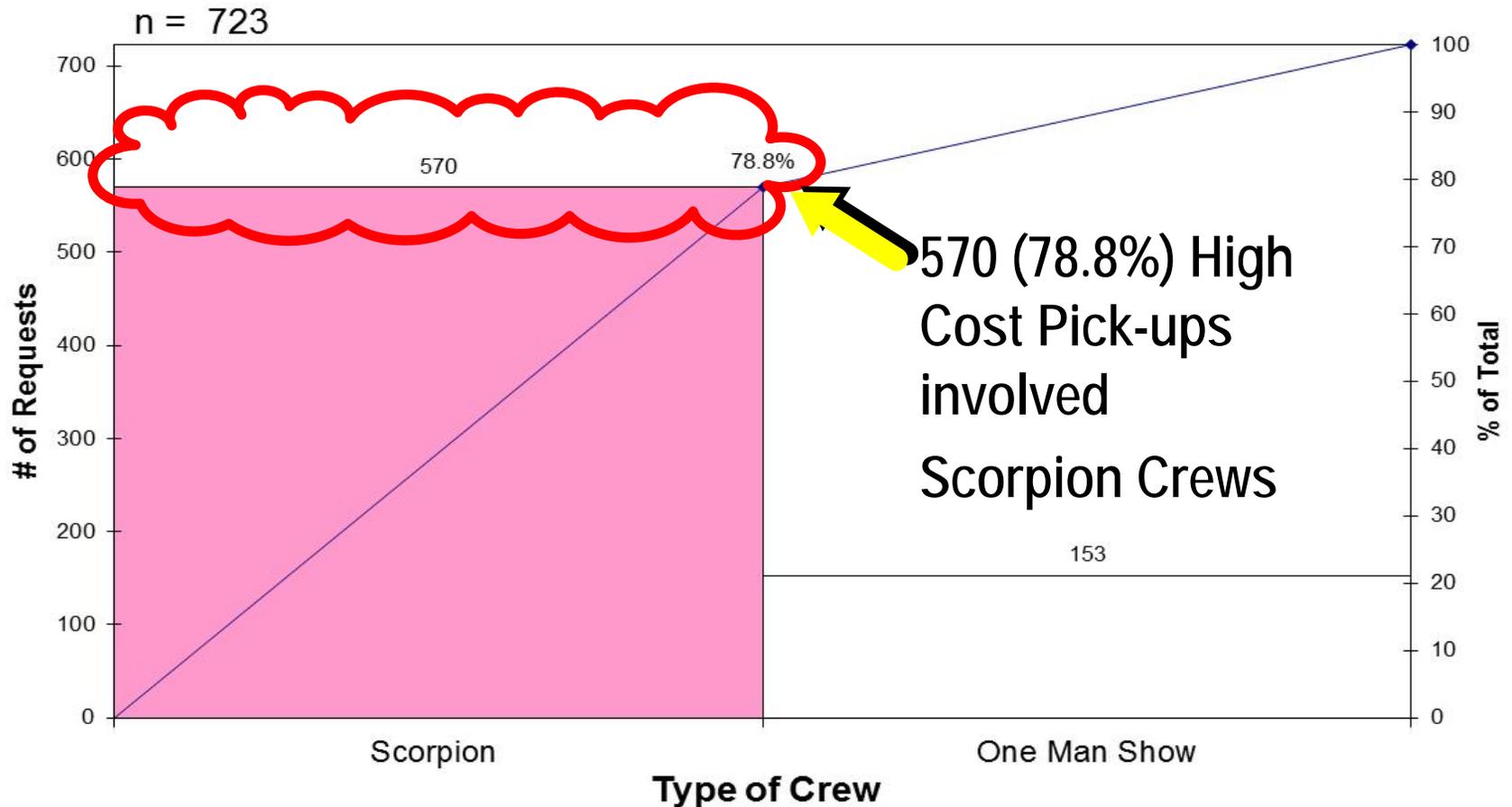
The team looked closer at these 723 high cost Pick-ups.



Stratify the Problem

The team stratified the 723 high cost pick-ups many ways and found...

