Six Sigma DMAIC Improvement Story

Green Belt **Project Objective:**

To Reduce Waste Transfer Costs

Last Updated: 11-29-12

Team: *Trash Talkers*

Michael Moore (Co-Team Leader)
Lourdes Avalos (Co-Team Leader)
Ray Scher
Michelle Chong
Deborah Silver
David Clodfelter

Ray Scher (Sponsor)
Chris Rose (Sponsor)

Active Strategy

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	• 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	• Stratify Problem (i.e."Gap") • Identify Problem Statement
3	ANALYZE	• Identify Potential Root Cause(s) • Verify Root Cause(s)
4	IMPROVE	• Identify and Select Improvement(s) • Identify Barriers and Aids • Develop and Implement Improvement Plan • Confirm Improvement Results
5	CONTROL	• Standardize Improvements within Operations • Implement Process Control System (PCS) • Document Lessons Learned • Identify Future Plans

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Define → Measure → Analyze → Improve → Control

Select Problem

Management reviewed many problems using a selection Matrix.

Project Selection Matrix

	Problem(s)	Customer (Internal or External)	Selection Criteria: A Impact on Customer (Accuracy/ Cost /Timeliness)	B Need to Improve (Performance Gap)	Supports Miami Dade Strategic Goal(s)? Y/N	C=A*B Overall
1	Too high of waste transfer costs	Diposal Haulers (Int/Ext)	4	2	Y	8
2	[illegible]	[illegible]	[illegible]	[illegible]	Y	4
3	Disposal: Tipping fees not adequately covering all of disposal [illegible]	Haulers Internal/External	3	4	Y	[illegible]
4	Too [illegible] construction	Board	5	2	Y	10
5	Vendors (construction) take too long to get paid	Vendors (External)	4	4	Y	16
6	Capital construction projects not getting done quickly enough (especially length of time to launch project)	Internal/External	1	4	Y	4
7	Poor efficiency of the cart maintenance program	Residential Cust (External)	3	3	Y	9
8	Too many residential developments/households are not being served by PWWM (but that should be served, by code)	External/Internal	3	5	Y	15
9	Efficiency and effectiveness of Mosquito Control needs to improve including accounting for seasonality	R&B Customers (External)	3	4	Y	12
10	Public Works' Road & Bridge op's teams need to be more efficient/effective (e.g. generalist versus specialist teams)	R&B Customers (External)	3	2	Y	6
11	Road & Bridge (Public Works)- pothole routing needs to be optimized.	R&B Customers (External)	3	2	Y	6
12	Public Works' Road & Bridge operations needs to be more efficient/effective	R&B Customers (External)	3	4	Y	12
13	Discipline process takes too long (especially on Waste Mgmt side)	Mgmt & Empls (Internal)	3	1	Y	3
		Rating Scores:	5= Extreme 4= High	3= Moderate 2= Low 1=None		

"Tipping Fees not adequately covering all of the Disposal Costs" was selected as the other 2 higher rated problems had been assigned. The team later narrowed the team's focus to reducing the "Waste Transfer Costs" component to work on first as data was readily available.

Identify Project Charter

The team developed a team Project Charter.

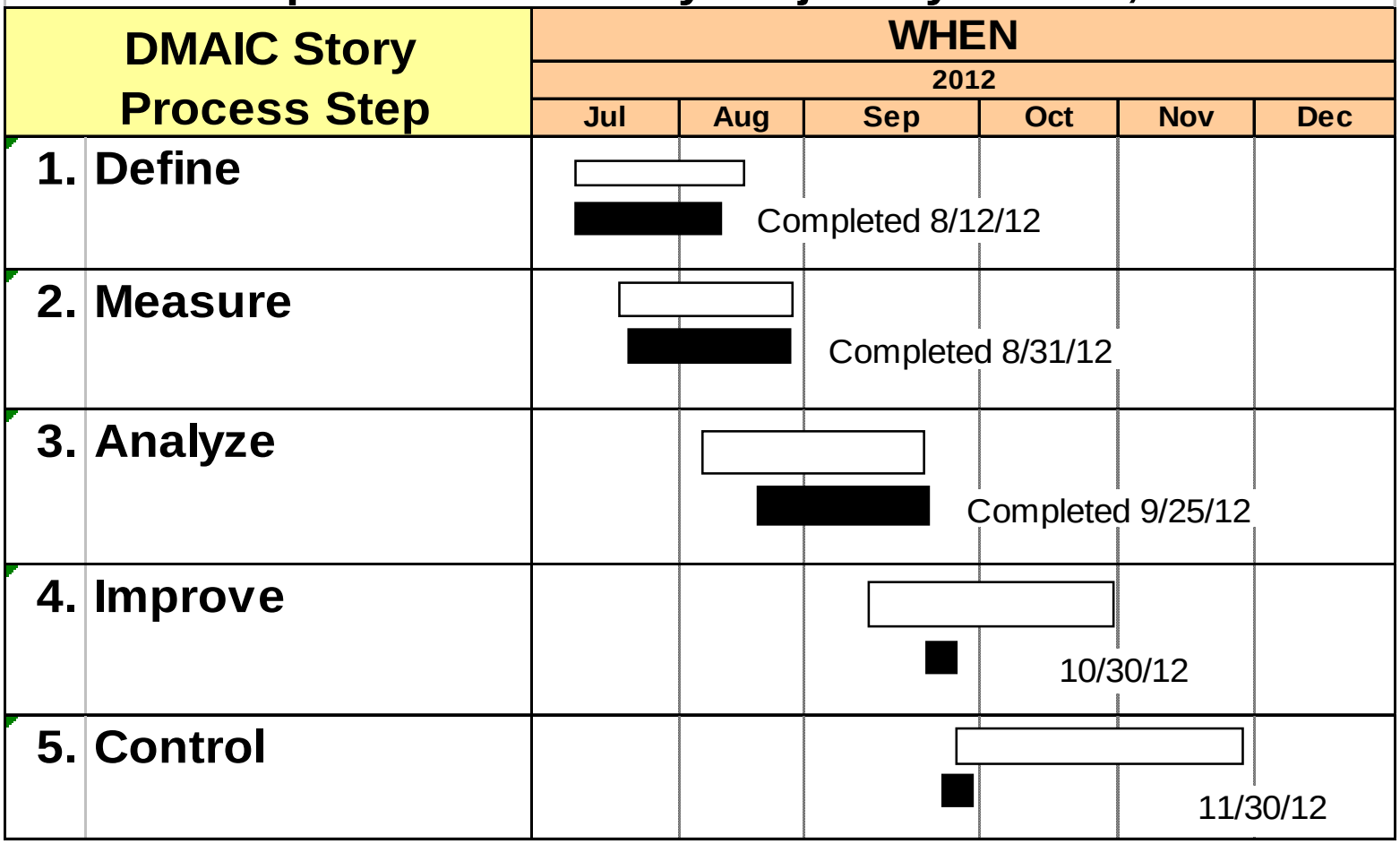
Project Charter		
Business Case	*Project Name:*	Reduce Waste Transfer Costs 2.
	Problem/Impact:	Waste Transfer fees are increasing at a faster than revenue intake. Tonnage has been down about 20% over past 4 or 5 years: lower tonnage but largely fixed costs means higher cost per ton. 1.
	Expected Benefits:	Improvement will result in reduced Waste Transfer Costs and more efficient Waste Transfer operations.
Objectives	*Outcome Indicator(s)*	Q1- Transfer Costs per Ton of Waste
	Proposed Target(s)	Target=12.32 per ton (Close gap by 25%)
	Time Frame:	July 2012 through Nov 2012
	Strategic Alignment:	Supports the County's Business Plan
Scope	*In Scope:*	Costs associated with Transfer Trucks transporting waste from Transfer Stations to landfill or recovery facility
	Out-of-Scope:	Other Trucks hauling Waste directly to Landfill or Recovery Facillities; Private haulers
	Authorized by:	Ray Scher; Chris Rose
Team	*Sponsor:*	Ray Scher
	Team Leader:	Michael Moore, Lourdes Avalos
	Team Members:	Ray Scher, Michelle Chong, Deborah Silver, David Clodfelter
	Process Owner(s):	Michael Moore
	Mgmt Review Team:	Ray Scher; Chris Rose; Kathleen Woods-Richardson
Schedule	*Completion Date:*	30-Nov-12
	Review Dates:	Monthly and Final Review in November 2012
	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 Nov 30, 2012



Define → Measure → Analyze → Improve → Control

Monitor Team Progress

The Team and Management used a Checklist to monitor team progress.

