SMART

Operational Field Test Evaluation:
Operations Database Report

FINAL REPORT

September 1997

The University of Michigan

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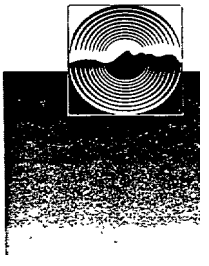

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This report presents the results of an analysis of SMART's Community Transit (paratransit) operations database as part of the University of Michigan's evaluation of SMART's ITS Operational Field Test. This report also is an official deliverable as described in the Statement of Work for the evaluation.

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SMART ITS EVALUATION:

OPERATIONS DATABASE REPORT

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EXECUTIVE SUMMARY'

Based on the Suburban Mobility Authority For Regional Transportation's (SMART) weekly operating reports from its Macomb, Wayne, Troy, and Pontiac terminals, this Operations Database Report explores productivity measures over time, and examines how operations changed after the implementation of advanced public transportation systems (APTS). The former employs an univariate time-series analysis on different operations related indicators in order to observe how the operating conditions changed. The latter is an impact analysis of SMART's Quo Vadis[2] implementation. The indicators incorporated in this analysis are divided into four groups according to their characteristics. They are ridership related, vehicle-operations related, vehicle-efficiency related, and passenger-behavior related indicators.

DATA COLLECTION AND MANIPULATION

The data for this report were collected from the SMART Community Transit weekly operating reports from January 1993 to December 1996. This report examines daily data in terms of service supplied, service consumed, and lost service for the Macomb, Wayne, Troy (including the city of Detroit), and Pontiac terminals. The variables analyzed in this report include:

- Service supplied
  - Total vehicle hours scheduled
  - Total vehicle hours operated
  - Total vehicle miles operated
  - Total revenue hours operated
  - Total revenue hours operated
  - Deadhead hours
  - Deadhead miles

[1] *Acknowledgment*-- The authors are grateful to Ron Ristau, Philip Shaw, and Steven Bush at SMART for assistance with data collection.

[2] Quo Vadis is the advanced scheduling and dispatch (ASD) product included as part of SMART's APTS deployment.

- Service consumed
  - Regular full-fare passengers
  - Older-adult (people 65 and over) passengers
  - People with disabilities using a wheelchair passengers
  - People with disabilities not using a wheelchair passengers
  - Total passengers
- Lost service
  - Cancellations
  - No-shows

For analytic purposes, the above variables were transformed to develop needed indicators. These indicators are divided into four groups according to their characteristics, as listed below:

- Ridership indicators:
  - Total passengers
  - Non-full-fare passengers
  - Passengers per operated vehicle mile
  - Passengers per operated vehicle hour
- Vehicle-operation indicators:
  - Total operated vehicle miles
  - Total operated vehicle hours
- Vehicle-efficiency indicators:
  - Deadhead miles
  - Deadhead hours
  - Operating speed
- Lost service indicators
  - No-show-passenger trips
  - Canceled trips

METHODS

For both the time-series analysis and the impact analysis, time is divided into three analysis periods, standing for three development stages of the four terminals (Table 1). Time is cut into three periods by two event bands. The first band is composed of the implementation of Quo Vadis in Macomb terminal and the millage elections in all areas. This band of omitted data begin with the implementation of Quo Vadis in Macomb (2/27/95) to one month after the millage election in Oakland County (7/8/95). The second band of omitted data ranges from the time of the implementation of Quo Vadis in Wayne County (3/15/96) to two months after Quo Vadis implementation in Oakland County (6/23/96) Thus, time periods are the same for all four terminals, not different according to their individual events. This manipulation is based on the research purpose of establishing comparable periods for the cross-terminal analysis. Also, the

ending time of each omitted band was set at one or two months after key events to eliminate the unstable period of adjustment resulting from these events.

Table 1. Three Analysis Periods and Two Omitted Periods.

	Time
Period 1	1/93 – 2/26/95
Omitted Band 1	2/27/95 -- Quo Vaclis to Macomb County 5/23/95 -- Millage Election in Macomb and Wayne 6/8/95 -- Millage Election in Oakland 7/8/95 -- End of Adjustment
Period 2	7/9/95 – 3/14/96
Omitted Band 2	3/15/96 -- Quo Vadis to Wayne County 4/22/96 -- Quo Vadis to Oakland County 6/22/96 -- End of Adiustment
Period 3	6/23/96 – 12/3 1/96

ANALYSIS

Time-Series Analysis

The time-series analysis aims to show how the four terminals operated during the study period. This analysis not only examines trends along the time axis, it also provides a cross-terminal comparison for each of the indicators. For analytic purpose, this analysis uses 29-day moving average in time-series figures for each of the indicators. The 29-day moving average is defined as the average of data between 14 days before and after one day, which can derive a some one-month average of the indicators for one day. This data manipulation can avoid the bias caused by exceptional cases, for example, ridership on one day may be very low due to a holiday.