**Bulky Trash Pick-Up Requests Completed
from Oct 18 - Oct 31, 2012 Costing over \$50 Pick-up Cost per Yard**

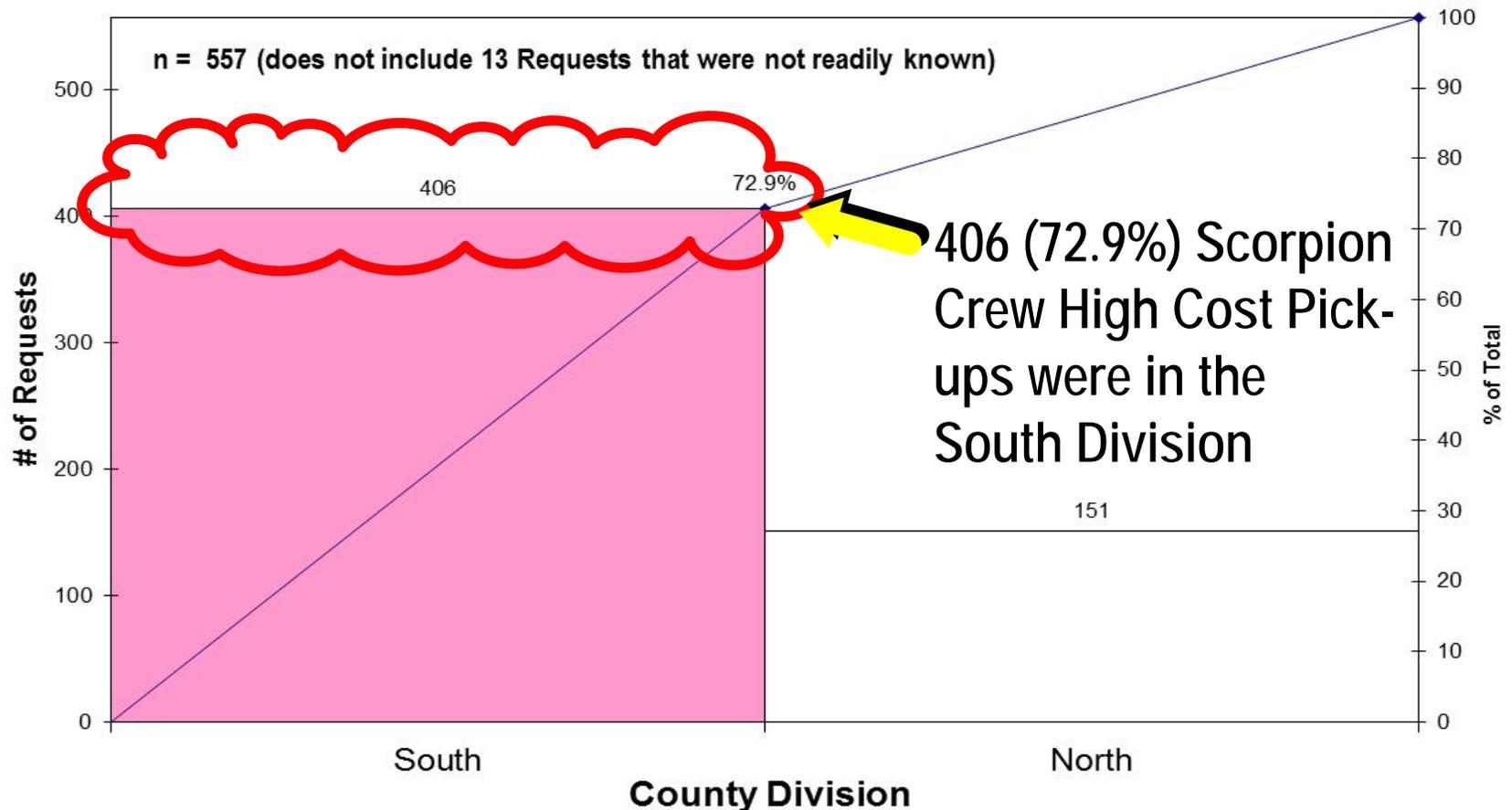


The team looked closer at these Scorpion Crew Pick-ups.

Stratify the Problem

The team stratified the 570 high cost Scorpion pick-ups many ways and found...

