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Lean Six Sigma
DMAIC Improvement Story

Black Belt Project Objective:

To Reduce the # of Days to Complete Heavy Fleet Work Orders

Last Updated: 7-14-21

Team: *Heavy Hauler Heroes*

Roy Ferreira (Co-Team Leader), Gigi Bolt (Co-Team Leader),

Alex Alfonso (Co- Team Leader)

Danny Diaz (DSWM), Scott Stephens (ISD Fleet), Yoamel Zequeira (ISD Fleet)

Mike Fernandez, Director DSWM (Sponsor)

Alex Muñoz, Director ISD (Process Owner)

Lean Six Sigma Problem Solving Process

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

Process Step		Description of Key Team Activities
Number	**Name**	
1	DEFINE	• Establish Method to Monitor Team Progress • Select Problem and Identify Project Charter and Timeline • Display Process Indicator Performance "Gap" • Construct related Process Flowchart • Identify Stakeholder Process output needs • Identify Costs of Poor Quality (for not meeting output needs)
2	MEASURE	• Develop Data Collection Plan • Stratify Problem (i.e. "Gap") • Develop Problem Statement from remaining data set and finalize target
3	ANALYZE	• Identify Potential Root Causes (s) • Verify Root Cause(s) • Assess Impact of Root Causes on Problem in Measure Step
4	IMPROVE	• Identify and Select Countermeasure(s) • Identify Barriers and Aids • Develop and Implement Action Plans • Confirm / Document Pilot Improvement Plan Effectiveness
5	CONTROL	• Confirm / Document Improvement Results • Standardize Improvements within Operations • Implement New Process Control System (PCS) • Document Lessons Learned • Identify Future Plans for Improvement

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▪Define Measure ▪Analyze ▪Improve ▪Control

Monitor Team Progress

The team and management used a Checklist to monitor team progress.

DMAIC/ QIC STORY CHECKLIST

APCD	Process Step		Process Step Objectives and Checkpoints	Check √	Key Tools
	DMAIC	QIC Story			
Plan			**Step 1** *Objective: Demonstrate the importance of improvement needs in measurable terms.*		
	DEFINE	Reason for Improve-ment	1. The stakeholders' needs were identified with the most important problem selected.	✓	
			2. The selected problem is an "object" with a "defect" with unknown cause(s) that need identification.	✓	
			3. A project charter including a project timeline was developed to address the problem.	✓	
			4. A trend indicator was constructed with an appropriate target that measures the performance gap.	✓	**Line graph**
			5. When process known, a flowchart was constructed with in-process and end-of-process indicators.	✓	**Flowchart, SIPOC, CRM**
			6. The Cost of Poor Quality (COPQ) impact of the indicator performance gap was identified.	✓	**COPQ chart**
			Step 2 *Objective: Stratify indicator related data and finalize an improvement target.*		
	MEASURE	Current Situation	7. The data collection plan developed included indicator related demographics and process milestones.	✓	**Spreadsheet**
			8. Data were stratified from various viewpoints (i.e. what, where, when and who) and a significant data set was chosen.	✓	**Histogram, Pareto**
			9. A problem statement that descibes the stratified "remaining data" was developed.	✓	
			10. The target for improvement was finalized based on the most appropriate target setting methodology.	✓	
			Step 3 *Objective: Analyze stratified data to identify and verify root causes(s).*		
	ANALYZE	Analysis	11. Cause and effect analysis was performed after a closer review of the problem statement "remaining data"	✓	**Single Case Bore**
			12. Potential cause(s) identified were either "Failed Standards" and/or "People Failing Standards".	✓	**Fishbone**
			13. A relationship between the root causes and the problem was verified with data.	✓	**Root cause verification**
Do	IMPROVE	Counter-Measures	**Step 4** *Objective: Develop and implement countermeasures to eliminate verified root cause(s).*		
			14. Countermeasures were selected to address verified root cause(s).	✓	
			15. The method for selecting countermeasures considered both effectiveness and feasibility.	✓	**Countermeasure matrix**
			16. Barriers and aids were determined for countermeasures worth implementing.	✓	**Barriers and aids analysis**
			17. An action plan reflected both accountability and schedule.	✓	
Check		Results	**Step 5** *Objective: Confirm countermeasures impacted root causes, indicator, costs and achieved target.*		
			18. Countermeasure effects on root causes were demonstrated with "before and after" summary graphs.		
			19. Countermeasure effects on the indicator were demonstrated with a "before and after" trend graph.		
			20. The overall performance improvement impact on the Cost of Poor Quality (COPQ) was quantified.		
			21. The target was achieved or cause(s) of significant variation were determined and addressed.		
Act	CONTROL	Standard-ization	**Step 5 / Step 6** *Objective: Maintain gains and prevent root cause(s) from recurring.*		
			22. The process flowchart was revised to incorporate the new countermeasure standards and/or training.		
			23. A Process Control System (PCS) was developed to monitor the revised process indicators on-going.		
		Future Plans	**Step 7** *Objective: Evaluate the team's effectiveness and plan for future activities.*		
			24. Lessons learned documented replication opportunities, effective techniques and team success factors.		
			25. Next steps were identified to monitor the process and address any remaining problems or gaps.		

Identify Project Charter

The team developed a team Project Charter and secured signed off from sponsor.

Project Charter

Business Case	Project Name:	To reduce the number of days to complete heavy fleet work orders
	Problem/Impact:	Fewer heavy fleet vehicles are available for the Department of Solid Waste Management (DSWM) to complete their daily routes. DSWM has a high volume of vehicle repair and maintenance requests.
	Expected Benefits:	Quicker service in repairing and maintaining heavy fleet vehicles and increase the number of vehicles available for DSWM service delivery. Improve customer satisfaction.
Objectives	Outcome Indicator(s)	Q1- Average # of Days to Complete Heavy Fleet Work Orders
	Proposed Target(s)	Target= 2.25 Days
	Time Frame:	March 2021 through August 2021
	Strategic Alignment:	Supports MDC Strategic Plan Objective
Scope	In Scope:	ISD Heavy Fleet
	Out-of-Scope:	ISD Light Fleet
	Authorized by:	David Clodfelter, Director OMB
Team	Sponsor:	Michael Fernandez, Director DSWM
	Co-Team Leaders:	Alex Alfonso, Gigi Bolt, Roy Ferreira
	Team Members:	Danny Diaz (DSWM), Scott Stephens (ISD Fleet), Yoamel Zequeira (ISD Fleet)
	Process Owner(s):	Alex Muñoz, Director ISD
	Mgmt Review Team:	Michael Fernandez, Carlos Maxwell, Mike Ruiz, Alex Muñoz
Schedule	Completion Date:	7/31/21
	Review Dates:	Monthly and Final Review in July 2021
	Key Milestone Dates:	See Action Plan

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Define ⟩ Measure ⟩ Analyze ⟩ Improve ⟩ Control ⟩

Develop Project Timeline Plan

3. ☑

The team developed a Timeline Plan to complete their Project.

WHAT: **Reduce the Average Days to Complete Heavy Fleet Work Orders**

HOW	WHEN						
	Month 2021						
	Mar	Apr	May	Jun	Jul	Aug	Sep
1. DEFINE	Completed 3/21/21						
2. MEASURE		Completed 4/15/21					
3. ANALYZE			Completed 6/4/21				
4. IMPROVE				6/30/21 Completed 7/8/21			
5. CONTROL							8/31/21

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Background

The Internal Services Department (ISD) Fleet Management Division (FMD)

- ➤ 261 employees with an annual budget of $86 million
- ➤ Provides repair maintenance and fuel services to 25 County departments and external customers
- ➤ 20 repair facilities and 29 fuel stations throughout Miami-Dade County

- ▪ **Types of Vehicles Serviced**
- ➤ Sedans, light trucks, vans, SUVs, & police vehicles
- ➤ Garbage trucks, tractor/trailers, dump trucks
- ➤ Construction equipment

- ➤ FMD repairs over 3,430 Heavy Fleet vehicles for the County and 200 are part of the Solid Waste Management Side Loader fleet.

