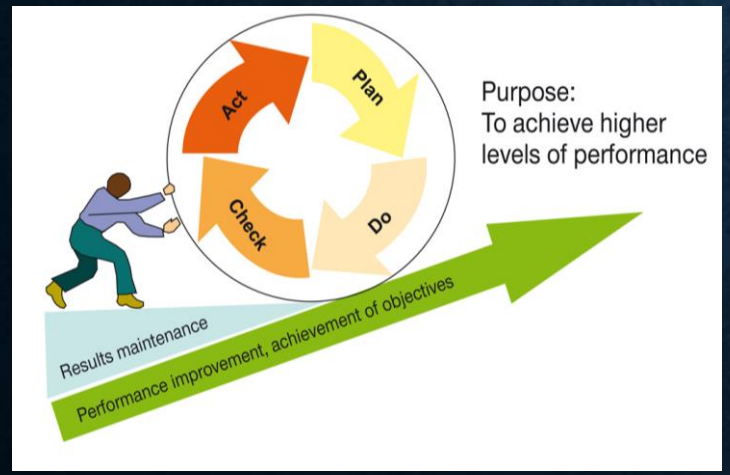
SCHOOL BUS TRANSPORTATION TWO CASE STUDIES

Presented By: Conley Salyer

Attorney & KyCPE Manager of Consulting Services

KYCPE COACHES PROCESS IMPROVEMENTS BECAUSE WE WANT TO SEE ORGANIZATIONS THRIVE



TO ACCOMPLISH THIS GOAL KYCPE USES BOTH THE EXAMINATION PROCESS AND A COACHING PROCESS

- The Coaching Process is fee-based and provided by KyCPE subject matter experts
- We have worked with 23 KY School districts over the last 3 years
- School District savings are solid and far exceed the cost of services
- In fact, KyCPE provides a guarantee to that effect in each contract

THE FIRST STORY
LAWRENCE COUNTY SCHOOLS
IN THEIR WORDS

Project Start: April 1, 2016

Project End: September 1, 2016

Project Wins

- By doing this project and using the steps presented, it made us realize that we could make changes in routes to save valuable time and money by analyzing routes, buses, and student demographics. It made us more conscious about what was going on in transportation department.

DMAIC Approach

- DMAIC is a data-driven, five-step approach to improving processes.
  - Define the process that has opportunity for improvement with project goals.
  - Measure the beginning status of the process – potential savings or new revenue
  - Analyze the data/process to determine root causes and current obstacles.
  - Improve the process by eliminating root causes and current obstacles.
  - Control the improved process for continued success.

Context

- Transportation had gotten to a point where it was run a certain way and so everyone just automatically thought it had to be that way. Everyone just assumed that things couldn't be changed.

WHAT WE FOCUSED ON
OPERATIONAL DEFINITIONS

Passenger Logs-Records showing number of pupils riding each bus, time students are picked up and dropped off, addresses and phone numbers for each student.

Fuel Usage-Record showing number of gallons used and average MPG for each bus.

Demographics-How the land lays (very hilly) and student addresses and phone numbers.

DEFINE

- **Problem Statement:** Extended student travel time on buses, Increased maintenance/fuel cost on buses due to long bus routes.

- **Goal Statement:**
- Minimize student travel time and to minimize fuel and maintenance cost

Why: Routes needed evaluation due to the changes in student and driver demographics.

What: Extended miles and time spent on bus due to routes needing adjustment.

How: Team members evaluated the routes to see what changes could be made, to do away with unnecessary miles traveled.

MEASURE

- Measure what was determined for the project:
- Measured MPG on different style buses.
- studied all routes and time spent on routes.

Why: To see if certain buses averaged better fuel mileage and to see if we could save miles and time traveled on buses.

What: Looked at fuel sheets to determine which buses had the best MPG and checked for wasted miles and time spent on buses.

How: Keep record of fuel used and miles traveled on each bus and made sure we were putting the right bus and driver to each route.