DMAIC Story Checkpoints				
PLAN	Step 1 Define	**Objective: Demonstrate the importance of improvement needs in measurable terms.**		▪Team identified an indicator; developed a Flowchart and a Spreadsheet
		1. The stakeholders' need(s) were identified.	✓	
		2. The problem can be described as an "object" with a "defect" with unknown cause(s) that need to be identified.	✓	
		3. A line graph outcome indicator was constructed that appropriately measures the problem (or gap).	✓	
		4. A schedule for completing the five DMAIC Story steps was developed.	✓	
	Step 2 Measure	**Objective: Investigate the features of the indicator, stratify the problem and set a target for improvement.**		▪Target Set at 25% reduction in Gap from $12.32/Ton ; Paretos and Histograms
		5. Data contained or directly linked to the indicator were stratified from various viewpoints (i.e., what, where, when and who) and a significant dataset was chosen.	✓	
		6. A target for improvement was established based on the stakeholders' need.	✓	
		7. The impact of the target on the indicator was determined.	✓	
		8. A problem statement that describes the "remaining dataset" was developed.	✓	
	Step 3 Analyze	**Objective: Analyze the stratified data to identify and verify the root causes.**		▪Single Case Bore; Fishbone ; RC Verification Matrix
		9. Cause and effect analysis was taken to the root level.	✓	
		10. Potential causes most likely to have the greatest impact on the problem were selected.	✓	
		11. A relationship between the root causes and the problem was verified with data.	✓	
		12. The impact of each root cause on the gap was determined.	✓	
DO	Step 4 Improve	**Objective: Develop and implement countermeasures to eliminate the verified root causes of the problem.**		▪Countermeasures Matrix; Barriers and Aids; Action Plan
		13. Countermeasures were selected to address verified root causes.	✓	
		14. The method for selecting the appropriate countermeasures was clear and considered effectiveness and feasibility.	✓	
		15. Barriers and aids were determined for countermeasures worth implementing.	✓	
		16. The action plan reflected accountability and schedule.	✓	
CHECK		**Objective: Confirm that the countermeasures taken impacted the root causes and the problem; and that the target has been met.**		Line Graph
		17. The effect of countermeasures on the root causes was demonstrated.	✓	
		18. The effect of countermeasures on the problem (or indicator) was demonstrated.	✓	
		19. The improvement target was achieved and causes of significant variation were addressed.	✓	
		20. The effect of countermeasures on the indicator representing the stakeholders' need was demonstrated.	✓	
ACT	Step 5 Control	**Objective: Prevent the problem and its root causes from recurring. Maintain and share the gains.**		▪Process Flowchart; Process Control Chart
		21. A method was established to document, permanently change, and communicate the revised process or standard.	✓	
		22. Responsibility was assigned and periodic checks scheduled to ensure compliance with the revised process or standard.	✓	
		23. Specific areas for replication were identified.	✓	
		Objective: Evaluate the team's effectiveness and plan future activities.		Lessons Learned
		24. Any remaining problems (or gaps) were addressed.	✓	
		25. Lessons learned, P-D-C-A of the Story process, & team growth were assessed & documented.	✓	

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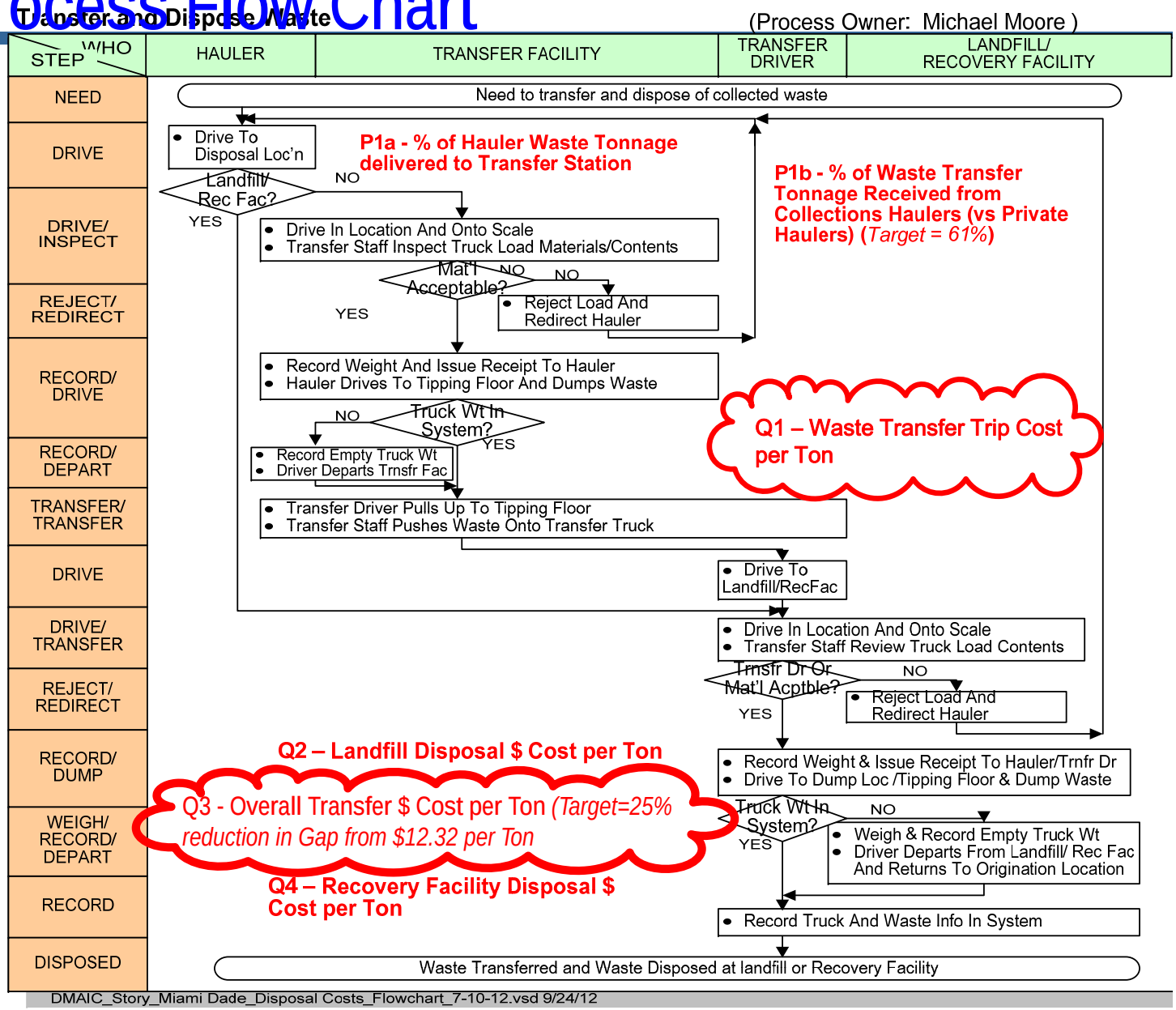
Define → Measure → Analyze → Improve → Control

Review Process Flow Chart

The team constructed a Process flow chart describing the Process.

The team next looked closer how to capture indicator data.



Waste Transfer "Cost per Ton" Factors

5.

The team identified several factors to be considered in estimating costs per ton for Waste Transfer Trips.

Waste
Transfer
Trip Cost
per Ton = (Fuel Costs + Truck Costs + Driver Costs)/Trip Tonnage

Where…

Fuel Cost = (Trip Mileage*Fuel Cost per Gallon)/(Miles per gallon)

Truck Cost = (Annual non-fuel operating and Maintenance costs+ Annual Depreciation expense) * (Trip Minutes/60) /(Total Truck Available Hours per Year)

Driver Cost = (Avg Driver Rate of Pay per Hour)/(Trip Minutes/60)

The team incorporated these calculations into data collection spreadsheet in order to estimate Waste Transfer Costs for every Trip.

Identify Data Collection Needs

The team developed a data collection spreadsheet from readily available electronic Waste Transfer Trip data and added Trip mileage and estimated trip times based on time of day. The spreadsheet will help the team estimate trip "costs per ton" for every trip and thereby allow team to focus in on the high cost per ton trips to determine root cause(s).