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Background

The Department of Solid Waste Management (DSWM)

- 1,112 employees with an annual budget of **$551M**

- Provides residential and commercial garbage and trash collection, curbside collection of recyclable materials, litter clean-up, transit bus stop litter collection, removal of storm debris, code enforcement and mosquito control services throughout Miami-Dade County

- Responsible for operation and management of 3 Regional transfer stations and associated fleet, and the operations and maintenance of two County-owned landfills

Cost of DSWM 200 vehicles:

- Capital cost per standard side loader; **$315,000** (annual maintenance and repairs: **$41,700**)

- Capital cost per Hybrid side loader: **$402,000** (annual maintenance and repairs **$50,460**)

- **Types of Heavy Fleet Vehicles Serviced**

- Garbage trucks, tractors/trailers, cranes
- Rear loaders, Side loaders, Side loaders-Hybrid

Project Alignment to Strategy

ISD Fleet Management Division (FMD) directly supports the MDC Strategic Plan under the **General Government** strategic area by supporting the following goal:

Optimal internal Miami-Dade County operations and service delivery:

- **GG3-3 - Acquire "best value" goods and services in a timely manner**
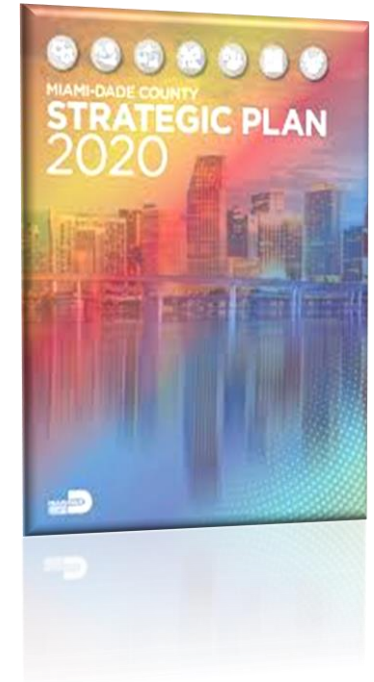
Additional supported MDC Strategic Plan goals include:

Public Safety strategic area:

- **PS3-1 – Increase countywide preparedness**
- **PS3-2 – Ensure recovery after community and countywide shocks and stresses**

Neighborhood and Infrastructure:

- **NI1-1 – Provide livable and beautiful neighborhoods**
- **N12-3 – Provide adequate and sustainable solid waste collection and disposal capacity**

Display Indicator Performance "Gap"

The team collected Q1 indicator data and reviewed performance trends:

Q1- Average # of Days to Complete Heavy Fleet Work Orders

- Avg Days to Complete WO
- Previous 6 Mo Avg=3.04
- Target= 2.25

GOOD

Average Days values: 3.2, 2.82, 2.89, 2.52, 2.97, 2.96, 3.12, 3.21, 3.28, 3.43, 3.05, 3.61, 2.45, 2.42

Avg= 3.04 Days

GAP

Target= 2.25 Days

Months: Jan'20, Feb'20, Mar'20, Apr'20, May'20, Jun'20, Jul'20, Aug'20, Sep'20, Oct'20, Nov'20, Dec'20, Jan'21, Feb'21, Mar'21, Apr'21

Month 'Year

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Construct Process Flow Chart

The team reviewed the FBC Macro Flowchart for Municipalities.

0.0 Provide Municipal Services *(FBC Quality Delivery System Macro)*

WHO / STEP	CUSTOMER	MUNICIPAL DEPTS / STAFF	SUPPLIER(S)	SUPPORT PROCESSES
NEED	Needs Municipal Services			9.0 Manage Human Resources (HR)
1.0 IDENTIFY NEEDS	1.0 Identify Existing And Emerging Customer Needs			.1 Forecast HR Needs .2 Hire Empl's .3 Start & Orient New Hires .4 Train Employees
2.0 DEVELOP	Existing Svcs. Meet Needs? NO — YES — 2.0 Develop New/Enhance Existing Services			.5 Manage Employee Benefits .6 Manage Employee Perf. .7 Recognize Perf. .8 Survey Employee Satisfaction
3.0 EDUCATE	Customers Interested? NO — YES — 3.0 Educate Public In Available Services — Cust. Inquires About Svcs? NO — YES			.9 Follow-Up On Concerns .10 Terminate Employm't
4.0 SIGN-UP	4.0 Sell Services / Sign-Up Customers To Meet Their Needs — Cust Signed-Up? NO — YES			10.0 Manage Information Technologies (IT)
5.0 PROVIDE	5.0 Provide Services			11.0 Manage Risk (RM)
	AS. Animal Services	PO. Police		
	BD. Building Development and Review	RR. Road Repair		
	CV. Civic Engagement	SC. Solid Waste – Collection		12.0 Purchase Manage Materials/Supplies (PU)
	CE. Code Enforcement	SW. Solid Waste – Disposal		
	EM. Environmental Management	SD. Stormwater and Drainage Maintenance		
	FR. Fire Rescue	TE. Traffic Engineering		
	FM. Fleet Management	WW. Water and Wastewater		
	PR. Parks and Recreation			
6.0 COLLECT	6.0 Collect Taxes / Revenues For Services Rendered			13.0 Provide General Services (GE
7.0 RESOLVE	Cust Satisf'd? NO — YES — 7.0 Resolve Customer Inquiries/Complaints			
8.0 EVALUATE/ SURVEY	8.0 Evaluate System Performance And Survey Customer Satisfaction			14.0 Conduct Strategic Planning
REC'D	Municipal Services Provided			

The team constructed a Process flow chart describing the Process. (see appendix for SIPOC and Cust Rqmts Matrix)

The team next looked Stakeholder process needs

5FMh.0 Maintain/Repair DSWM Heavy Fleet Vehicles (Process Owner: Fleet Mgmt Div Director)

WHO / STEP	CUSTOMER (OPERATORS/ VEHICLE USERS)	FLEET ADMIN/ M5	FLEET SHOPS (SUPV, MECHANICS, STOCK)	3RD PARTIES (CONTRACTORS/ VENDORS)
NEED	Need To Provide Repair Services As Required By Customer			
IDENTIFY/ EMAIL/CALL	• Transport Vehicle To Shop			
ACCESSES	Vehicle Require Repair Is Parked At Deadline (Minor/Hotline Significant/ Deadline)	P1 – # of Maintenance request forms per unit no	Legend M5= Fleet Maintenance Software WO= Work Order	
SCHEDULE				
RECEIVE			• Supv Receive Vehicle • Open WO In M5 And Assign To Mechanic	
TRANSPORT			Assign To ISD Mechanic? NO	Outsource Vendor? NO
RECEIVE/ OPEN			YES • Store Until Shop Bay Is Avail	YES Vendor Completes Work
STORE			• Mechanic Secures Keys & Transports Vehicle To Shop Bay • Inspect Vehicle For Other Issues And Parts Needed	
SECURE/ INSPECT	P3 - # of days to open a work order from vehicle drop-off • Notify Customer, Discuss Findings And Resolve Issues	NO	Free Of Other Issues?	
NOTIFY	NO Ready For Repair? YES		YES P2 - # of WOs with no additional diagnoses added	
TAKE	• Take Action (e.g. Hold Vehicle, Skip PM, Apply Vendor Warranty etc.)			
SECURE			• Secure Parts From Stock Room	
ORDER			All Parts Avail? NO	
COMPLETE/ CLOSE/ NOTIFY	P4 - Average # of days to receive a standard and/or custom parts		YES • Order Parts & Deadline Vehicle Until Parts Arrive • Mechanic Completes Repair • Supv Closes WO In M5 & Notifies User	
PICK-UP	• Pick Up Vehicle At Shop	Q1 - Average # of days to return vehicle		
PROVIDED	Vehicle PM Provided And Available To Users For Operations			

FBC_BB_DMAIC Story_Reduce Days to Complete Heavy Fleet Maint_MDC_FLOWCHART_061721.vsd 7/14/21

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Stakeholder Needs

The team identified stakeholder needs for the process outputs.