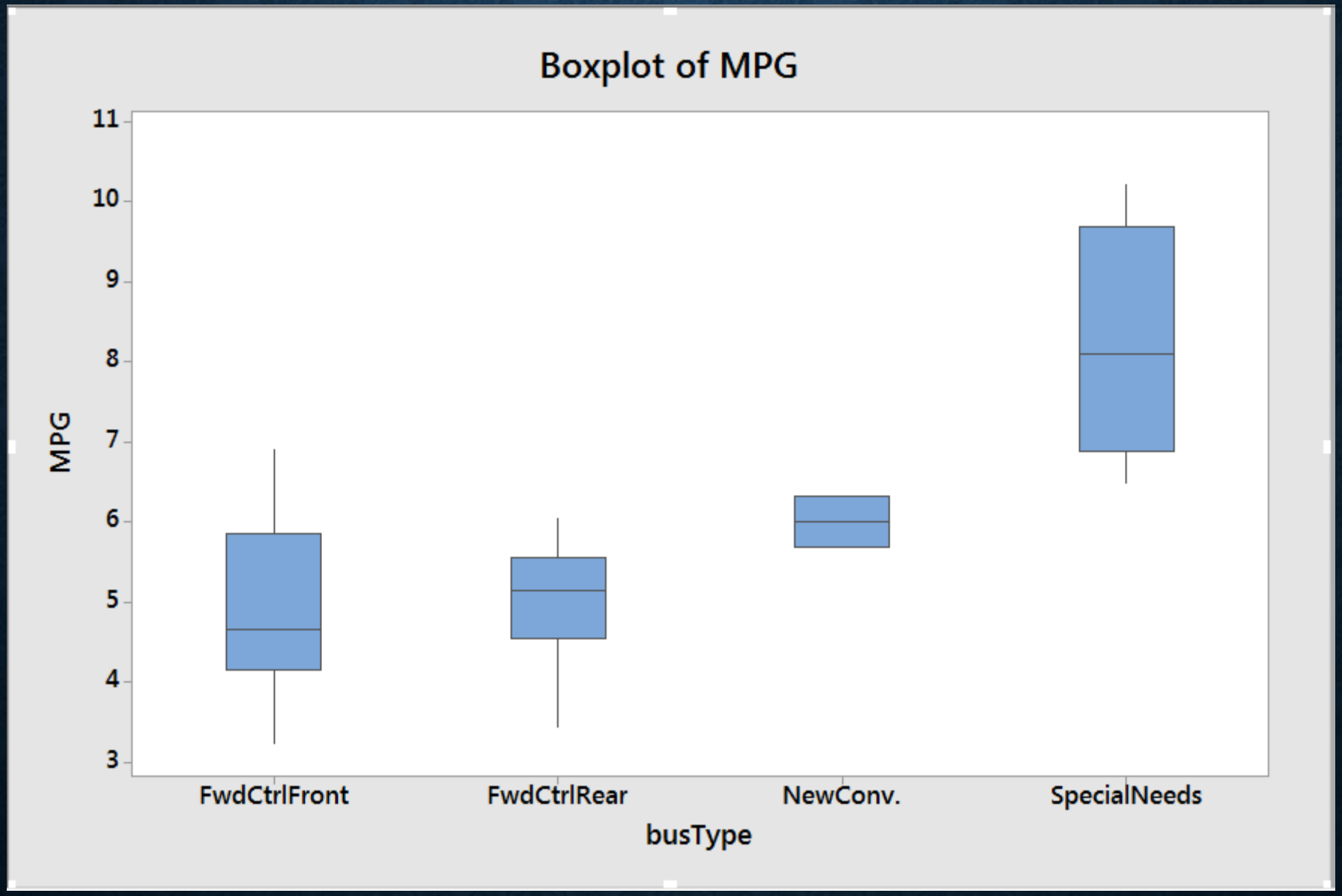
BASELINE DATA - APRIL 2016

Overall Baseline data:

Thomas Conventional buses had better fuel mileage than forward control and rear engine buses.