PWWM Waste Transfer Trip Cost Summary

(Each Row is Transfer Trip)

AS OF: 8/3/12

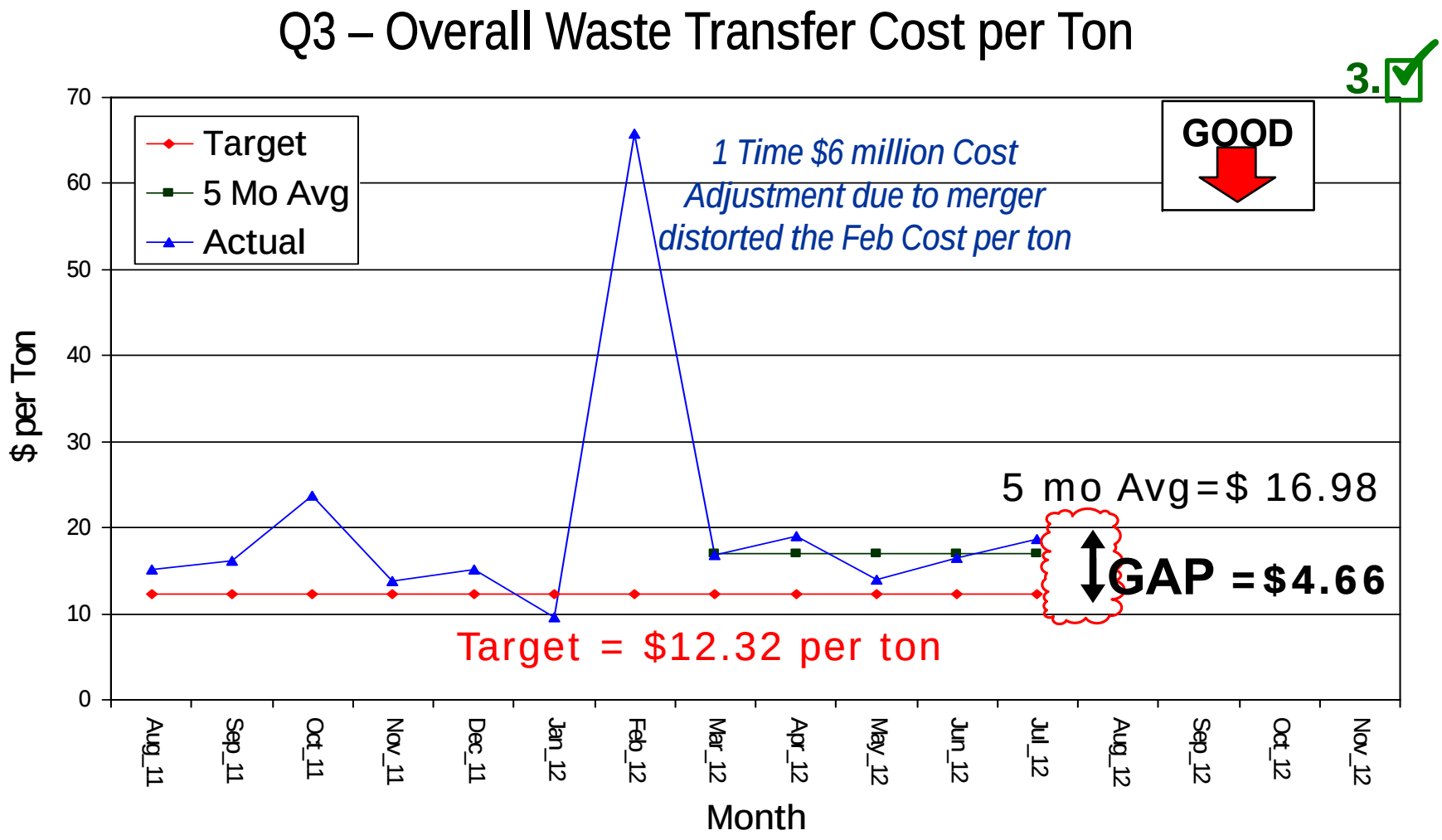
BCB

Line #	DEMOGRAPHICS										MILESTONES		DURATION	OUTCOMES		
		Trip Information								Scale Op	2		Trip Min	Trip Costs	Costs/ Ton	
				Trip Stops		Trip Mileage										
	B	C	D	G	H	J	K	L	M	U	TIME	HR (Military Time)	AT = AK - AG	AY = (K*Fuel$/Mile) +(AT/60* Truck&Dr$/Hr)	BA = AY/M	
	Truck #	Date	Day of Wk	Transfer Pick-up Facility	Delivery Location	Transfer Facility TO Landfill/ Rec Fac	Total Miles	Waste Type	Waste Tonage	Name	2 - Arrives At Transfer Station		Trip Time (Minutes)	Total Trip Costs	Total Trip Disposal Cost per Ton	Comments
						Avg	Avg		Avg				Avg Min	Totals		
						16.8	16.8		15.3				45.0	$419,182	$29,075	
														P3	Q1	
1	110451	3/24/12	Sa	10-Unders/Garb F	5-North Dade	9.2	9.2	5-Clean Tires	1.37	LDH	13:24	13	45	$63.86	$46.61	
2	110480	3/1/12	Th	8-South Dade Fac	61-Medley Lar	25.1	25.1	21-Transfer T	1.99	YPR	7:09	7	45	$82.94	$41.68	
3	110454	3/22/12	Th	8-South Dade Fac	61-Medley Lar	25.1	25.1	21-Transfer T	2.16	YPR	15:49	15	45	$82.94	$38.40	

Define → Measure → Analyze → Improve → Control

Review Selected Indicator

The team collected Q3 indicator data and reviewed performance trends:

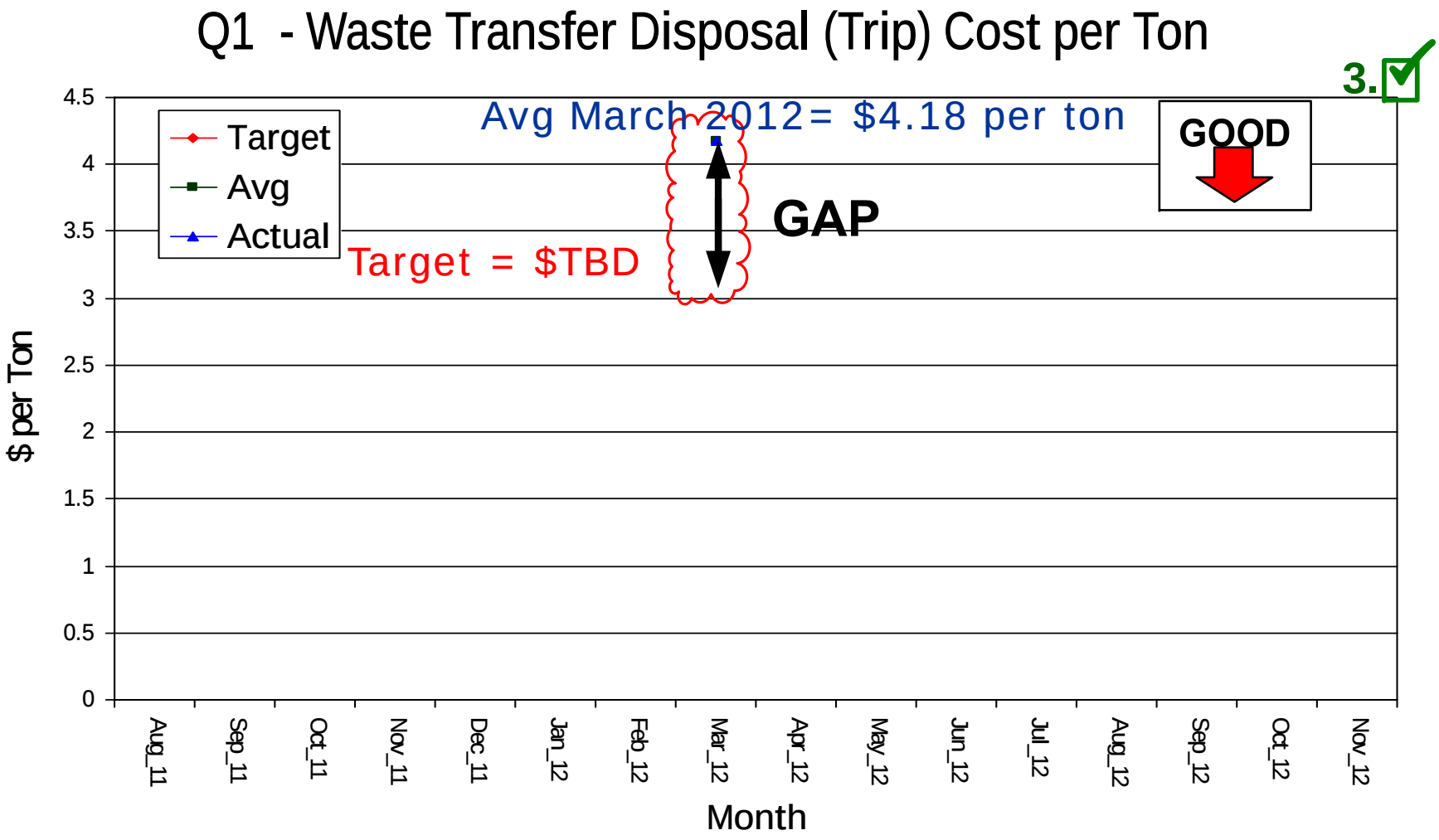


The team next looked closer at Q1 indicator for transfer trip costs.

Define | Measure | Analyze | Improve | Control

Review Selected Indicator

The team calculated Q1 indicator data from the spreadsheet.