Stakeholders Needs	
Stakeholders	**Process Output Needs**
Residents	Timely garbage collection
	No increase in waste collection fees
	Environmentally and mechanically sound vehicles
DSWM Drivers	Vehicles are ready and safe to perform services
ISD Fleet Mechanics	Accurately communicate symptoms
	Timely repairs of vehicles
	Safe environment to perform repairs
ISD Fleet Division/DSWM/ BCC	Meet strategic objectives
	Increase resident satisfaction with garbage collection services
	Ongoing analysis to continually improve process

Cost of Poor Quality

The team identified the hidden costs of failing to perform Timely Fleet Maintenance.

Stakeholder	Pain Experienced	Annualized "Costs"
Residents	1. No pick-up, Unsightly Piles causing Complaints (due to vehicle in for maintenance)	1. Est Annual $ for Complaints=(# of Trash Complaints per yr) *(% of complaints due to late WOs)* Hrs to handle per complaint)* Salary per hour) = 8,000 * 10%* 1hr * $30 per labor hr= **$24,000**
DSWM Drivers	2. Driver Down time for vehicle diagnosis and repair; Finding an alternate use of driver's time; 3. Labor inefficiencies of older vehicle substitutes	2. Cost=($40 Drivers Loaded Pay rate) * (.79 Avg Days Late Per WO) * (787 of Vehicles)* Avg. 5.3 WOs per vehicle)= **$98,855** 3. Use older vehicles, overtime, how often do we have to do it (10% more hours per a day) –> 787 WO/yr * 0.75 days late/event * 2 people * $60 OT/hr = **$70,830**
ISD Fleet Mechanics	4. Parts availability requires start and stop interruption Amount of qualified vendors	4. Cost= 55.9 unnecessary Interruptions * 0.33 Hrs per Interruption * $35 Loaded pay Rate for Mechanic= **$636**
ISD Fleet Division/DSWM/ BCC	5. Additional vehicle maintenance costs on older substitute heavy fleet vehicles	5. Use older vehicles more likely to breakdown. 10 older substitute vehicles will be worked 0.75 days more than expected (2.25 days) which is 33% more than expected 10 older vehicles * ($41,000*(75/2.25)) = **$130,667**

Total Cost of Poor Quality Savings = $324,988 Annually

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The team developed a spreadsheet to help analyze the process.
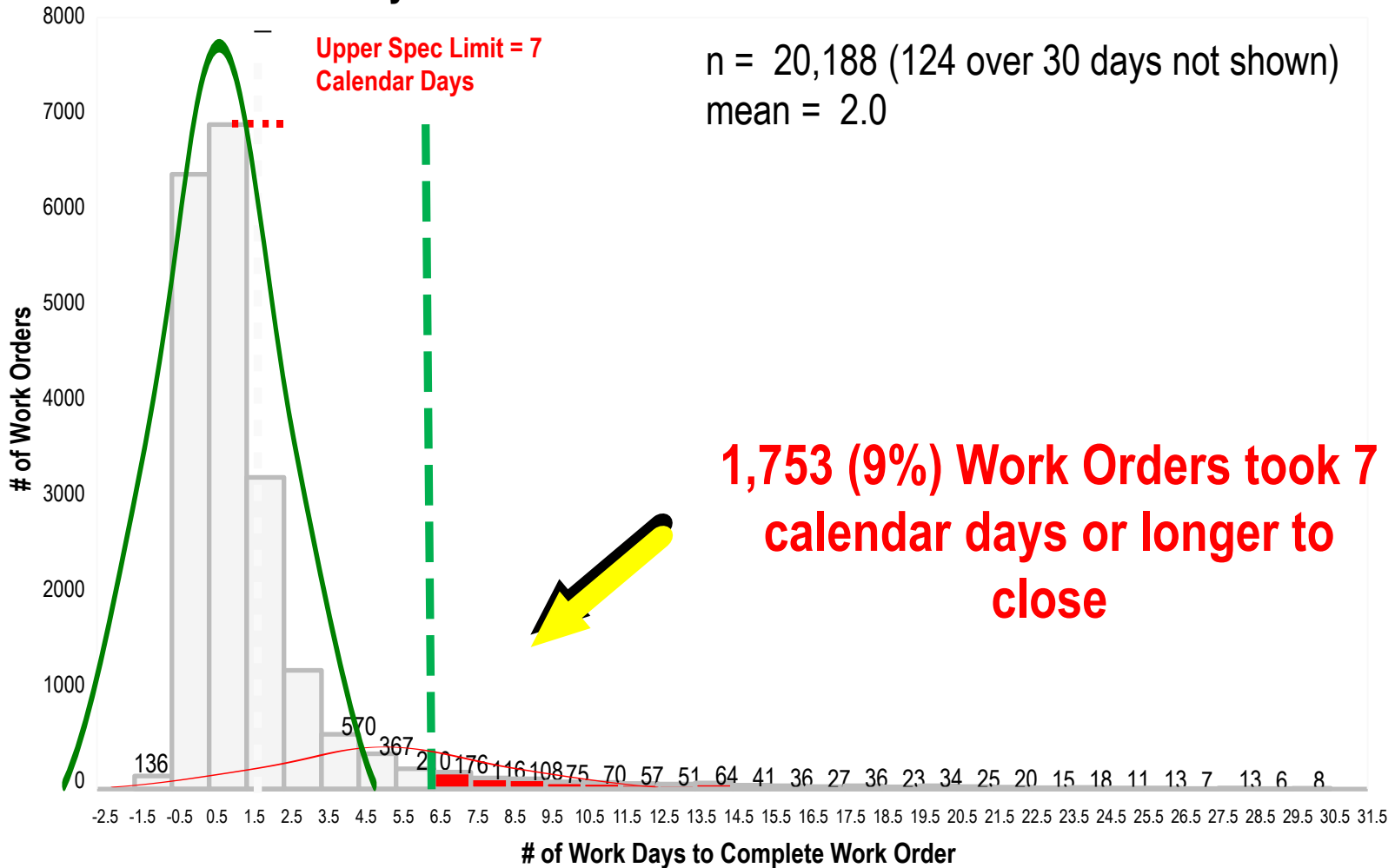
Heavy Fleet WO Summary *(every row is a Completed WO)*

CATEGORY DESC	UNIT NO	YEAR	MAKE	MODEL	WO NO	METER	OPEN DATE	Day of Week Opened	TIME	CLOSE DATE	Day of Week Opened	TIME	Work Days	Days Open
						Avg 64,421							Avg 1.97	Avg 2.79
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	119642	23,805	10/2/2017	Mo	1:57:57 AM	10/2/2017	Mo	6:39:57 AM	0	0
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	124502	24,524	10/24/2017	Tu	6:21:42 AM	10/25/2017	We	7:45:33 AM	1	1
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	124162	24,419	10/23/2017	Mo	2:10:45 AM	10/24/2017	Tu	6:20:57 AM	1	1
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	128684	24,995	11/15/2017	We	6:13:31 AM	11/15/2017	We	6:28:47 AM	0	0
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	124886	24,537	10/26/2017	Th	8:09:48 AM	10/26/2017	Th	7:08:41 AM	0	0
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	128217	24,995	11/13/2017	Mo	11:04:49 AM	11/13/2017	Mo	7:19:28 AM	0	0
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	126585	24,721	11/3/2017	Fr	11:32:54 AM	11/3/2017	Fr	11:34:21 AM	0	0
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	129617	25,324	11/20/2017	Mo	10:59:18 AM	11/20/2017	Mo	7:29:04 AM	0	0
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	132098	25,747	12/5/2017	Tu	6:14:17 AM	12/5/2017	Tu	5:17:05 AM	0	0
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	132777	25,747	12/7/2017	Th	1:58:49 AM	12/7/2017	Th	2:00:28 AM	0	0
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	131540	25,747	12/1/2017	Fr	6:50:40 AM	12/4/2017	Mo	2:28:24 AM	1	3
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	135048	26,405	12/19/2017	Tu	6:39:12 AM	12/22/2017	Fr	7:09:05 AM	3	3
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	137243	26,854	1/3/2018	We	1:20:31 AM	1/5/2018	Fr	7:45:00 AM	2	2
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	135988	26,405	12/26/2017	Tu	7:00:41 AM	12/28/2017	Th	3:30:07 AM	2	2
STRAIGHT TRUCKS-SANITATION-SIDELO	061056	2015	AUTOCAR	ACX64	139155	27,059	1/12/2018	Fr	10:25:06 AM	1/17/2018	We	6:04:45 AM	3	