Had routes overlapping and was able to make changes so they didn't overlap.

	conventional	forward-control	rear-engine
Number of buses	7	20	8


Boxplot of MPG
MPG
11
10
9
8
7
6
5
4
3
FwdCtrlFront
FwdCtrlRear
NewConv.
SpecialNeeds
busType

Bus Number	Age of Bus	LEE	LWE	LMS	LCHS	FES	BES	LAST DROP-OFF		MPG	Bus	Age	Stops
1	16	250	255	305	320			430		5.5	1	16	4
3	16						355	500		4.6	3	16	1
13	15	250	255	305	320			440		3.3	13	15	4
21	14	255	250	305	320			440		5.1	21	14	4
22	14	255	250	305	320			430		4.8	22	14	4
23	4	250	255	305	320			435		5.2	23	4	4
41	12				320		355	440		6.4	41	12	2
43	12				320	340		435		3.3	43	12	2
44	12						355	500		4.6	44	12	1
45	12	245		305	130			345		10.2	45	12	3
52	11	255	250	305	320			435		5.4	52	11	4
53	11				320	340		445		4.3	53	11	2
54	11				320	340		435		6.9	54	11	2
55	11	250	255	5	320			425		4.1	55	11	4
61	10						355	450		5.1	61	10	1
62	10						355	445		6.3	62	10	1
63	10	255	250	305	320			420		3.4	63	10	4
64	10	250		300				415		8.1	64	10	2
71	9	250	255	305	320			450		6.5	71	9	4
72	9				320		355	430		5.4	72	9	2
73	9	250	255	305	320			420		3.8	73	9	4
91	8	255	250	305	320			425		5.8	91	8	4
92	8	250	55	305	320			445		6.4	92	8	4
93	8	250	255	305	320			435		4.4	93	8	4
94	8						355	455		5.1	94	8	1
110	6	255	250	305	320			445		4.2	110	6	4
121	4	255	250	305	320			420		4.7	121	4	4
122	4	255	250	305	320			430		5.5	122	4	4
210	6					330		430		8.1	210	6	1
131	3				320	340		500		6.1	131	3	2
132	3	255	250	305	320			400		4.4	132	3	4
141	2				320	340		445		5.6	141	2	2
142	2						355	511		5.7	142	2	1
143	2	255	250	305	320			445		6.3	143	2	4
144	2				320	340		445		6.0	144	2	2

ANALYZE

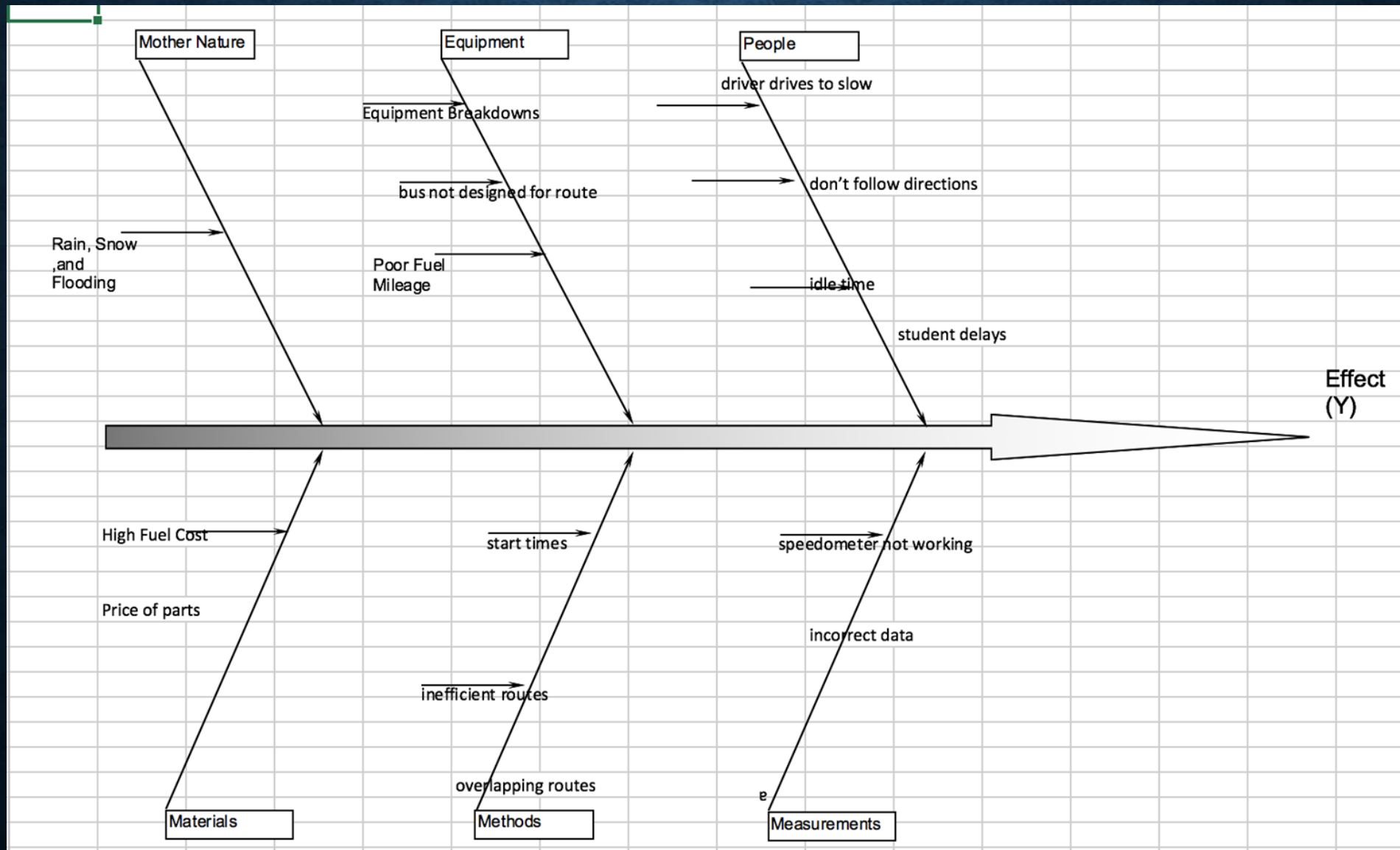
Why: Team continues to monitor data to assure we get best possible results from data collected.