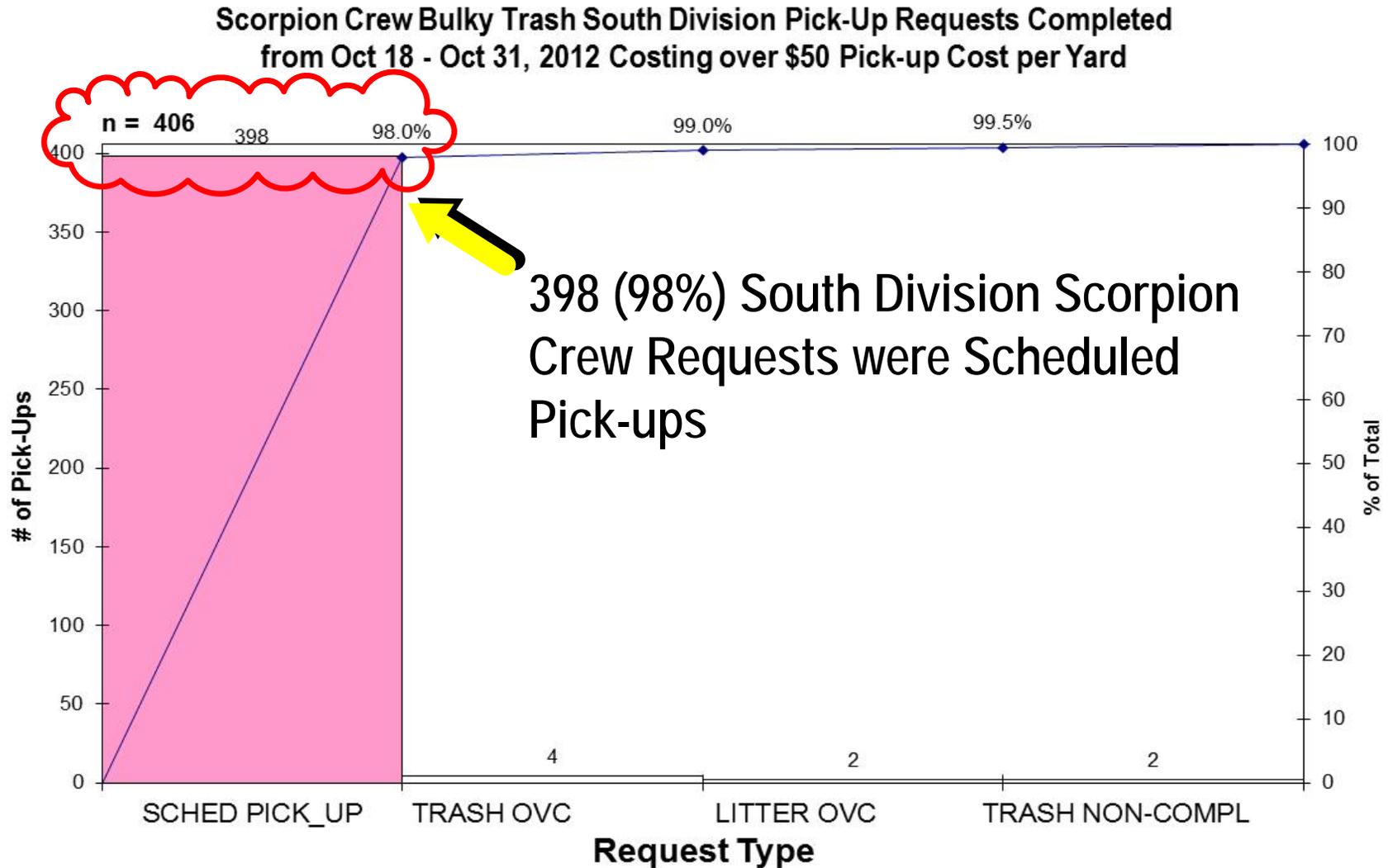
Scorpion Crew Bulky Trash Pick-Up Requests Completed
from Oct 18 - Oct 31, 2012 Costing over \$50 Pick-up Cost per Yard



The team looked closer at these South Division Pick-ups.

Stratify the Problem

The team stratified the 406 high cost South Division pick-ups many ways and found...