Define > Measure > Analyze > Improve > Control

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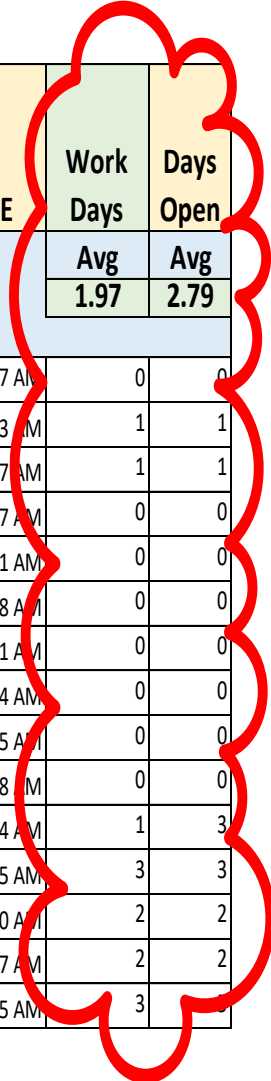
Stratify Problem

The team stratified the 20,188 WOs using a histogram and found…

### SWD Heavy Fleet Work Orders Closed 10-1-19 thru 2-28-21

Upper Spec Limit = 7 Calendar Days

n = 20,188 (124 over 30 days not shown)
mean = 2.0

1,753 (9%) Work Orders took 7 calendar days or longer to close

# of Work Orders

136   570   367   2   0 176 116 108 75   70   57   51   64   41   36   27   36   23   34   25   20   15   18   11   13   7   13   6   8

-2.5 -1.5 -0.5 0.5 1.5 2.5 3.5 4.5 5.5 6.5 7.5 8.5 9.5 10.5 11.5 12.5 13.5 14.5 15.5 16.5 17.5 18.5 19.5 20.5 21.5 22.5 23.5 24.5 25.5 26.5 27.5 28.5 29.5 30.5 31.5

# of Work Days to Complete Work Order

The team looked closer at the 1,753 late Work Orders.

Define > **Measure** > **Analyze** > **Improve** > **Control**

The team stratified the 1,753 SWD Heavy Fleet Orders that took more than 7 or more calendar days many ways and found…

SWD Heavy Fleet Work Orders taking 7 or more Work Days Closed 10-1-19 thru 2-28-21

n = 1753
mean = 11.842

1,064 (61%) of very late work orders involved less than 11 Labor hours
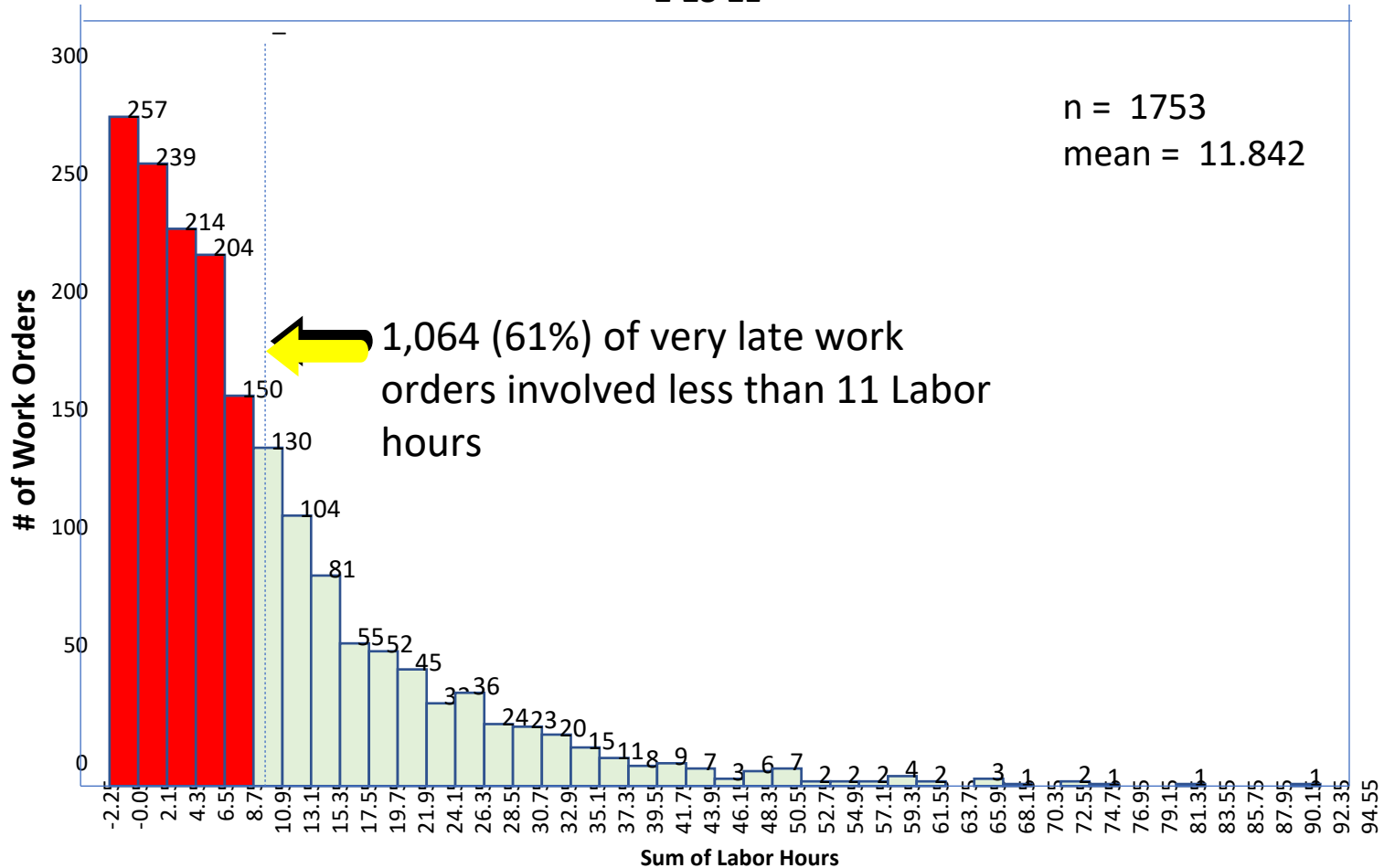
The team looked closer at the 1,064 work orders…….

Define Measure Analyze Improve Control

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Stratify Problem

The team stratified the 1,064 SWD Heavy Fleet Orders that took more than 7 or more calendar days and were less than 11 labor hours many ways and found…

SWD Heavy Fleet Work Orders taking 7 or more Work Days and less than 11 Labor Hours were Closed 10-1-19 thru 2-28-21

n = 1064
mean = 512.9739

787 (74%) of WOs involve Total Part Costs under $429.