What: Team was able to find routes with wasted miles and time and also discovered certain style buses were better on fuel mileage.

How: During this process the Fishbone Diagram was used to organize the work. The Fema (failure mode effects analysis) was also used to determine the problem's possible cause, possible effect, and the current process to control the time spent on buses, wasted mile's and wasted fuel by inefficient route designs.

PROBLEM STATEMENT: EXTENDED

STUDENT TRAVEL TIME ON BUSES, INCREASED MAINTENANCE/FUEL COST ON BUSES DUE TO LONG BUS ROUTES.



IMPROVE

Monitor fuel mileage of all buses for a year.

Monitor route designs and student demographics of all routes and made necessary changes where possible for the past year.

IMPROVEMENT DATA - 2016

Overall IMPROVEMENT data: Bus replacement Schedule

Our Thomas Conventional buses have 1.5 MPG better fuel mileage than forward control and rear engine buses so the decision was made to purchase three conventional buses to replace forward control buses that are due for replacement anyway.

We travel approximately 50,000 miles per month and if we had all conventional buses we would then save approximately $4600 per month with a fleet of 35 buses with current fuel prices of $1.95 per gallon.

Each bus travels an average of 14,286 miles/year.
If each new bus gets 6 MPG the gallons per bus per year is 2381 x $1.95 = $4643. If they only get 4.5 MPG the cost is 3175 Gallons x $1.95 = $6191. The difference is $1548 per bus x3 =$4643/yr. savings.

IMPROVEMENT DATA - 2016

Overall IMPROVEMENT data: Route Optimization

Had routes overlapping and was able to make changes so they didn't overlap.