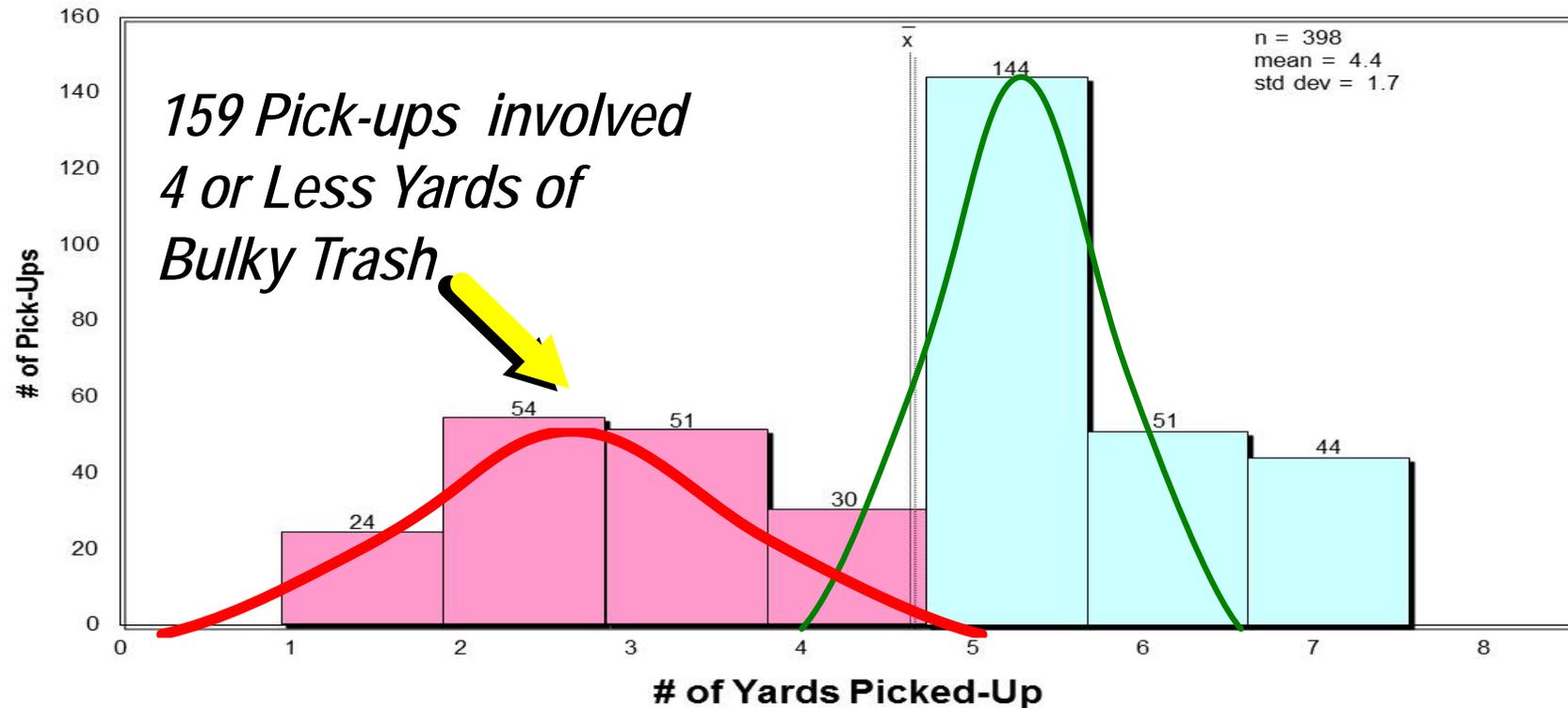


The team looked closer at these 398 Scheduled Pick-ups.

Stratify the Problem

The team stratified the 398 Scheduled Pick-ups many ways and found...

Scorpion Crew Bulky Trash Scheduled Pick-ups in the South Completed from Oct 18 - Oct 31, 2012 Costing over \$50 Pick-up Cost per Yard



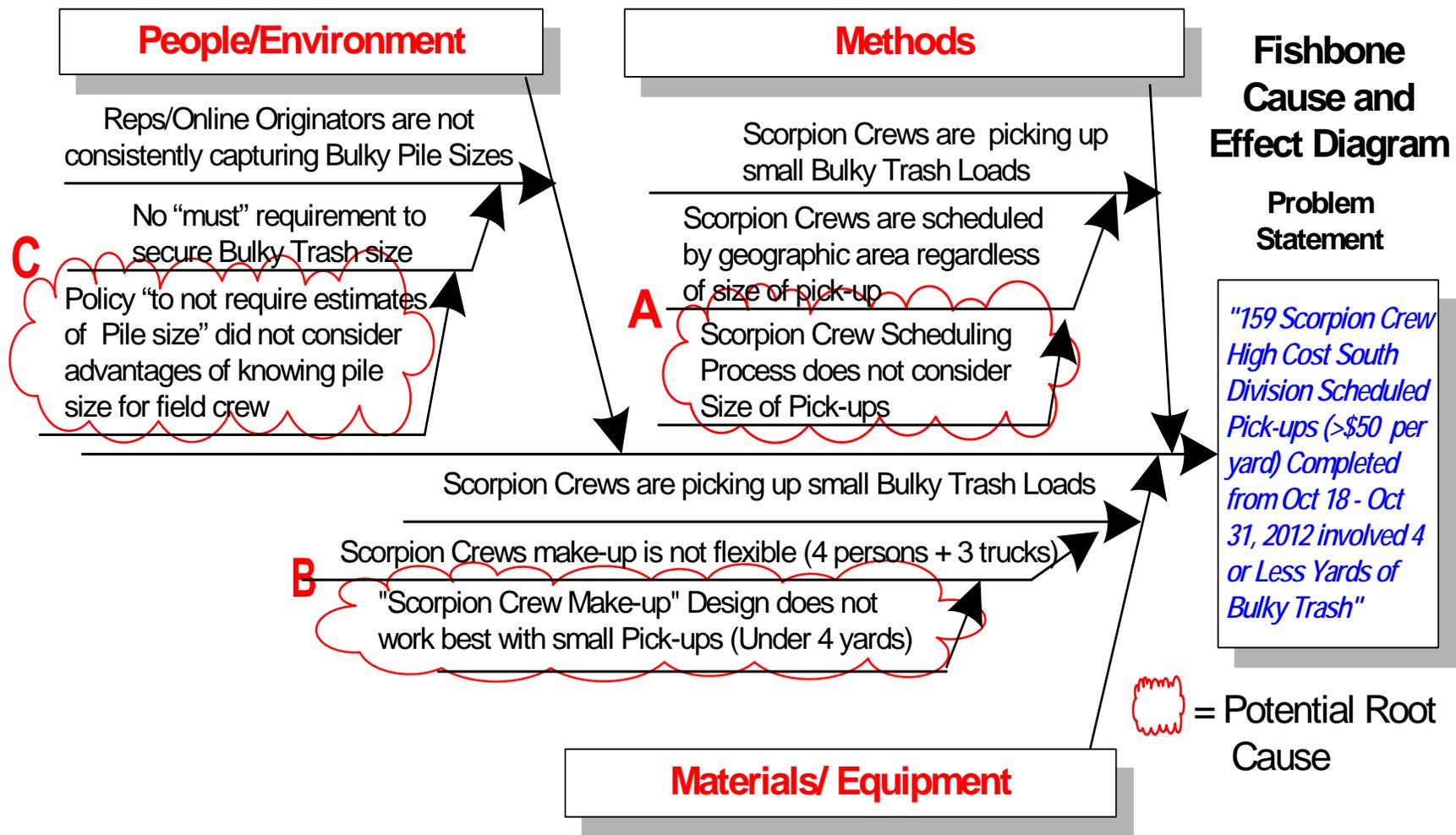
Problem Statement: *"159 Scorpion Crew High Cost South Division Scheduled Pick-ups (>\$50 per yard) Completed from Oct 18 - Oct 31, 2012 involved 4 or Less Yards of Bulky Trash"*



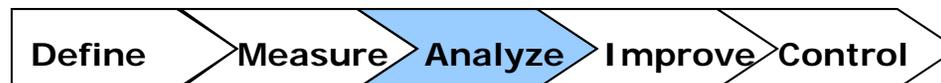
Identify Potential Root Causes

The team completed Cause and Effect Analysis and found...