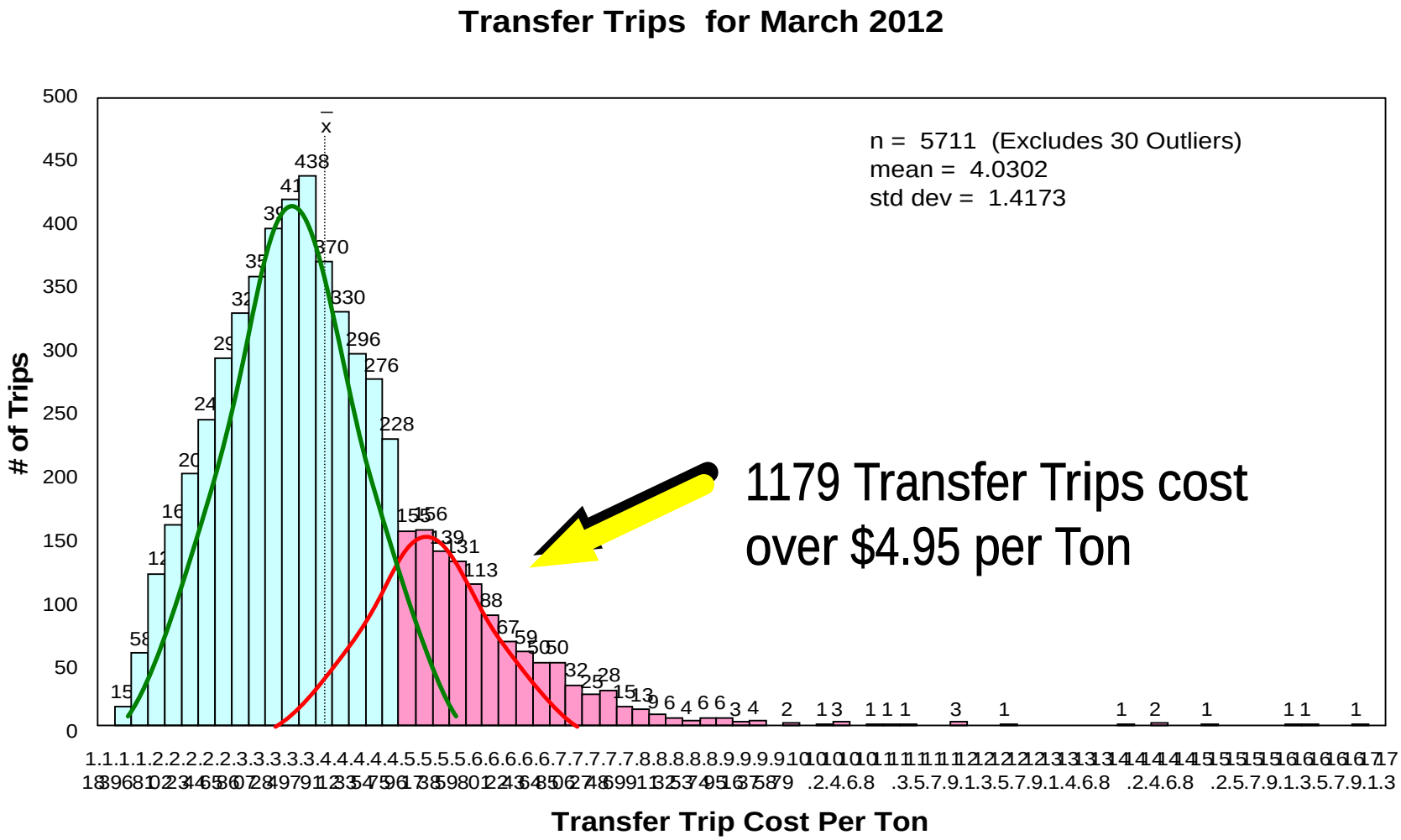
The team looked closer at the March Transfer Trip Data.

Define | Measure | Analyze | Improve | Control

Stratify the Problem

5.

The team stratified the March Trips and found…



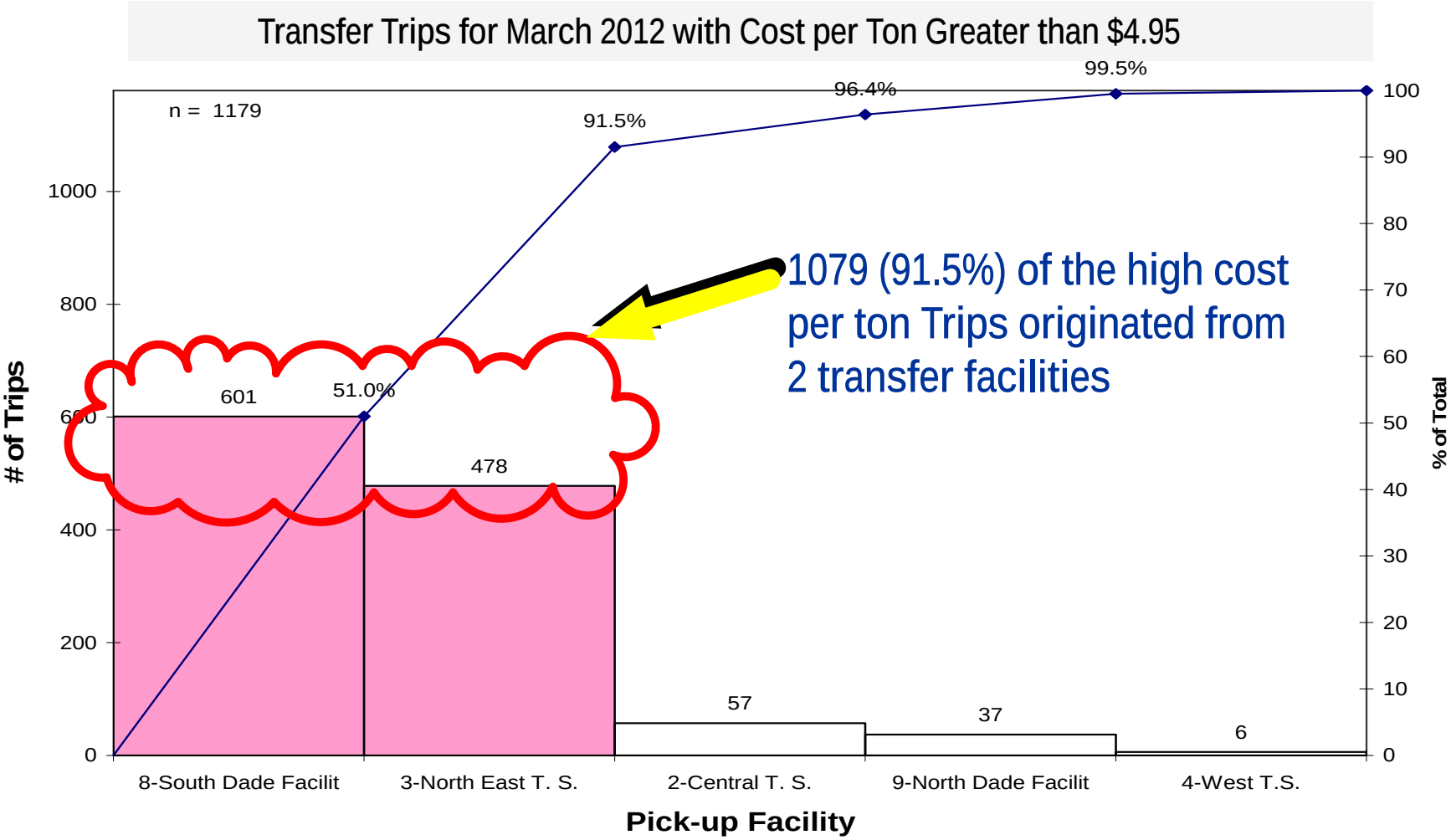
The team looked closer at these the High Cost per ton Trips.

Define | Measure | Analyze | Improve | Control

Stratify the Problem

5.

The team stratified the 1179 high cost per ton Trips many ways and found…



The team looked closer at these 1079 Trips.