Problem Statement: *"787 (74%) of the 1,064 SWD Heavy Fleet work orders that took more than 7 or more calendar days to close and took less than 11 labor hours were for orders with total parts costs under $429."*

Define ▷ Measure ▷ Analyze ▷ Improve ▷ Control

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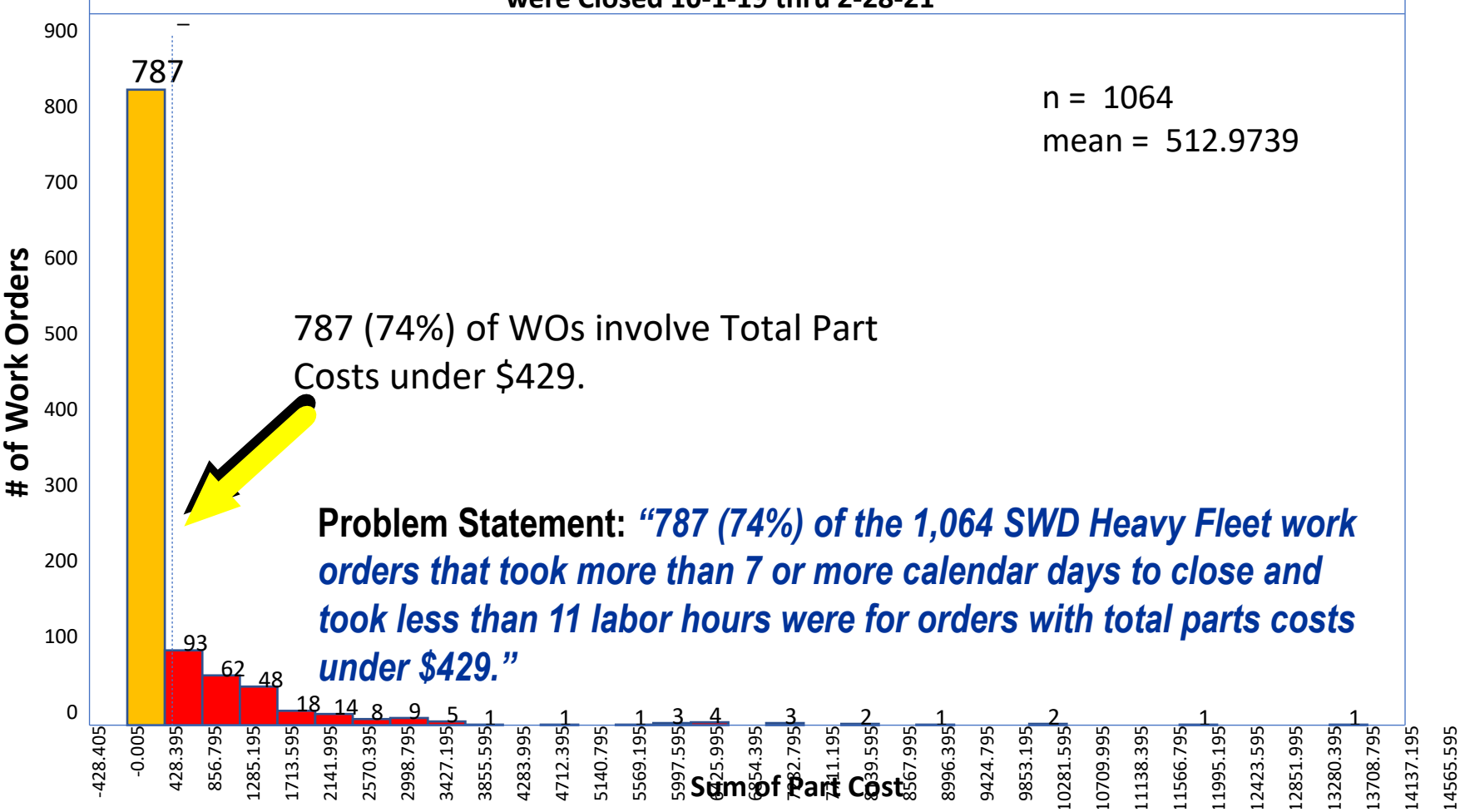
Identify Potential Root Causes

The team sampled 30 WOs from the Problem Statement and sent the matrix to the Heavy Fleet Service managers for comments on "what caused the delayed WO?"

Single Event Cause Identification Matrix (*"what caused delayed Work Order?"*)

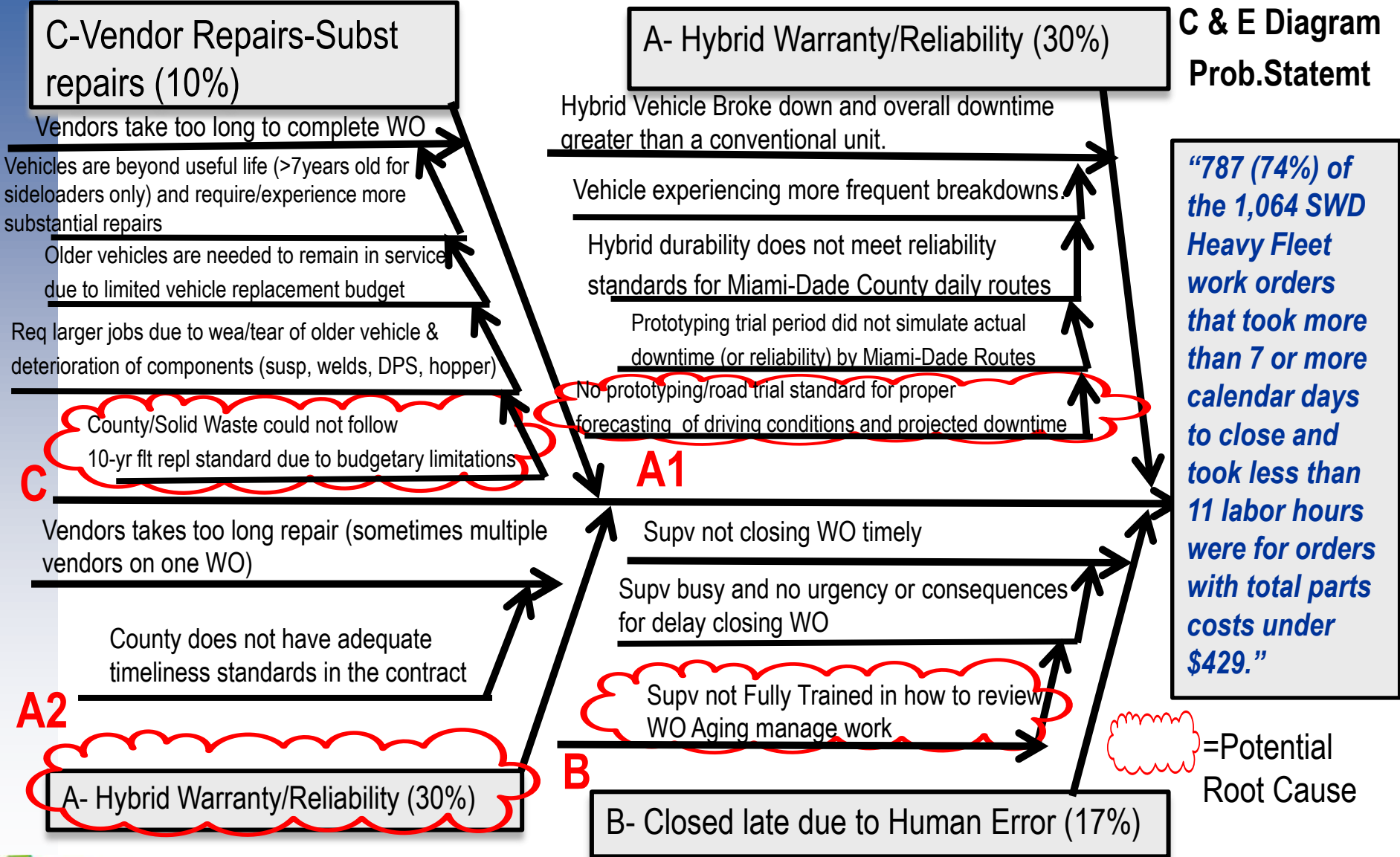| CATEGORY DESC	HYBRID YES/N	Shop	YEAR MAKE MODEL	Work Order	# of Jobs in WO	UNIT NO	OPEN DATE	Sum of LABOR HRS	Sum of LABOR COST	Sum of PART COST	Sum of COMM COST	Sum of Total Repair Cost	Comments (What Caused the delay to close the Workorder)	Simplified Crosswalk
Straight Truck	STANDARD	3A	2005 PETE	270657	7	060848	11/21/2019	4.0	$436	$70	$5,376	$5,882	Work at vendor for welding repairs.	Vendor repairs- Substantial repairs.
STRAIGHT TR	HYBRID	3A	2015 AUT	270652	3	061075	11/21/2019	2.9	$309	$20	$0	$	Hybrid Issue. At Vendor waiting on part for Hybrid system (accumulator).	Hybrid problem - Warranty
Straight Truck	STANDARD	3A	2020 AUT	295257	3	061179	3/26/2020	2.4	$177	$33	$0	$210	Work at vendor for AC repairs.	Vendor repairs Warranty.
Straight Truck	STANDARD	3A	2005 PETE	297499	2	060837	4/7/2020	4.3	$311	$0	$0	$311	was waiting for body repair estimate and retirement approval	estimate and retirement approval.
Straight Truck	STANDARD	3A	2005 PETE	308021	9	060858	6/4/2020	9.4	$681	$412	$0	$1093	Work completed on time. WO closed late due to human error.	Closed late due to human error.
Straight Truck	STANDARD	3A	2018 PETE	319949	4	061146	8/10/2020	3.6	$261	$18	$0	$280	Work completed on time. WO closed late due to human error.	Closed late due to human error.
Straight Truck	STANDARD	3B	2007 AME	263796	7	060975	10/18/2019	5.5	$573	$79	$6,585	$7,237	Truck was at suspension vendor for substantial amount of suspension work. Timeline matches severity of repairs.	Vendor repairs- Substantial repairs.
Straight Truck	STANDARD	3B	2007 AME	280492	7	060925	1/13/2020	8.8	$647	$329	$0	$976	WO initially open for PM, but work was not done until 1/21/20. This means that vehicle was being used and not available to perform PM until the day the work was done. Open ahead of time in error.	WO open ahead of time due to human error.