9.,10. 



The team next looked to verify these 3 Potential Root Causes.



Verify Root Causes

The team collected data to verify the root causes and found.... 11.,12. 

Root Cause Verification Matrix		
Potential Root Cause	How Verified?	Root Cause or Symptom
A Scorpion Crew Scheduling Process does not consider Size of Pick-ups	Team verified scheduling is only done by geographic location (Exceptions for priority or special pick-ups)	 Root Cause
B "Scorpion Crew Make-up" Design does not work best with small Pick-ups (Under 4 yards)	Team verified only 2 types of crews and Scorpion crew does not vary in # of People assigned.	 Root Cause
C Policy "to not require estimates of Pile size" did not consider advantages of knowing pile size for field crew	Checked written 311 Rep procedures and interviewed 311 Supervisor and found no written requirement to secure pile size (checked Online version and option provided (not Required) to provide pile size)	 Root Cause

...all three (3) were validated as root causes.

Identify and Select Countermeasures

13.,14. 

The team brainstormed many countermeasures and narrowed them down to these for evaluation:

Countermeasures Matrix							
Problem Statement	Verified Root Causes	Countermeasures	Legend: Ratings				
			Effectiveness	Feasibility	Overall	Take Action? Yes/No	
"159 Scorpion Crew High Cost South Division Scheduled Pick-ups (>\$50 per yard) Completed from Oct 18 - Oct 31, 2012 involved 4 or Less Yards of Bulky Trash"	A - Scorpion Crew Scheduling Process does not consider Size of Pick-ups	A1- Change Scheduling Process to better match Pick-up Criteria (i.e. Size of Pile, Type of Trash and Geographic Locations) to Type of Crew	5	3	15	Y	
		B1- Develop Standards for setting Ratio between # of Scorpion and Hawk Crews	4	4	16	Y	
		B2- Add/Upgrade "Litter Crews" and use in Scheduling process (perhaps upgrade truck, add lift gate, add trailer)	4	2	8	Maybe	
	B - "Scorpion Crew Make-up" Design does not work best with small Pick-ups (Under 4 yards)	B3- Use Neat Teams	3	1	3	N	
		C - Policy "to not require estimates of Pile size" did not consider advantages of knowing pile size for field crew	A1- Ask Customer to submit Picture of Trash	5	1	5	N
			A2- Require Size of Trash Pick-up from Customer at time of request (via online or 311 call)	5	5	25	Y
	A3- Require Type of Trash at time of Request	5	4	20	Y		

The team selected 5 countermeasures for implementation.



Pilot: Enhance Online Bulky Requests and Routing Process



Target

- 1) Add criteria to Bulky Requests made via the Web Application to identify the Type and Size of the Bulky Pickup. Utilize common visual aids to assist constituents in identifying the size of piles.
 - 1) Landscape/trees (minor, small, medium, large)
 - 2) Appliances (how many units)
 - 3) Furniture (how many pieces)
 - 4) Other (minor, small, medium, large)
 - 2) Modify existing Routing Process
 - 1) Use new criteria to identify minor/small piles
 - 2) Filter minor/small piles to be routed to **Hawk Crews ONLY**
 - 3) Identify minor/small piles on the Manifest for supervisors to distribute to staff
- ITD will modify the Web Application and charge their standard programming rates.
 - PWWM and ITD GIS SLA staffs will modify the existing Routing Process and Manifests.
 - Timeline for implementation is April 2013



Identify Barriers and Aids

The team performed Barriers and Aids analysis on the selected Countermeasures.

What: Implement Countermeasures To Reduce Costs of Bulky Trash Pick-Ups		
Barriers		Aids
Impact (H, M, L)	Forces against Implementation	Forces For Implementation
M	1) Fiscal Budget is limited <i>(Supported by Aid:A,B)</i>	A) Management Very Supportive
L	2) Possible Staff Pushback on changes <i>(Supported by Aid:A,B)</i>	B) Significant Project Savings and Benefits to Process Customers

The team next sought to incorporate this analysis into the team's Action Plan.



Develop and Implement Action Plan

Legend:
 ■ = Actual
 □ = Proposed

The team implemented an Action Plan for the team's Countermeasures.

16. 