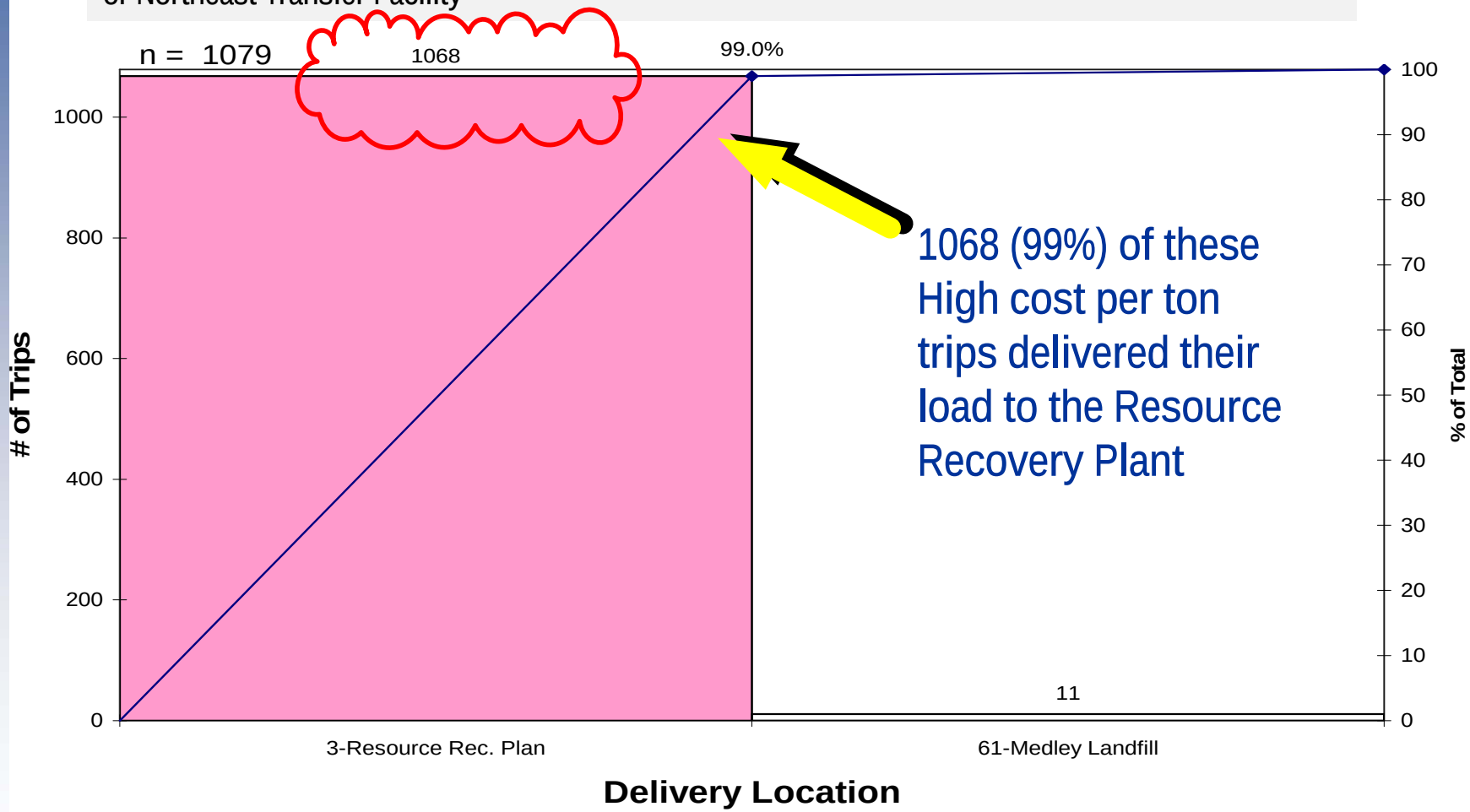
Define | Measure | Analyze | Improve | Control

Stratify the Problem

5.

The team stratified the 1079 trips many ways and found…

Transfer Trips for March 2012 with Cost per Ton Greater than $4.95 that Originated from South Dade or Northeast Transfer Facility



The team looked closer at these 1068 Trips.

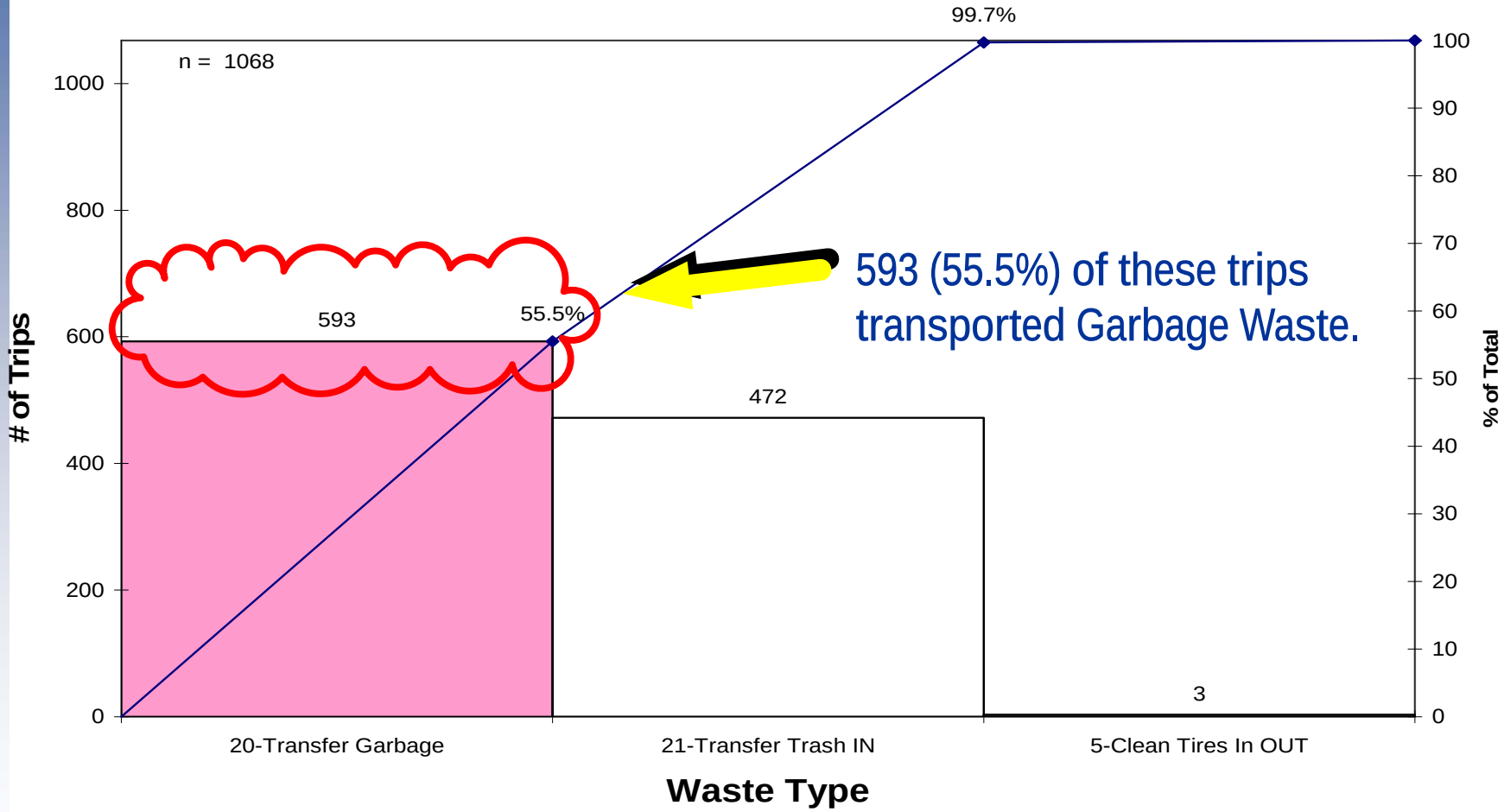
Define | Measure | Analyze | Improve | Control

Stratify the Problem

5.

The team stratified the 1068 trips many ways and found…

Transfer Trips for March 2012 with Cost per Ton Greater than $4.95 that Originated from South Dade or Northeast Transfer Facility to the Resource Recovery Plant



The team looked closer at these 593 Garbage Waste Trips.

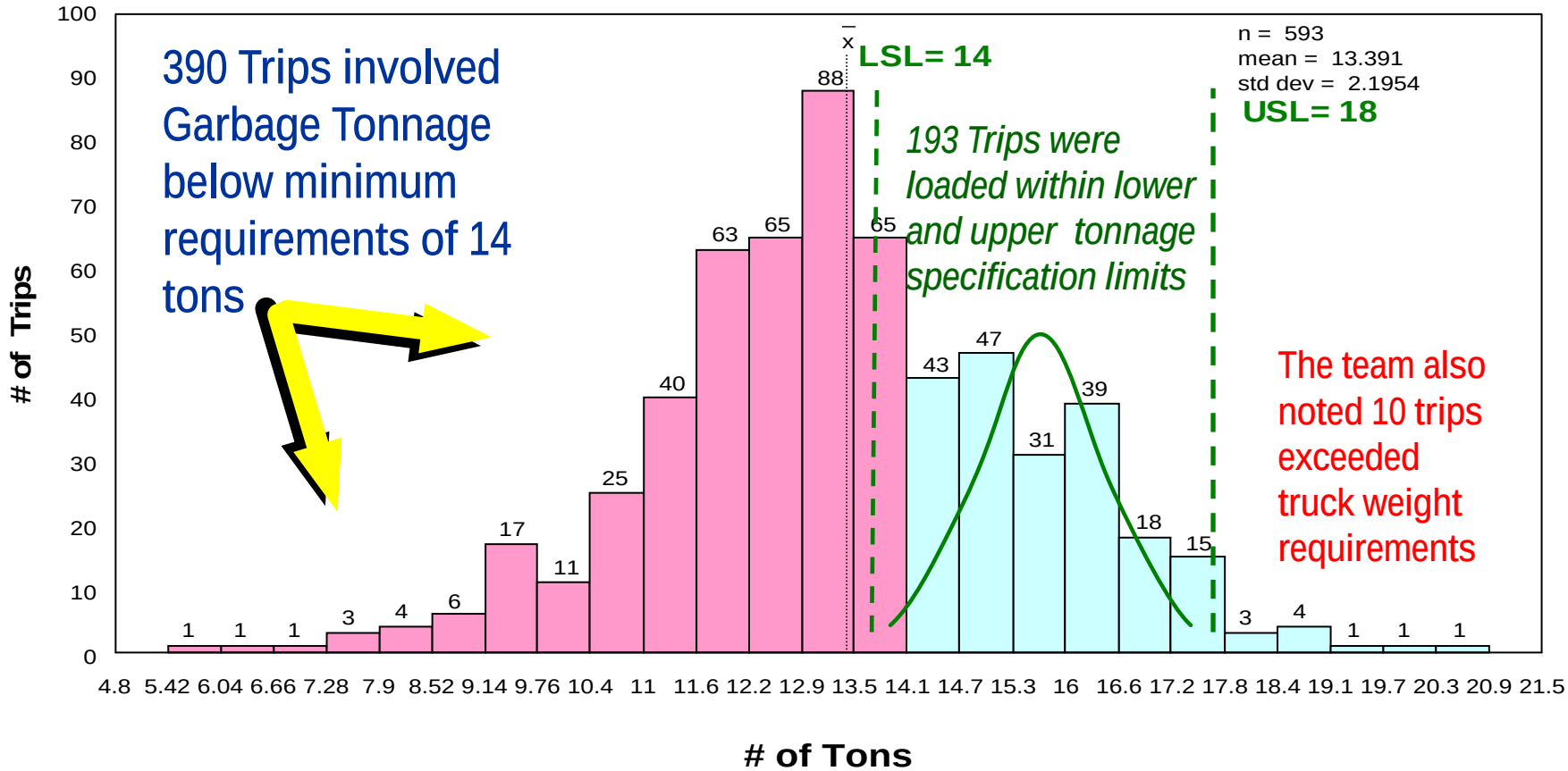
Define | Measure | Analyze | Improve | Control