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The team then affinized the Identified Cause comments and aggregated the data using a pivot table..

Row Labels	Count of Simplified Crosswalk	Count of Simplified Crosswalk2
B Closed late due to human error.	5	17%
Experimental unit- needed review from manufacturer.	1	3%
Hybrid Problem and Conventional Engine Repair problem afterward.	1	3%
Intermittent issue. Issue duplicated and repair performed.	1	3%
Intermittent issue. Issue not duplicated.	1	3%
Parts on order.	2	7%
Pending body repair estimate and retirement approval.	1	3%
Pending retirement approval.	1	3%
Substantial repair- Vehicle had daily partial repairs to prioritize other active units.	1	3%
C Substantial repairs.	1	3%
Vendor repairs- Substantial repairs.	3	10%
Vendor repairs- Warranty.	2	7%
WO open ahead of time due to human error.	1	3%
A Hybrid Problem - Warranty	9	30%
Grand Total	**30**	**100%**

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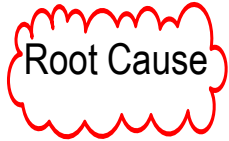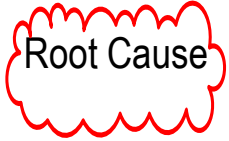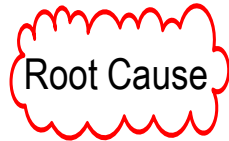
The team completed the Fishbone Analysis…

C & E Diagram
Prob.Statemt

C-Vendor Repairs-Subst repairs (10%)

A- Hybrid Warranty/Reliability (30%)

Vendors take too long to complete WO

Vehicles are beyond useful life (>7years old for sideloaders only) and require/experience more substantial repairs

Older vehicles are needed to remain in service due to limited vehicle replacement budget

Req larger jobs due to wea/tear of older vehicle & deterioration of components (susp, welds, DPS, hopper)

County/Solid Waste could not follow 10-yr flt repl standard due to budgetary limitations

C

Hybrid Vehicle Broke down and overall downtime greater than a conventional unit.

Vehicle experiencing more frequent breakdowns.

Hybrid durability does not meet reliability standards for Miami-Dade County daily routes

Prototyping trial period did not simulate actual downtime (or reliability) by Miami-Dade Routes

No prototyping/road trial standard for proper forecasting of driving conditions and projected downtime

A1

Vendors takes too long repair (sometimes multiple vendors on one WO)

County does not have adequate timeliness standards in the contract

A2

A- Hybrid Warranty/Reliability (30%)

Supv not closing WO timely

Supv busy and no urgency or consequences for delay closing WO

Supv not Fully Trained in how to review WO Aging manage work

B

B- Closed late due to Human Error (17%)

"787 (74%) of the 1,064 SWD Heavy Fleet work orders that took more than 7 or more calendar days to close and took less than 11 labor hours were for orders with total parts costs under $429."

=Potential Root Cause

The team collected data to verify the root causes and found….

Root Cause Verification Matrix

	Potential Root Cause	How Verified?	Root Cause or Symptom
A1	No prototyping/road trial standard for proper forecasting of driving conditions and projected downtime	Reviewed fleet repair data and it confirmed higher frequency of Hybrid breakdowns when compared to conventional trucks	Root Cause
A2	County does not have adequate timeliness standards in the contract	Interviewed ISD Subject Matter Expert and they reviewed the Manufacturer Warranty Contract and confirmed no maximum repair time standard.	Root Cause
B	Supv not Fully Trained in how to review WO Aging manage work	Interviewed ISD Subject Matter Expert and they advised that WO data was too large for shop staff to review.	Root Cause
C	County/Solid Waste could not follow 10-yr flt repl standard due to budgetary limitations	Interviewed ISD Subject Matter Expert and they reviewed County Contracts and determined no timeline stipulations existed.	Root Cause

All four (4) were validated as root causes.

Identify and Select Countermeasures

14., 15. ☑

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

Countermeasures Matrix 5=Extreme; 4=High; 3=Moderate; 2=Somewhat; 1=Little

Problem Statement	Verified Root Causes	Countermeasures	Effective ness	Feasa bility	Overall	Take Action? Yes/No
"787 (74%) of the 1,064 SWD Heavy Fleet work orders that took more than 7 or more calendar days to close and took less than 11 labor hours were for orders with total parts costs under $429."	A1 - No prototyping/road trial standard for proper forecasting of driving conditions and projected downtime	**A1 -** Revise department demo of new technologies and/or equipment operational standards to include thorough prototype period acceptance criteria that reflect actual driving conditions and repair forecast needs.	4	4	16	Y
	A2 - County does not have adequate timeliness standards in the contract	**A2 -** Revise vendor contracts to establish repair timelines for outsourced work.	4	2	8	Y
	B - County/Solid Waste could not follow 10-yr fleet replacement Standard due to budgetary limitations	**B1 –** Revise current vehicle replacement purchase plan (5yr and 10yr) to evalute operational vs. maintenance costs	4	5	20	Y
	C - Supv not Fully Trained in how to review WO Aging report	**C1 -** Conduct semi-annual training on managing WO aging reports	2	5	10	Y
		C2 – Delegate easy work orders for someone else to do	3	1	3	N
		C4 – Create a standard for supervisor to regularly check WO aging report	1	5	5	N
		C5 – Create a daily dashboard for the Supervisor to view multiple reports (aging, deadline, etc)	3	3	9	N
		C6- Create an automated report that would identify and forecast is what deemed to be late per the type of job	5	3	15	Y

The team selected 5 Countermeasures for implementation.

Define ⟩ Measure ⟩ Analyze ⟩ Improve ⟩ Control

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The team conducted "Ride Alongs" with Heavy Fleet Drivers and through discussions with the SW Staff identified additional "Quick Win" countermeasures using a LEAN WASTE Analysis Matrix.

Waste Analysis and Improvement Matrix for Process: **Solid Waste Heavy Fleet Operations**

5=Extreme; 4=High; 3=Moderate; 2=Somewhat; 1=Little

Wastes Found

H=Handling too much; U=Unnecesary
O=Over Production; Processing;
W=Wait Time; I=Inventory/WIP;
R=Rework M=Motion

	Process Step (Issue)	H	O	W	R	U	I	M	Possible Action(s) to Implement	A Effectiveness	B Ease to Implement	C= A X B Overall	Implement? Y/N
1	Driver's Checklist at the start of the Day does not account for driver experience on vehicle repairs			W	R	U		M	Have mechanic available at start of day for driver consults	4.0	3.0	12.00	N
2	Driver's vehicle had repairs complete and vehicle was not in ready line			W	R			M	Mechanic that completed job delivers vehicle to ready line once job is complete	5.0	5.0	25.00	Y
3	Driving behavior varies based on driver experience (rush/stop/wear on brakes/route planning)			W	R			M	Score driver behavior in order to assess high risk drivers	3.0	2.0	6.00	N
4	Unloading of trash (wait time/drive other route/overload)			W				M	Place a scale in vehicle to improve optimum waste density for each trip	4.0	2.0	8.00	N
5	End of the day vehicle check (does vehicle need repairs)			W	R			M	Train drivers to drop off vehicle at end of shift for repairs if no policy in place. (reference HOTLINE in early morning)	4.0	4.0	16.00	Y

The team performed Barriers and Aids analysis on the Countermeasure A1 (1 of 5).