WHAT: Implement Countermeasures to Reduce Cost of Bulky Trash Pick-ups

HOW	WHO	WHEN									
		2012	2013								
		Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	
1. Develop Countermeasures:											
A1- Change Scheduling Process to better match Pick-up Criteria (i.e. Size of Pile, Type of Trash and Geographic Locations) to Type of Crew	Rey	■		□ 1/15/13							
B1- Develop Standards for setting Ratio between # of Scorpion and Hawk Crews	Alonzo / Alejandro	■	□ 4/30/13								
B2- Add/Upgrade "Litter Crews" and use in Scheduling process (perhaps upgrade truck, add lift gate, add trailer)	Alonzo / Alejandro	■	□ 4/30/13								
A2- Require Size of Trash Pick-up from Customer at time of request (via online or 311 call)	Rey/Vivian	■		□ 1/15/13							
A3- Require Type of Trash at time of Request	Rey/Vivian	■		□ 1/15/13							
2. Secure Management Approval of Countermeasures (share benefits and cost savings)	Team			□ 5/1/13							
3. Communicate/Train PWWM Staff in Countermeasures and related policies/procedures (share benefits and cost savings)	Team			□ 2/10/13				□ 5/10/13			
4. Implement Countermeasures and Pilot Countermeasures	Team			□ Scheduling Pilot	□ 3/1/13			□ 5/30/13			
5. Review Pilot and determine Benefits and adjust as necessary and present results to management	Team				□ 3/7/13			□ 6/15/13			
6. Establish On-going responsibilities and standardize countermeasures into operations	Team						□ On-going				



Implement “Scheduling Pilot” to Quantify Savings

“Scheduling Pilot” Steps:

16. 

1. **Complete Implementation of 311 Rep Call (and Online) procedures** that will *add Trash Type and Estimated Pile Size to System Generated Work Orders*
2. **Identify # and type of Crews to use for “Scheduling Pilot”** (for example, 2 Scorpion Crews, 2 Hawk Crews and 1 modified “Litter Crew”)

3. **Develop Pilot Scheduling Matrix**
4. **Select “Pilot” Time Period** (1-2 weeks)

Pilot Scheduling Matrix				
Crew Type	Crew Make-up	Crew Cost per Pick-Up	Desired	
			Trash Type	Pile Size
Scorpion	1-Crane Truck 2- Trash Trucks 4- People	\$429.91	All Types	Over 8 Yards
Hawk	1-Crane/Trash Truck 2- People	\$264.63	All Types	3- 8 Yards
Modified Litter Crew	1-Pick-up Truck 1- Trailer 2- People	TBD	Brush, Small Tree Limbs, Small Household items	2 Yard or Less

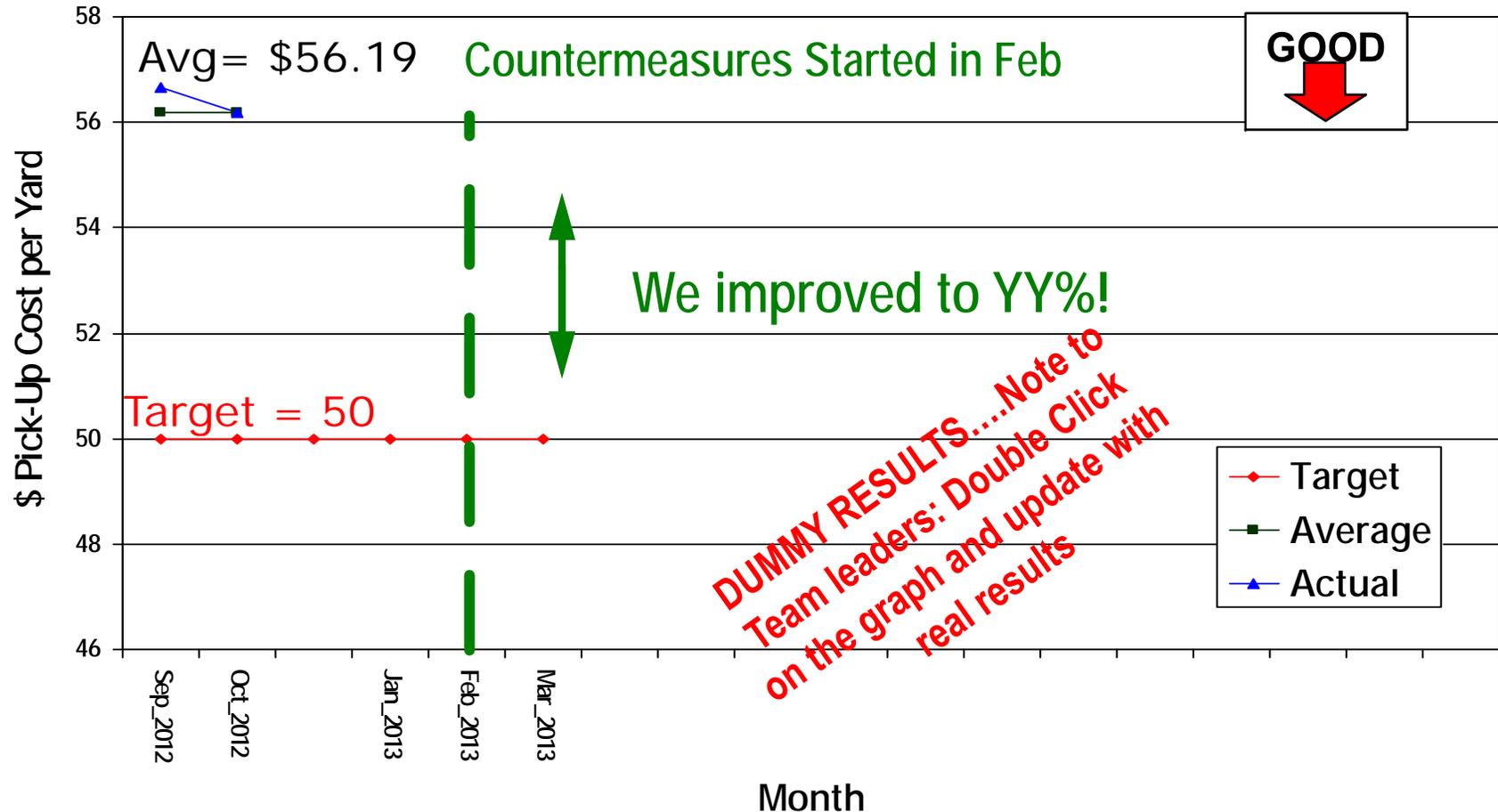
5. **Supervisor picks up system generated scheduled books and redistributes work orders between the Pilot Crews** to best match each Crew Type with the Pile Size and Trash Type according to “Pilot Scheduling Matrix”.
6. **After time period, the team (and Black Belt) will calculate the savings and statistical differences** between the Pilot Crews and Regular Crews.