- Had two buses running Donithan RD was able to take #092 off saving average of 20 miles a week.
- Was able to take bus #163 off of Top Of World route and put bus #052 on it, saving an average of 40 mile a week.
- The kids that lived on RT 3 were switched to bus #162 and the town kids were switched to bus #063 eliminating overcrowding and bus #052 from going on town RT saving average of 10 mile a week.
- Switched four drivers to RT's they live on to keep buses from crossing paths saving an average of 420 miles a week plus wear and tear on buses.
- Due to student demographics we were able to go from 36 routes to 35 routes saving an average of 430 miles a week.
- By cutting unnecessary miles and waste it saves an average of 29,440 miles a year. Saving approximately $11,480 in fuel, plus a driver salary at approximately $12,500 per year, one bus at approximately $109,000 , and approximately $3000 for maintenance and supplies.
- Cost avoidance = $109,000 (enough for ~2FTEs?)
- Hard savings = $11,480 Fuel + $12,500 Driver + $3000 Maint. =$15,500/Yr
- 5 year estimated savings = $77,500

CONTROL

Monitor monthly fuel sheets to keep updated on fuel mileage.
Monitor student demographics to assure routes are designed for the safest and for the most efficient routes possible.
monitor supply cost and most efficient supplier.

NEXT STEPS

Continue to monitor and report findings to big rock planning every month.

LESSONS LEARNED

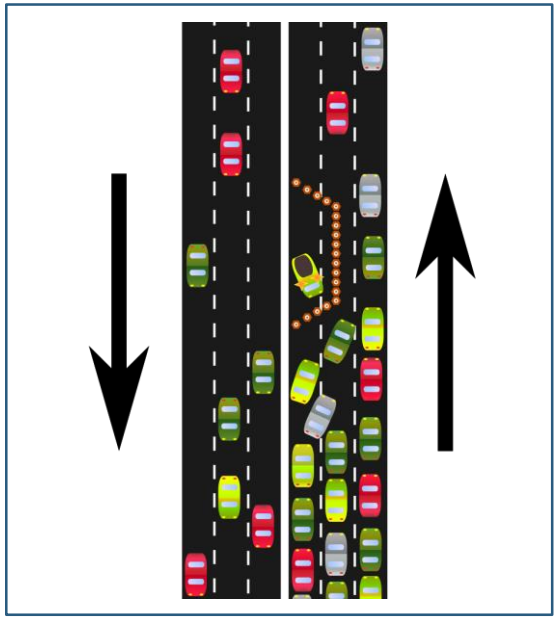
By identifying your problem you can use the cause and effect from the Fishbone to make you think about what might need to be worked on. By using the FMEA it helped us identify the severity of the problem. By using the Flow Chart it helped decide the order to proceed. By seeing all the data in a chart showed us which buses had the best mileage.

THE SECOND STORY
WARREN COUNTY PUBLIC SCHOOLS

- At the request of Nannette Johnston and Phil Eason from KASA, KyCPE agreed to test new approaches to improving school bus transportation
- 3 transportation subsystems KyCPE helps improve
  - Recruit-hire-train-retain transportation personnel
  - Facilities Management
  - Bus routing – this is what we worked on at Warren County

STEP 1
THE AGREEMENT

- KyCPE & Warren County Public Schools (WCPS) entered into a written agreement to analyze data for one school
- Because this was a test of new analytical tools, we did the work at no cost



COMMENTS ON KYCPE'S PROCESSES FOR IMPROVEMENT

- Warren County Director of Transportation, John Odom, had this to say
- Mr. Salyer and KyCPE have opened my eyes to new thoughts and methods for making Warren County's transportation system more efficient
- Conley was great to work with in this process

STEP 2
THE SCHEDULE

- Kickoff Meeting (1-15-2017)
- District Completes Data Gathering Tool (3/7/2-17) – available upon request
- Parties Resolve Issues Regarding Data (3/14/2017)
- KyCPE Analyzes Data – Completes Draft Report (3/31/2017
- KyCPE & WCPS Meet To Review Draft Report (4/10/2017)
- WCPS Elects To Continue Process For All Schools (Fee Based) (pending)
- KyCPE Provides Onsite Training To WCPS Employees (when contract begins)
- KyCPE Provides Remote Support During Life of Agreement

STEP 3
THE WORK

- The Work Comprises 7 Phases
  - Compiling Costs & Other Data for Existing Buses on Current Routes
  - Examining Data for "right sized" Buses on Current Routes
  - Compiling Data to generate Proposed New Routes
  - Compiling Costs & Other Data for Existing Buses on Proposed New Routes
  - Compiling Costs & Other Data for "right sized" Buses on Proposed New Routes
  - Preparing Report with Recommendations for Senior Leaders
  - Implementing the New Plan