Countermeasure: A1 - Revise department demo of new technologies and/or equipment operational standards to include thorough prototype period acceptance criteria that reflect actual driving conditions and repair forecast needs.

Barriers		Aids
Impact (H, M, L)	**Forces Against Implementation**	**Forces For Implementation**
H	Manufacturer push back (uncollectable time, labor, and equipment cost) (Supported by: A)	A) Potential savings
M	Availability of long term demonstration equipment. (Supported by: A, B, C)	B) Practical hand-on operator testing and feedback.
L	Risk Liability waivers (in the event of damage) (Supported by: C)	C) Written agreement with the manufacturers.

▪ **The team completed Barriers and Aids Analysis on the other Countermeasures.**

Identify Barriers and Aids

The team performed Barriers and Aids analysis on the Countermeasure A2n(2 of 5).

Countermeasure: A2 - County does not have adequate timeliness standards in the contract

	Barriers	Aids
Impact (H, M, L)	**Forces Against Implementation**	**Forces For Implementation**
H	Manufacturer push back (uncollectable time, labor, and equipment cost) **(Supported by: A)**	**A) Potential savings**
M	Vendors may not wish to partner with the County. **(Supported by: B)**	
L	Holding vendors financially liable for delayed repairs. **(Supported by: A & B)**	**B) Written agreement with the manufacturers.**

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Define > Measure > Analyze > Improve > Control

Identify Barriers and Aids

The team performed Barriers and Aids analysis on the Countermeasure B1 (3 of 5).

Countermeasure:B1 – Adhere to the current vehicle replacement purchase plan (5yr and 10yr)

	Barriers	Aids
Impact (H, M, L)	**Forces Against Implementation**	**Forces For Implementation**
H	Unforeseen budgetary impacts (COVID, economic downturn, budget cuts) **(Supported by: A)**	**A) Potential savings**
M	Rising equipment cost if production order times are not met. **(Supported by: A & B)**	**B) Written agreement with the manufacturers.**
H	New technologies may require additional infrastructure (i.e. CNG filling station, Electrical charging units, etc) **(Supported by: A & C)**	**C) Embracing sustainability Initiatives**

Identify Barriers and Aids

The team performed Barriers and Aids analysis on the Countermeasure C1 (4 of 5).

Countermeasure: C1 - Conduct semi-annual training on managing WO aging reports

	Barriers	Aids
Impact (H, M, L)	**Forces Against Implementation**	**Forces For Implementation**
M	**Timing and availability of staff** (Supported by: A & B)	A) Management buy-in and support for flexibility training schedule.
M	**Supervisory staff maybe reluctant to take on additional administrative responsibility with limited resources.** (Supported by: A & B)	B) ISD management buy-in and support

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The team performed Barriers and Aids analysis on the Countermeasure C6 (5 of 5).

Countermeasure: C6- Create an automated report that would identify and forecast is deemed to be late per the type of job		
Barriers		**Aids**
Impact (H, M, L)	**Forces Against Implementation**	**Forces For Implementation**
M	Requires significant ITD expertise and potential investment **(Supported by A & B)**	A) Minimize missing WOs that are going to be late B) Management and front line support

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

Implement Action Plan

The team incorporated the Barriers and Aids analysis into the Action Plan.

Legend:
■	= Actual
☐	= Proposed

WHAT: **Implement 5 Countermeasures to Improve**

HOW	WHO	WHEN 2021 Jul	Aug	Sep	Oct	Nov
1.Develop Countermeasures/ Practical Methods:						
A1- Revise department demo of new technologies and/or equipment operational standards to include thorough prototype period acceptance criteria that reflect actual driving conditions and repair forecast needs.	Team	☐ ■				
A2- Revise vendor contracts to establish repair timelines for outsourced work.	Team	☐ ■				
B1- Revise current vehicle replacement purchase plan (5yr and 10yr) to evaluate operational vs. maintenance costs	Team	☐ ■			■Completed 7/16/21	
C1- Conduct semi-annual training on managing WO aging reports	Team	■				
C6- Create an automated report that would identify and forecast is what deemed to be late per the type of job	Team	■				
2.Secure Management Approval of Countermeasures *(share benefits and savings)*	Team	☐ ■	8/15/21			
3.Communicate/Train Staff in Countermeasures and related policies/procedures *(share benefits and Mgmt Support)*	Team		☐	9/15/21		
4.Implement /Pilot Countermeasures (Review results and adjust countermeasures for ongoing operations)	Team			■ ☐	11/15/21	
5.Establish On-going responsibilities and standardize countermeasures into operations	Team			■On-Going ☐		

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Estimate Countermeasures Costs/Benefits/ROI

The team estimated the Costs and Benefits of the countermeasures.   **20.** ☑

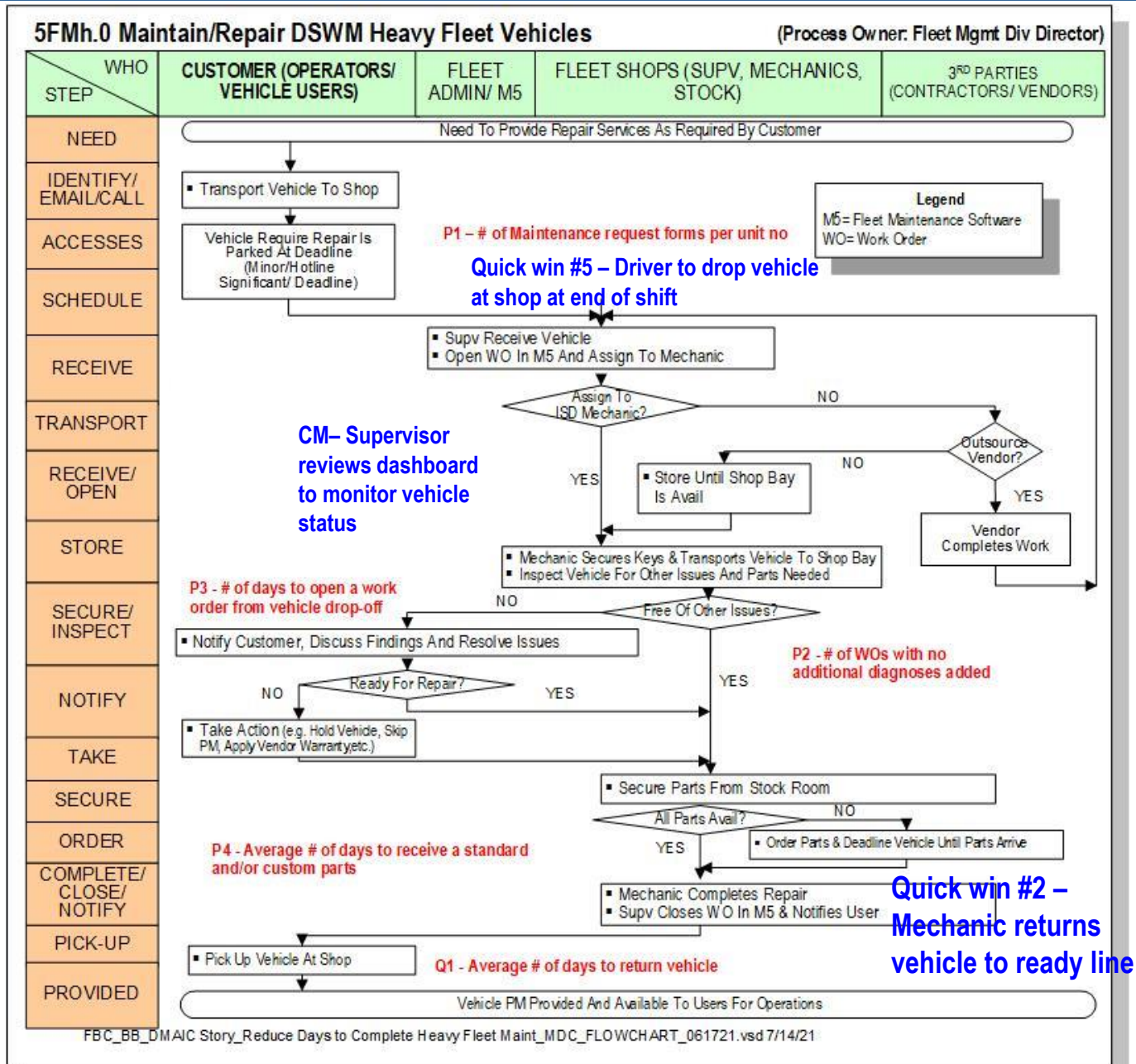**ROI WORKSHEET for: Reduce the Heavy Fleet Maintenance Cycle Time**