Review Results

17.,18.,19.,20. ✓

The team collected indicator data and reviewed performance trends:

Q1- Bulky Trash Pick-Up Cost per Yard



The team was encouraged by the results and will continue to monitor the countermeasures.

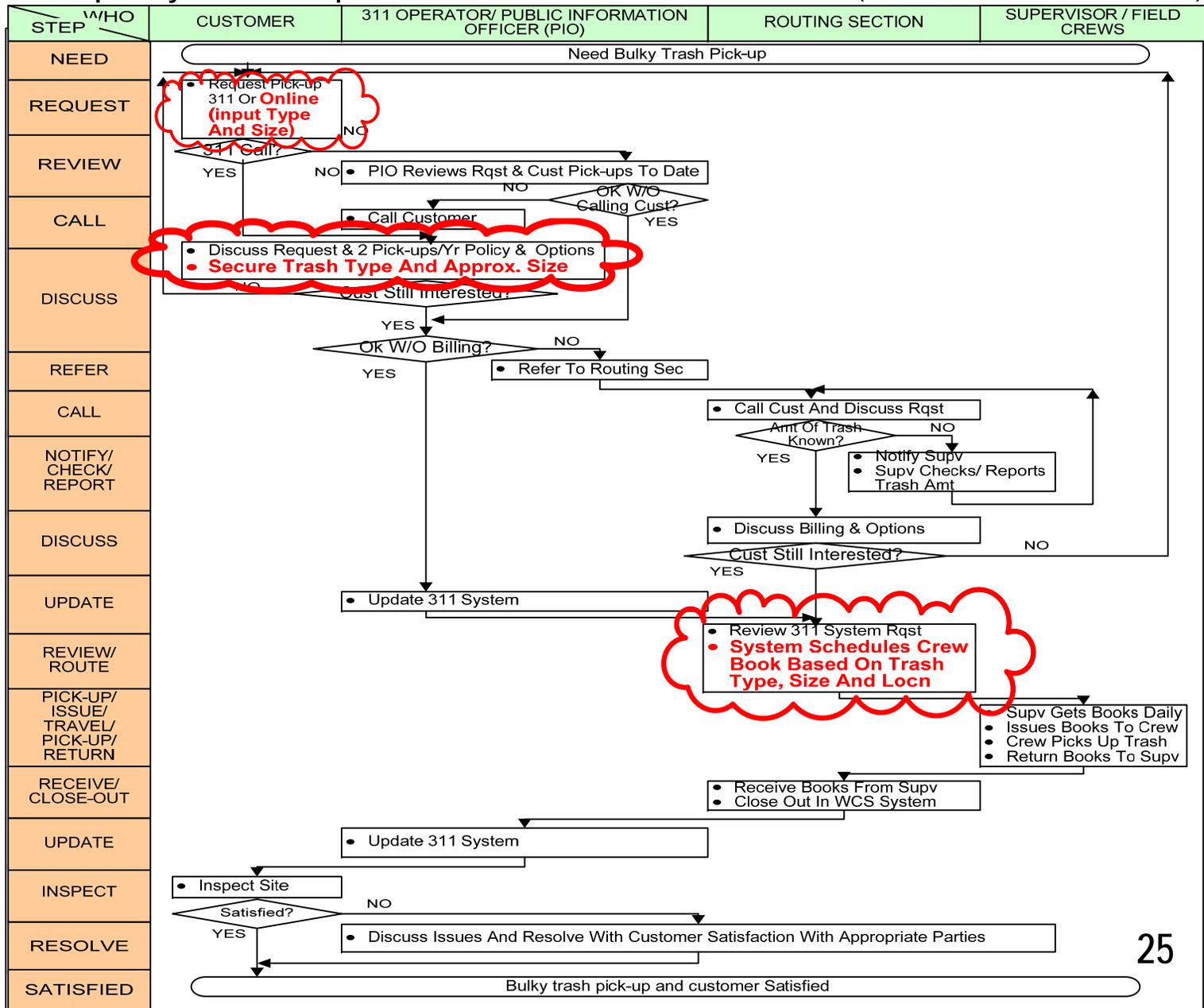
Standardize Countermeasures

21.,22.,23. ✓

The team incorporated the improvements into the Process.