Stratify the Problem

5.

The team stratified the 593 Waste Garbage Trips many ways and found…

Transfer Trips for March 2012 with Cost per Ton Greater than $4.95 that Originated from South Dade or Northeast Transfer Facility to Resource Recovery Hauling "Garbage"



Problem Statement: *"390 Transfer Trips during March 2012 from South Dade or North East Transfer Facility to the Resource Recovery Plant Hauled Waste Garbage under 14 tons resulting in trips with cost per ton greater than $4.95"*

Identify Potential Root Causes

9.

The team sampled 12 of the 390 Low Tonnage waste Garbage Trips and reviewed trip documentation before conducting Single Case Bore Analysis.

Problem Statement: ***"390 Transfer Trips during March 2012 from South Dade or North East Transfer Facility to the Resource Recovery Plant Hauled Waste Garbage under 14 tons resulting in trip cost per ton greater than $4.95"***

Reasons or Factors (That possibly contributed to light loaded Trucks)	Sampled 12 of the 390 High Cost per Ton Trips													
	1	2	3	4	5	6	7	8	9	10	11	12	Total	Percentage
A														
[redacted] New Loader/Grizzly Op (work schedules)								X	X	X	X	X	5	[redacted]
2) Waste Dry (weather logs)			X	X									2	17%
B														
3) Loads From Other Facility's NDLF, CTS, WTS. (trip logs)		X											1	8%
[redacted] 4) NO Verification of Trailer Loaded to Rim [redacted] packed down.		X	X	X				X	X	X	X	X	8	[redacted]
C														
[redacted] 5) Overcompensation for heavy loads	X		X		X	X	X	X					6	[redacted]

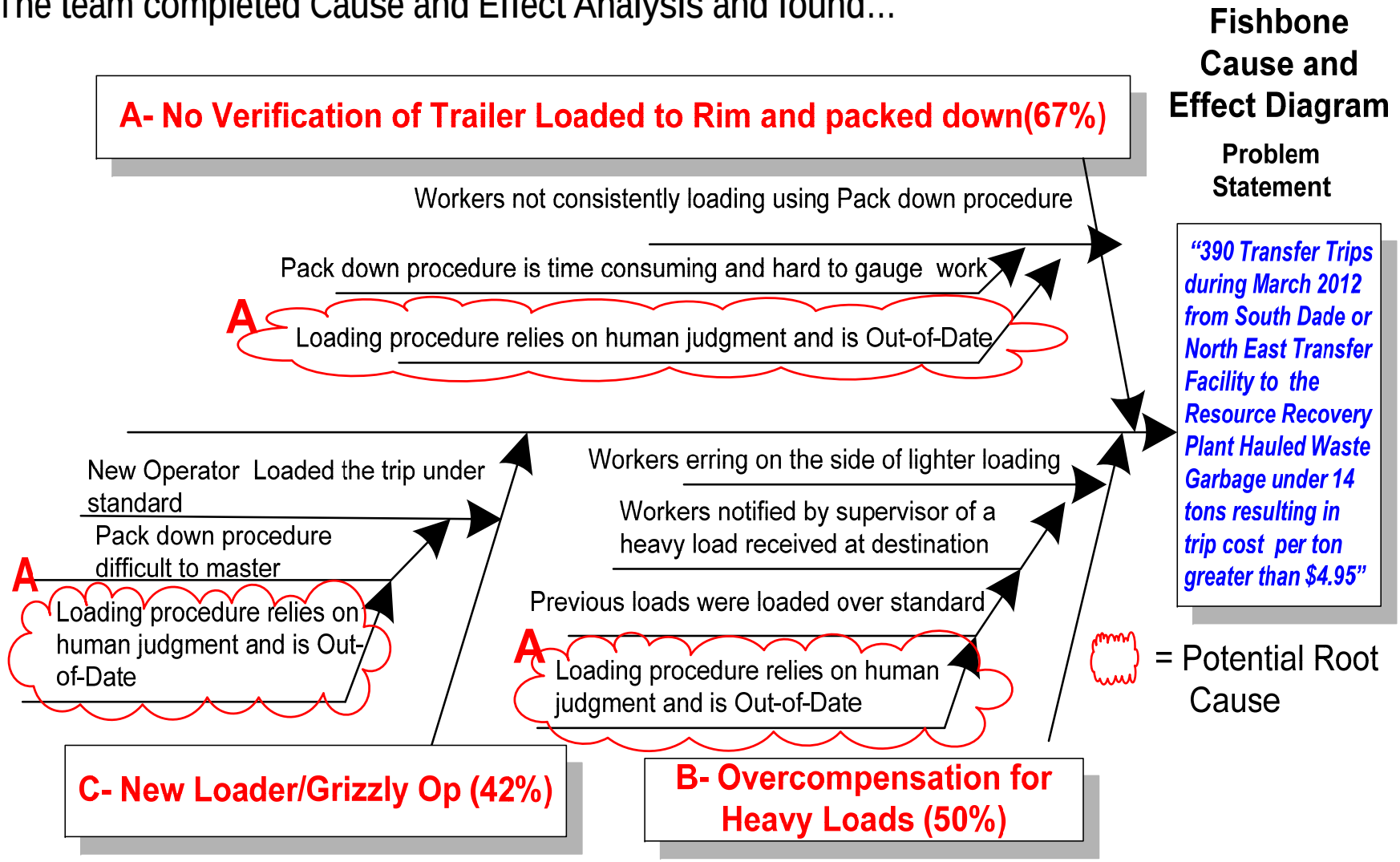
The team next looked closer at these factors.

Define > Measure > Analyze > Improve > Control

Identify Potential Root Causes

9.,10.

The team completed Cause and Effect Analysis and found…



The team next looked to verify this Potential Root Causes.

Define | Measure | Analyze | Improve | Control

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	Loading procedure relies on human judgment and is Out-of-Date	Review Procedure manual and current industry standards and contact other Waste Management haulers and verified that the Pack Down method is Out-of-Date (or at best used when other more precise methods are not available).	Root Cause

…the potential root cause was validated as a root cause.

Identify and Select Countermeasures

13.,14.

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

Countermeasures Matrix

Legend: 5=Extremely, 4=Very, 3=Moderately, 2=Somewhat, 1=Little or None

Problem Statement	Verified Root Causes	Countermeasures	Ratings: Effectiveness	Feasibility	Overall	Take Action? Yes/No
"390 Transfer Trips during March 2012 from South Dade or North East Transfer Facility to the Resource Recovery Plant Hauled Waste Garbage under 14 tons resulting in trip cost per ton greater than $4.95"	A - Loading procedure relies on human judgment and is Out-of-Date	A1- **Provide clear communication of expected load parameters (high & low) to staff,** as well as the consequences of non-compliance, via policy/procedure updates, emails, annual reviews, training sessions, signage, etc.	2	5	10	Y
		A2- **Develop and deploy a (weekly) landfill scale house report** of transfer vehicle facility deliveries that arrive over/under given parameters	2	5	10	Y
		A3- **Develop/deploy of a new measure in ASE** that reflects the percentage of deliveries that arrive over or under weight	2	5	10	Y
		A4- **Extend period of "mentoring"** of new operators by experienced operators	3	4	12	Y
		A5 - **Purchase and install Weight Scales on Trucks**	5	3	15	Y

The team selected 5 countermeasures for implementation.