STEP 4
THE RESULTS

Time, Fuel, and Maintenance Consumed for Existing Runs
Using Existing Buses

School	Bus #	ROUTE	Number of Students (Monitor add 1)	Miles per Run	STOPS	Run time in minutes	Bus Miles per Gallon	Gallons per run	DIESEL	Av Cost per Gallon $	Fuel Cost Per run $	M & D Per Run $
Oakland	1	M	40	44.8	28	56	6.43	6.97	D	2.02	14.08	10.33
Oakland	2	M	43	11.3	17	33	7.21	1.57	D	2.02	3.17	10.36
Oakland	3	M	53	28.1	10	25	7.21	3.90	D	2.02	7.87	12.11
Oakland	4	M	39	18.2	26	40	6.87	1.813	D	2.02	5.35	8.47
Oakland	5	M	46	11.4	20	30	8.13	1.402	D	2.02	2.83	13.61
Oakland	6	M	41	24.3	23	30	7.5	3.240	D	2.02	6.54	13.61
Oakland	7	M	21	19	22	35	6.87	2.766	D	2.02	5.59	10.55

STEP 4
RESULTS (CONT.)

Annual operating costs for current buses on current routes (Fuel + M&D)

Bus #	Annual Cost per Run	Runs per day	Annual operating costs - 2 runs (1 route)
1	$4,270	2	$8,540
2	$2367	2	$4,735
3	$3,409	2	$6,818
4	$2,428	2	$4,837
5	$2,789	2	$5,579
6	$3,526	2	$7,052
7	$2,824	2	$5,649
Total			$43,210

STEP 4
RESULTS (CONT.)

Fuel savings realized utilizing alternate buses on 6 of the current 7 routes

Rural Bus# (A= alternate)	Miles in Route (as % of 100 miles)	Fuel Savings - Gallons	Fuel Cost per Gallon $	Fuel Cost Savings $	# of Student Days	Annual Fuel Cost Savings $	12-Year Fuel Cost Savings $
1A	89.60%	4.047	2.02	8.17	175	1,430.46	17,165.51
2A	22.60%	1.021	2.02	2.06	175	360.81	4,329.69
3A omitted							
4A	36.40%	1.644	2.02	3.32	175	581.12	6,973.49
5A	22.80%	1.030	2.02	2.08	175	364.00	4,368.01
6A	48.60%	2.195	2.02	4.43	175	775.90	9,310.76
7A	38.00%	1.698	2.02	3.43	175	600.28	7,203.38
Total						4,910.82	58,929.80

STEP 4
RESULTS (CONT.)

Proposed New Route Costs Using Existing Buses

(route costs – morning and evening)