Pick-up Bulky Trash on Request for Customers

(Process Owner: Alonzo Kendrick)



The team looked ahead to the future.

Implement Process Control System

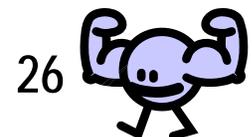
21.,22.,23. 

The team developed a Process Control System to better monitor the process on-going.

Process Control System						
Process Name: Pick-up Bulky Trash on Request for Customers			Process Owner: Alonzo Kendrick			
Process Customer: County Constituents			Critical Customer Requirements: Pick-up Bulky Trash Timely and Cost Effectively			
Process Purpose: Pick-up Bulky Trash			Current Sigma Level: TBD		Outcome Indicators: Q1, Q2, Q3, Q4	
Process and Quality Indicators			Checking / Indicator Monitoring			Contingency Plans / Misc. • Actions Required for Exceptions • Procedure References
Process Indicators	Control Limits	Data to Collect	Timeframe (Frequency)	Responsibility		
And	Specs/ Targets	What is Checking Item or Indicator Calculation	When to Collect Data?	Who will Check?		
Quality Indicators						
P1	# of Days FROM WCS Request Received TO Request Routed	2 days	# of Days FROM WCS Request Received TO Request Routed	Monthly	Alonzo Kendrick	• 311 system
P2	# of Days FROM Request Routed TO Bulky Trash Picked-Up	7 days	# of Days FROM Request Routed TO Bulky Trash Picked-Up	Monthly	Alonzo Kendrick	• 311 System
Q1	Bulky Trash Pick-Up Cost per Yard	\$50 per Yard	(Bulky Trash Pick-Up Cost per Pick-up) / (Yard per Pick-up)	Monthly	Alonzo Kendrick	• 311 system • ASE Scorecard
Q2	# of Days Bulky Trash Picked-Up Late	TBD	# of Days Bulky Trash Picked-Up Late	Monthly	Alonzo Kendrick	• Overdue Report (over 9 days)/ • 311 system
Q3	# of Days FROM WCS Request Received TO Bulky Trash Pick-Up	9 Days	# of Days FROM WCS Request Received TO Bulky Trash Pick-Up	Monthly	Alonzo Kendrick	• Overdue Report (over 9 days)/ • 311 system • ASE Scorecard
Q4	% of Bulky Trash Pick-ups that were Late	TBD	100*(# of Bulky Trash Pick-ups that were Late) / (# of Bulky Trash Pick-ups)	Monthly	Alonzo Kendrick	• Overdue Report (over 9 days)/ • 311 system • ASE Scorecard

Approved: _____ Date: _____ Rev #: _____ Rev Date: _____

The team looked ahead to the future.



Identify Lessons Learned

24.,25. 

Lessons Learned

- 1) Team Bonding is important *since teams need all team members' active involvement and respect to be successful. One helpful technique learned to promote this team bonding is using Icebreakers at the start of team meetings. The technique used is "Sharing Unites, Opinions Divide the Group"...so we shared some little know fact about ourselves before meetings.*
- 2) All Root Causes come from either "Standards that Fail or People that Fail the Standards"

Next Steps

- 1) Run a pilot and continue to develop the "Litter Crew" scenario to pick up smaller Bulky Trash Pick-ups.



Appendix – Crew cost per Pick-up Calculations

Crew Cost per pick-up:

1. Scorpion Crew (12 pick-ups per day and 6 loads)

- Crane Oper.....\$30.45 (includes Fringe)
- Drivers (2) \$25.38 each (includes Fringe)
- Waste Attendant.... \$20.05 (includes Fringe)

2. Scorpion Truck Daily Rate = \$273.55

3. Trash Truck Daily Rate= \$211.40

4. Transfer Avg Fee per 32 yard Load = $(\$575 \times 6 \text{ loads per day}) / 12 \text{ pick-ups} = \287.50

1. Hawk crew... (8 Pick-ups per day and 3 Loads to Transfer Station)

- Crane Oper\$30.45 (includes Fringe)
- Waste Attendant.... \$20.05 (includes Fringe)
- Hawk Truck Daily Rate = \$264.33

2. Transfer Avg Fee per 25 yard Load = $(\$575 \times (25/32)) \times 3 \text{ loads} / 8 \text{ Pickups} = \168.46



APPENDIX - Hidden Costs of Late Pick-Ups

The team identified additional costs of late Pick-ups.

1. Handling Costs for Inquiries/Complaints asking about delays
2. Managing Pick-up Requests Backlog
3. Staff Overtime
4. Customer Complaints cause dissatisfaction and possible claims for restoration of property

To Be developed in follow-up improvement project