ITEMIZED COUNTERMEASURE COSTS (DESCRIPTION)	$ VALUE (ANNUALIZED)	ITEMIZED BENEFITS (DESCRIPTION)	$ VALUE (ANNUALIZED)
A1- Revise department demo of new technologies and/or equipment operational standards to include thorough prototype period acceptance criteria that reflect actual driving conditions and repair forecast needs.	N/A	The team estimated that these countermeasures including quick wins should achieve at least 2/3 of our COPQ = $324,988 * 0.67	$217,742
A2 - Revise vendor contracts to establish repair timelines for outsourced work.	N/A		
B1- Revise current vehicle replacement purchase plan (5yr and 10yr) to evaluate operational vs. maintenance costs	$1,000		
C1 - Conduct semi-annual training on managing WO aging reports	$2,500		
C6 - Create an automated report that would identify and forecast is what deemed to be late per the type of job	$10,000		
2 Quick Wins	N/A		
Total Investment Cost	**$13,500**	**Total Expected Annualized Benefits**	**$217,742**
Net Benefits=(Annl Benefits – Investment Cost)==>		$217,742 - $13,500 = $204,242	
ROI=(Net Benefits/Investment Cost) ==>		16.1 : to 1 ratio	

Define > **Measure** > **Analyze** > **Improve** > **Control**

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The team incorporated their counter-measures into their Process Flowchart.

FBC_BB_DMAIC Story_Reduce Days to Complete Heavy Fleet Maint_MDC_FLOWCHART_061721.vsd 7/14/21

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The team completed the Process Control System form for the Process.

Process Control System					
Process Name: Maintain/repair Heavy Fleet Vehicles for DSWM			**Process Owner: ISD Fleet Division Director**		
Process Customer: DSWM Heavy Fleet			**Critical Customer Requirements: Return vehicle in less than 7 days**		
Process Purpose: to Maintain Vehicles			**Current Sigma Level: TBD**		
			Outcome Indicators: Q1		
Process and Quality Indicators		**Checking / Indicator Monitoring**			
Process Indicators And	Control Limits	Data to Collect	Timeframe (Frequency)	Responsibility	
Quality Indicators	Specs/ Targets	What is Checking Item or Indicator Calculation	When to Collect Data?	Who will Check?	**Contingency Plans / Misc.** • **Actions Required for Exceptions** • **Procedure References**
P1- # of maintenance request forms per vehicle unit no.	2	Count the number of maintenance request forms submitted per vehicle unit no per quarter calculated from the M5 system	Quarterly	Fleet Supervisor	**Data Collection Spreadsheet**
P2- # of WOs with no additional diagnoses added	<6	This is the difference between the initial WO (job) versus the actual jobs completed on the WO. Data is pulled from M5 system.	Quarterly	Fleet Supervisor	**Data Collection Spreadsheet**
P3- # of days to open a WO from vehicle drop-off	0	This is calculated from the difference in date between the hard copy WO request and the data entered in the M5 system.	Monthly	Fleet Supervisor	**Data Collection Spreadsheet**
P4 – Average # of days to receive a standard/ custom order part	1	This is data pulled from the M5 system.	Quarterly	Fleet Supervisor	**Data Collection Spreadsheet**
Q1 – Average # of days to return vehicle	2	This is data that is calculated in M5 from the date WO opened vs date WO closed	Monthly	Fleet Supervisor	**Data Collection Spreadsheet**

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Lessons Learned

1) Importance of data collection and the cleaning up of data.

2) Ride-alongs help with a firsthand look at the issues and a different perspective.

3) Histograms were effective at stratification. Paretos were not used in this project.

4) Maintaining close communication between fleet and client departments is essential to success.

Next Steps

1) Continue to Implement Countermeasures and monitor performance results.

Appendix A - S. I. P. O C. Analysis for:

Process: Complete Work Order for Solid Waste Vehicles

S.I.P.O.C. Analysis

Process: Maintain/repair DSWM Heavy Fleet Vehicles
Process Owner: ISD Fleet Mgmt Division Director
Date Approved: _____

Suppliers	Inputs	Process	Outputs	Customers
Solid Waste Drivers ISD Fleet	Vehicle Availability Checklist M5 System	• Inspect Vehicle in satisf running condition • Identify Vehicle Maint Needs	Vehicle ISD Maintenance Request Form	Solid Waste ISD
SW Drivers ISD Fleet	Vehicle Availability ISD Maintenance Request Form	• Schedule Maint/Repairs • Generate work order and jobs	Parts Order Work Order	Solid Waste ISD
ISD Fleet Maintenance Parts Vendors Subcontractors	Work Order Vehicle Availability Parts	• Perform work Free of other issues? → • Discuss and resolve	Completed WO Vehicle	Solid Waste ISD
ISD Fleet Maintenance Solid Waste	Vehicle Completed WO	•Complete WO •Pick up Vehicle	Vehicle	Solid Waste Driver

How do our customers want our outputs?

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Appendix B - Customer Requirements Matrix

<table>
<tr><td colspan="5" align="center">Customer Requirements Matrix</td></tr>
<tr><td>**Process:**</td><td colspan="4">*Maintain/repair DSWM Heavy Fleet vehicles*</td></tr>
<tr><td colspan="2" align="center">Survey Voice of Customer</td><td rowspan="2" align="center">Process Output(s)</td><td rowspan="2" align="center">Customer Valid Requirement</td><td rowspan="2" align="center">Outcome Indicator(s)
In-Process (Ps)
End-of-Process (Qs)</td></tr>
<tr><td align="center">Quality Element</td><td align="center">Example Question</td></tr>
<tr><td>Accuracy</td><td>*How accurate do the process outputs need to be?*</td><td>ISD Maintenance Request Form</td><td>Work order form needs to include all vehicle information (Unit no, mileage, make, and description of defect)</td><td>P1 - # of Maintenance request forms per unit no</td></tr>
<tr><td>Accuracy</td><td>*How accurate do the process outputs need to be?*</td><td>Work Order</td><td>Work order should contain correct diagnosis of primary compaint or issue.</td><td>P2 - # of WOs with no additional diagnoses added</td></tr>
<tr><td>Timeliness</td><td>*When do customers need the process outputs?*</td><td>Work Order</td><td>Work order should diagnose issue within 24 hours</td><td>P3 - # of days to open a work order from vehicle dropoff</td></tr>
<tr><td>Timeliness</td><td>*When do customers need the process outputs?*</td><td>Parts and Services Order</td><td>Parts should be available, delivered, or made as soon as possible</td><td>P4 - Average # of days to receive a standard part; P5 - Average # of days to receive a custom part</td></tr>
<tr><td>Timeliness</td><td>*When do customers need the process outputs?*</td><td>Repaired Vehicle</td><td>Vehicle should be available in7 days or less.</td><td>Q1 - Average # of days to return vehicle</td></tr>
</table>

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