Estimated Savings Due to Countermeasures

5.

The team estimated Annual Cost Savings for 2 scenarios…

A. If the *Existing* Trip Weight Specifications are used (i.e. 16 Tons per trip for Garbage and 12 Tons per trip for Trash (plus or minus 2 tons)… estimated annual savings would be:

Transfer Facility	Type Waste	Estimated Annual Cost Savings
1. South Dade and Northeast	Garbage	$75,173
2. All other Facilities	Garbage	$20,599
3. All Facilities	Trash	$51,865
4.OT saved (10.8%)	All	$106,704
	Total	$254,341

Note: If Trash weight specification of 16 tons is used, additional savings of $209,301 would be realized. See appendix for cost savings calculations.

Estimated Savings Due to Countermeasures

5.

The second scenario…

B. If the *New* Trip Weight Specifications are used (i.e. 17 Tons per Trip plus or minus 1/2 ton)… estimated annual savings would be:

Transfer Facility	Type Waste	Estimated Annual Cost Savings
1. All Facilities	All Types	$626,799
2.OT saved (12.9%)	All	$127,848
	Total	$754,647

Wt Scales Payback Time = (121 Trucks)*($10,000 per truck)/($754,647 savings per Year)
= 1.6 years (19 months)

Also, 8,821 less tractor trailer round trips annually on our roadways each year can contribute to:

- Reduction in street congestion
- Less roadway damage (potholes)
- Reduction in liability to department
- Reduction in traffic (incl. wait times) at Res. Recovery & the landfills
- Reduced maintenance and operating expenses for the fleet

Note: see appendix for cost savings calculations

Onboard Scale

Define > Measure > Analyze > Improve > Control

Identify Barriers and Aids

15.

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

Countermeasure(s): Implement Countermeasures to Lower cost per Transfer Trip

Barriers		Aids	
Impact (H, M, L)	Forces against Implementation		Forces For Implementation	
H	1) Weight Scales expensive to Purchase *(Supported by Aid:A,B,C,D,E)*	A)	Workers likely to support Weight Scales and other countermeasures
M	2) Weight Scales need to be maintained *(Supported by Aid:A,B,C,D, E)*	B)	Weight Scales are industry standard
L	3) Weight Scales may not be reliable *(Supported by Aid: B,C)*	C)	Strong Relationships with Manufacturers
		D)	Beneficial Impact on Cost savings
H	4) Procurement time could be lengthy (Supported by Aid:C, E)	E)	Management very supportive of team's efforts in saving costs

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 5 Countermeasures to Reduce Transfer Trip Costs

HOW	WHO	WHEN (2012: Sep, Oct, Nov, Dec; 2013: Jan, Feb, Mar, Apr, May)
1. Develop Countermeasures:		
A1- Provide clear communication of expected load parameters	Michael Moore	10/1/12
A2- Develop and deploy a (weekly) landfill scale house report	Debra	Completed 9-25-12
A3- Develop/deploy of a new measure in ASE (P1)	Debra	10/10/12
A4- Extend period of "mentoring" of new operators	Michael Fernandez	11/30/12
A5- Purchase and install Weight Scales on Trucks (leverage Vendor relationship and future quantities for vendor discount; Secure Mgmt support to speed Procurement)	Michael Fernadez	Procure Scales; Pilot 4/30/13
2. Secure Management Approval of Countermeasures (share benefits and cost savings)	Team	Completed 9-24-12
3. Communicate/Train PWWM Staff in Countermeasures and related policies/procedures (share benefits and cost savings)	Team	10/31/12; Pilot 4/30/13
4. Implement Countermeasures and Pilot Weight Scales	Team	11/30/12; 4/30/13
5. Review Pilot and determine Benefits and adjust as necessary and present results to management	Team	1/31/13; Pilot 5/31/13
6. Establish On-going responsibilities and standardize countermeasures into operations	Team	On-going

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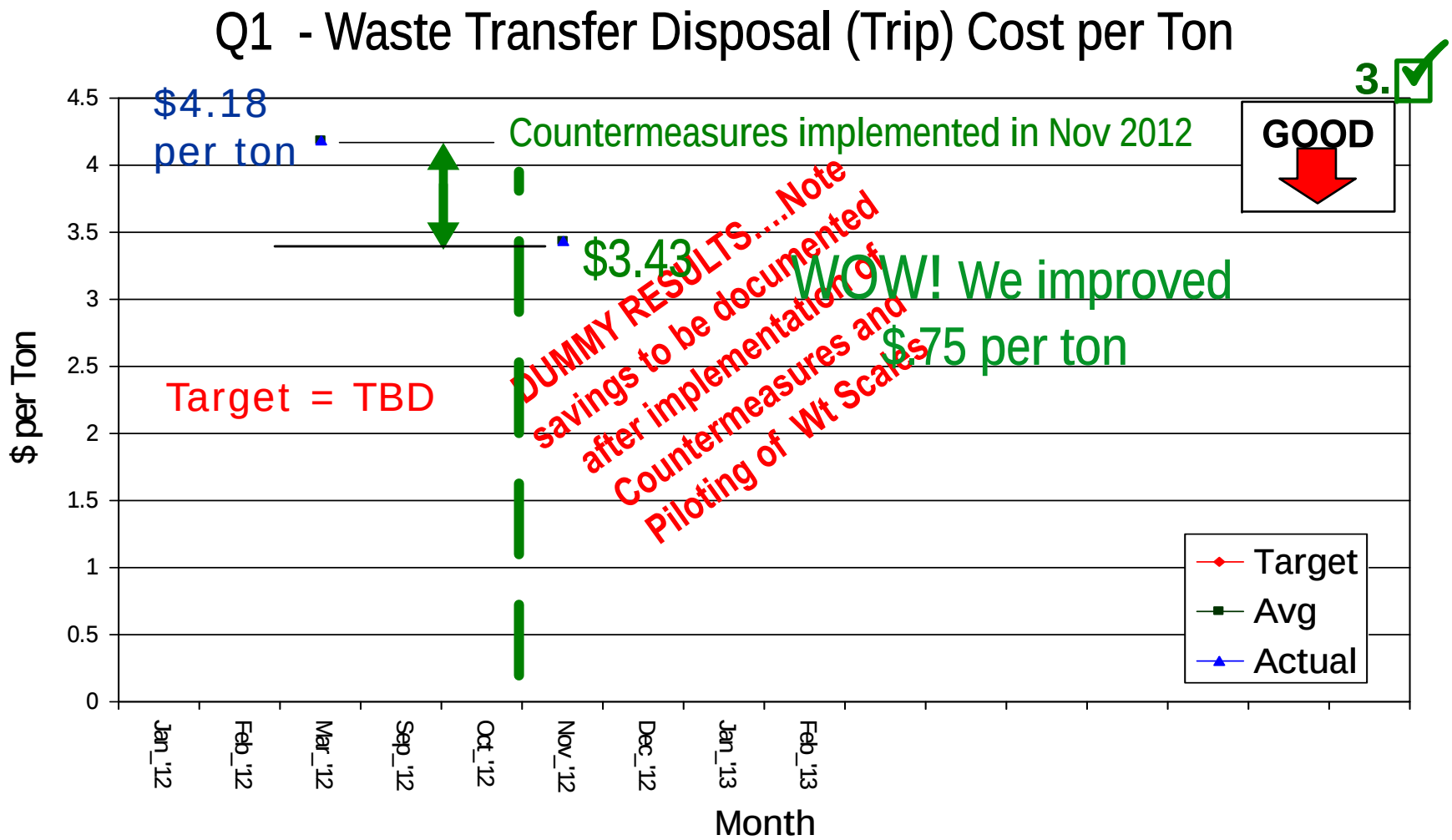
Define > Measure > Analyze > Improve > Control