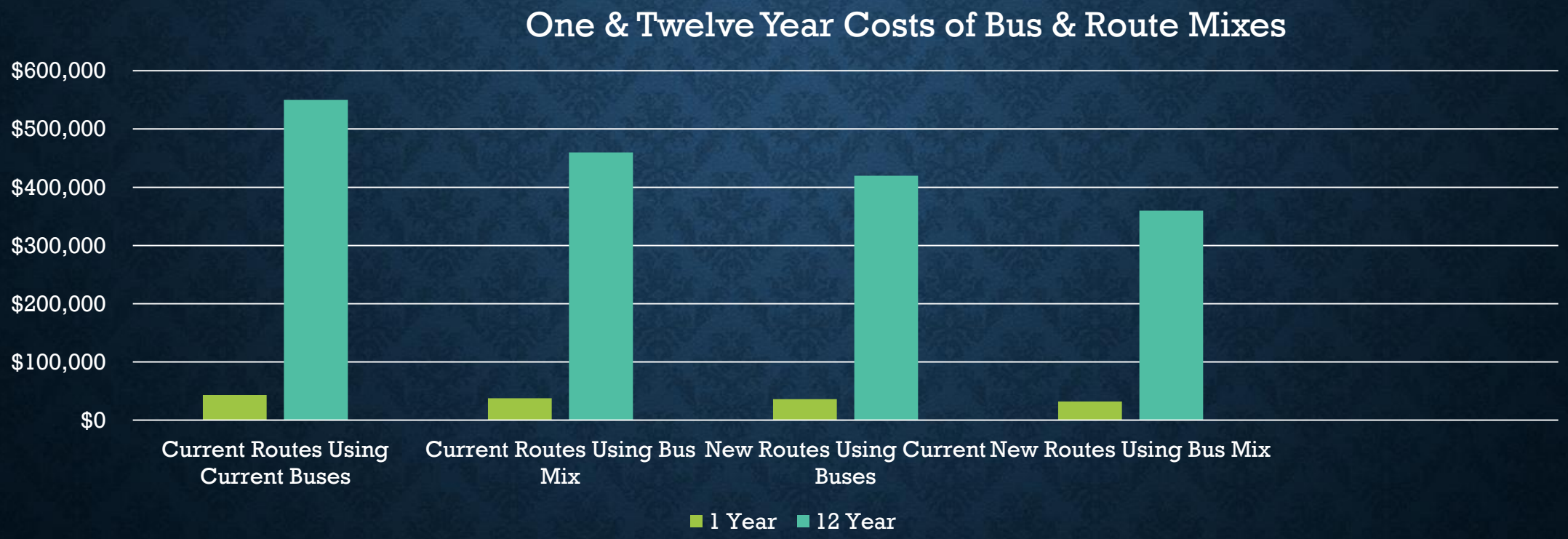
School	Bus Number	ROUTE	Number of Students (Monitor add 1)	Miles per Run	STOPS	Route Run Time in minutes	Bus Miles per Gallon	Fuel per run $	DIESEL	Av Cost per Gallon $	Fuel Cost Per run $	M & D Per Run $	Vehicle Annual Cost per 2 Runs $
Oakland	1	M	42	39.5	29	60 (est.)	6.43	6.14	D	2.02	12.41	$ 10.33	$7.959
Oakland	2	M	0				7.21		D	2.02			0
Oakland	3	M	56	9.8	9	15 (est.)	7.21	1.36	D	2.02	2.75	$ 12.11	$5,201
Oakland	4	M	38	17.4	23	40	6.87	2.53	D	2.02	5.12	$ 8.47	$3,927
Oakland	5	M	64	17.2	30	45 (est.)	8.13	2.12	D	2.02	4.27	$ 13.61	$6,258
Oakland	6	M	49	25	26	55 (est.)	7.5	3.33	D	2.02	6.73	$ 13.61	$7,119
Oakland	7	M	20	18.8	16	40 (est.)	6.87	2.74	D	2.02	5.53	$ 10.55	$5,628
Annual all runs													$36,092

STEP 4
RESULTS (CONT.)

Annual operating costs using new routes and new bus mix

Bus #	Bus Type	Annual M & D	Annual Fuel Costs	Annual Cost per Route
1	Alternate	$3,615	$690	$4,305
2				$0
3	Existing	$4,238	$959	$5,201
4	Alternate	$2,964	$1,224	$4,188
5	Existing	$4,763	$1,496	$6,259
6	Alternate	$4,763	$1,760	$6,523
7	Alternate	$3,692	$1,311	$5,003
Annual all runs				$31,479

STEP 4
RESULTS (CONT.)



STEP 4
RESULTS (CONT.)

Savings from Route Optimization

- Maximum Available Savings – 27.15%
- 1 YR - $11,732
- 12 YR - $140,784

Savings from Elimination of 1 Bus –12 YR

Bus Purchase Price Avoided = $109,000

Personnel Cost Avoided = $255,600

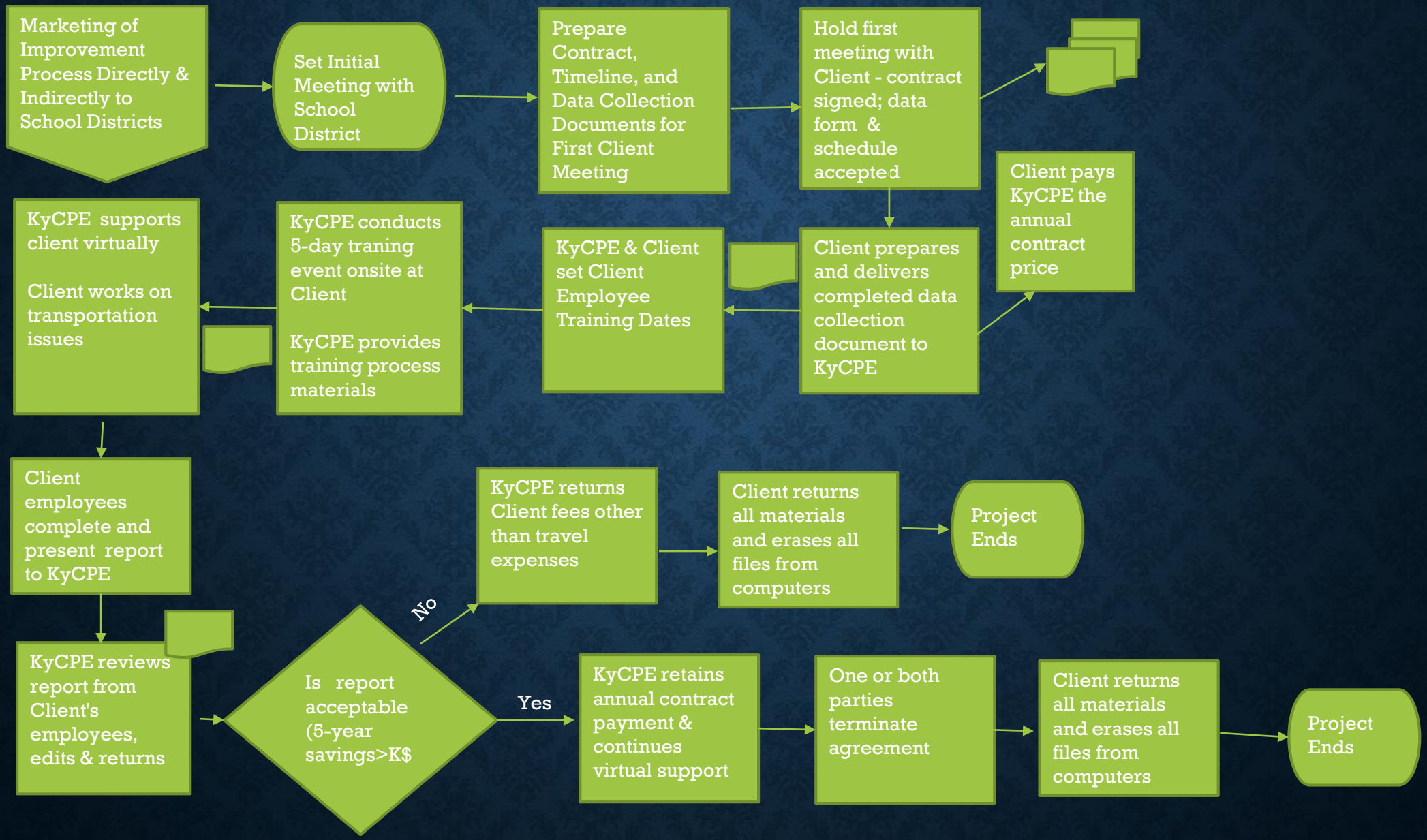
Fuel, M & Dep Avoided = $ 28,413

Total 12-Year Cost Savings for 1 School = $533,797

SO, HOW DID WE DO IT?

- WCPS spent a lot of time compiling the data needed
- KyCPE developed maps of current routes
- We developed run cost analysis for existing buses on current routes (baseline)
- We examined alternative buses and how they might impact efficiency
- We developed proposed new routes and tested them with various mixes of buses
- We eliminated one bus route
- We developed our report to WCPS
- We hope that WCPS will continue this work using this methodology – KyCPE will coach and support WCPS in its use the process

KYCPE – CLIENT PROCESS



IT IS A REPEATABLE TRANSPORTATION IMPROVEMENT PROCESS

- Additional Questions?

For further information and assistance, please contact

Conley Salyer, KyCPE Consulting Services Manager

kycpe1@gmail.com

859-281-1171

710 East Main Street, Lexington, KY 40502