Review Results

17.,18.,19.,20. ☑

The team collected indicator data and reviewed results of it's countermeasures

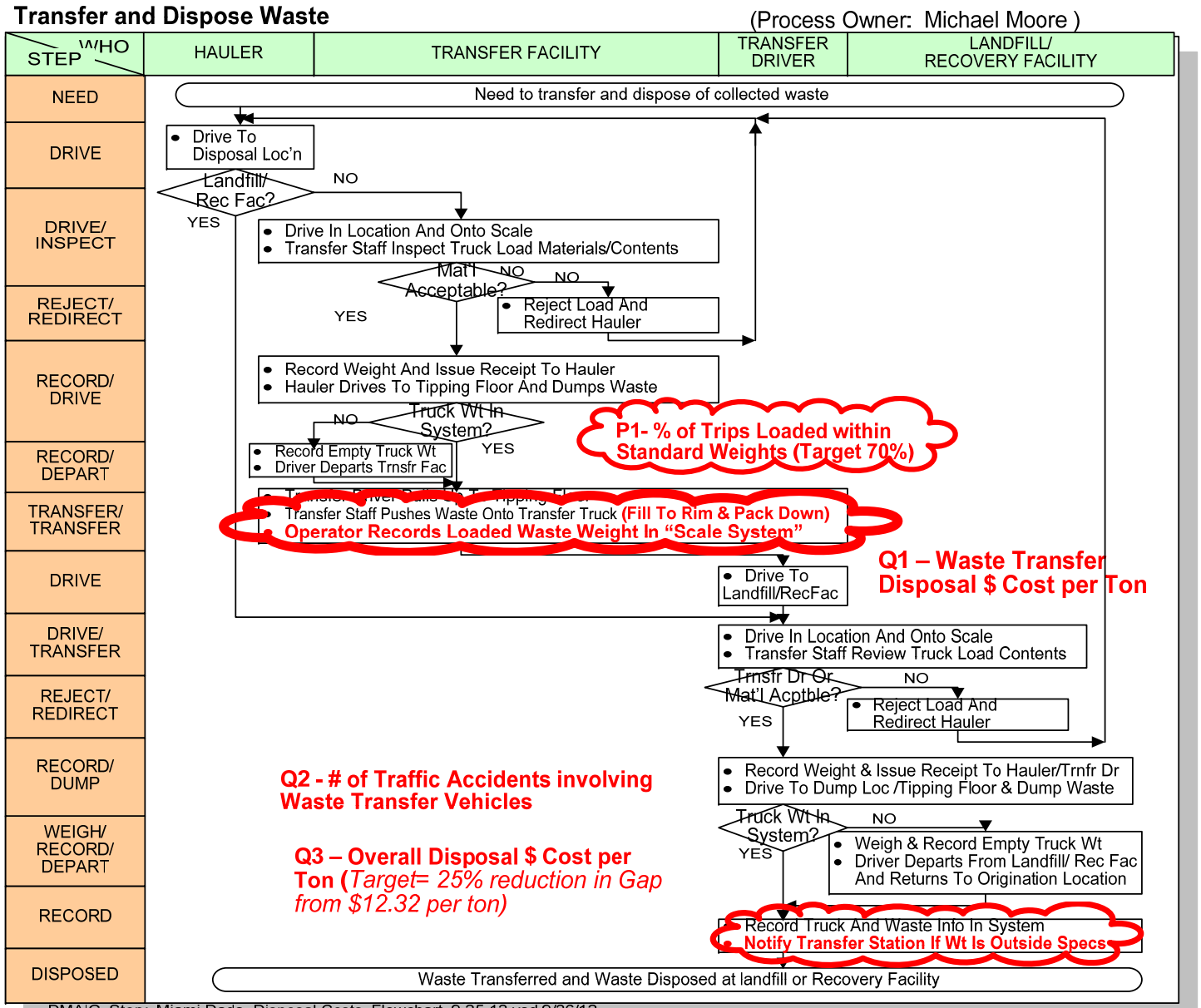


The team was encouraged by the results and will continue to monitor the countermeasures.

Standardize Countermeasures

21.,22.,23.

The team revised indicators and incorporated the improvements into the Process flowchart.



The team looked to standardize the Indicator monitoring

Define | Measure | Analyze | Improve | Control

Standardize Countermeasures

21.,22.,23.

The team Developed a Process Control System (PCS) to monitor the process on-going.

Process Control System

Process Name: Transfer and Dispose Waste	**Process Owner:** Michael Moore
Process Customer: Taxpayers; Management on behalf of Stakeholders; Other Governments	**Critical Customer Requirements:** Transfer Waste Safely and at low cost
Process Purpose: Transfer Waste from Private haulers to Land fill or Resource Rec Facility	**Current Sigma Level:** TBD **Outcome Indicators:** Q1, Q2, Q3

Process and Quality Indicators			Checking / Indicator Monitoring			Contingency Plans / Misc.
Process Indicators And Quality Indicators		Control Limits / Specs/ Targets	Data to Collect / What is Checking Item or Indicator Calculation	Timeframe (Frequency) / When to Collect Data?	Responsibility / Who will Check?	• Actions Required for Exceptions • Procedure References
P1	% of Trips Loaded within Standard Weights (14-18 tons standard weights specification) (Target 70%)	70%	100*(# of Trips Loaded within Standard Weights)/ (# of Trips)	Monthly	Division Director	• ASE Software and Scale System
Q1	Waste Transfer Disposal $ Cost per Ton	0	(total Waste Transfer Disposal $ Cost)/(Total tonnage)	Monthly	Division Director	Team Spreadsheet
Q2	# of Traffic Accidents involving Waste Transfer Vehicles	TBD	# of Traffic Accidents involving Waste Transfer Vehicles	Monthly YTD	Division Director	Safety Log
Q3	Overall Disposal $ Cost per Ton (Target= 25% reduction in Gap from $12.32 per ton)	$9.24	Overall Disposal $ Cost per Ton (Target= 25% reduction in Gap from $12.32 per ton)	Monthly	Division Director	ASE Software and Scale System

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

The team looked ahead to the future.

MIAMI-DADE COUNTY

Define > Measure > Analyze > Improve > Control

Identify Lessons Learned

24.,25. ☑

Lessons Learned

1) When generating Countermeasures…it is best to involve Individuals in silent idea generation first before engaging the full group in discussions

2) Data Collection is critical in problem analysis…careful identification of demographic related data for each poor performance outcome makes problem solving easier.

3) Identifying Root Cause(s) examining the data using the tools and techniques is better than guessing at what you think are the causes.

4) Having a Systematic standardized DMAIC process is essential to good problem solving.

Next Steps

1) Continue to monitor the countermeasures and performance results.

Appendix- Estimated Project Savings

5.

A1. Savings for South Dade and North East Transfer Facilities for loading Waste Garbage to average target levels.

a. 390 lightly loaded trips averaged 12.157 tons of Garbage (3.843 tons below the 16 ton target for Garbage).

b) # of Trips saved =(3.843 tons per trip)X(390 trips)X(12 Months per year)/ (16 tons per trip) = 1124 Trips per year

c) Annual $ Savings for efficient Waste Garbage Trips at 2 transfer Facilities = (1124 Trips per year)X($4.18 average cost per ton)X(16 Tons per trip)= $75, 173

A2. Savings for all other facilities loading Garbage Waste:

a. 111 additional lightly loaded trips averaged 12.3 tons of Garbage (3.7 tons below the 16 ton target for Garbage).

b) # of Trips saved =(3.7 tons per trip)X(111 trips)X(12 Months per year)/ (16 tons per trip) = 308 Trips per year saved.

c) Annual $ Savings for efficient Waste Garbage Trips at all other transfer facilities = (308 Trips per year)X($4.18 average cost per ton)X(16 Tons per trip)= $20,599

MIAMI-DADE COUNTY

Appendix - Estimated Project Savings

5.

A3. Savings for all facilities loading TRASH Waste to average target levels.

a. 507 lightly loaded trips averaged 9.95 tons of TRASH (2.0421 tons below the 12 ton target for trash).

b) # of Trips saved =(2.04 tons per trip)X(507 trips)X(12 Months per year)/ (12 tons per trip) = 1,034 Trips per year saved.

c) Annual $ Savings for efficient TRASH Waste Trips at all transfer facilities = (1,034 Trips per year)X($4.18 average cost per ton)X(12 Tons per trip)= $51,865

Appendix - Estimated Project Savings

5.

A4. Savings for all facilities loading TRASH Waste to average updated target levels (**16 tons**).

a. 1527 lightly loaded trips averaged 12.594 tons of TRASH (3.406 tons below the 16 ton target for trash).

b) # of Trips saved =(3.41 tons per trip)X(1527 trips)X(12 Months per year)/ (16 tons per trip) = 3,905 Trips per year saved.

c) Annual $ Savings for efficient TRASH Waste Trips at all transfer facilities = (3,905 Trips per year)X($4.18 average cost per ton)X(16 Tons per trip)= $261,166

A5. Overtime Savings= (2011-2012 Annual OT $)*(% reduction in trips per year *based on 16 tons per trip*)

= [($988,000)*(5337 trips saved)] /[(5680 trips per month) X (12 Months)]= $77,361

Appendix - Estimated Project Savings

5.

B1. Savings for all facilities loading Waste to new target levels of 17 tons per Trip (plus or minus ½ ton)

a. Annual Cost Savings=(5680 trips per month) X (12 Months)X(2.2 tons additional Capacity gained per trip)X($4.18) cost per ton)= $626,799

B2. Overtime Savings= (2011-2012 Annual OT $)*(% reduction in trips per year *based on 17 tons per trip*)

Trips saved = [5680 trips per month x (2.2 tons gained per trip) x 12 months] / (17 tons per trip)= 8,820 trips saved

= [($988,000)*[(8,820 trips saved)] / [(5680 trips per month) X (12 Months)]= $127,848