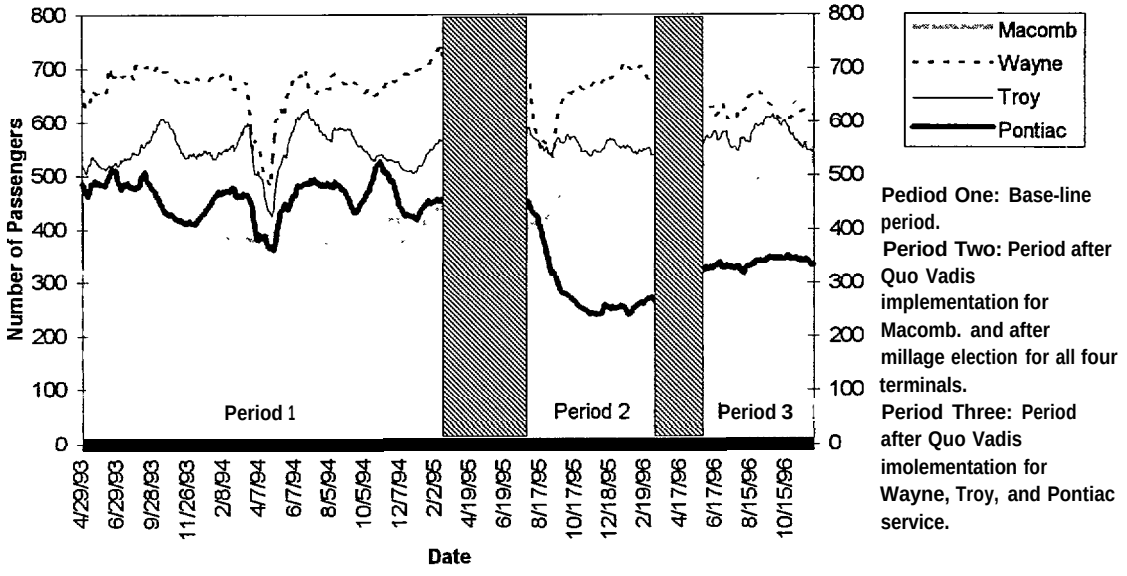
Ridership Indicators

I. Totalpassengers: During the study period, from 1993 to 1996, the total passengers per day at the Macomb terminal increased steadily from about 300 to 550 passengers per day (Table 2; Figure 1). The Wayne terminal carried the highest number of passengers per day among the four terminals, but its mean total decreased from period to period (664,638, and 624 passengers per day for periods 1,2, and 3, respectively). Clearly, the millage election producing opt-out communities which lost their service, shocked the Wayne terminal for a short period of time, during which ridership dropped precipitously, but afterwards ridership rebounded toward its former level. For the Troy terminal, ridership remained stable at around 545 passengers per day for all three periods. The Pontiac terminal proved to be the most unstable, with means of about 45 1,285, and 345 passengers per day for the three periods, respectively. At the same time that the millage election was held, rider-ship at Pontiac started to drop (also due to substantial numbers of opt-outs), but it went back up when Job Express service was added to Auburn Hills (4/18/96). With regard to the implementation of Quo Vadis, these trends show little noticeable impact, because ridership at all four terminals remained near original levels before and after Quo Vadis implementation. This service, however, was achieved within a smaller service area after the millage election.

Table 2. Mean Total Passengers per Day.

	Macomb	Wayne	Troy	Pontiac
Period 1	**361.9**	663. 9	544.3	450. 9
Period 2	479.7	638.3	552.3	284.9
Period 3	507.5	623. 6	543. 5	345.0

Figure 1. Total Passengers per Day (29-Day Moving Average).



2. Non-full-fare passengers: For SMART Community Transit, non-full-fare passengers consist of older-adult and people with disabilities riders, as well as children. This category accounts for most of the customers at all four terminals (Table 3; Figure 2); in other words, full-fare passengers are a minority for Community Transit. At the Macomb, Wayne, and Troy terminals, the numbers of non-full-fare passengers stayed almost the same from period one to three, but the percentages of non-full-fare passengers decreased. For the Macomb terminal, the percentage dropped from 94 to 64 after the addition of Job Express (1 /94). Essentially, Job Express attracted more full-fare passengers during period two, but the number of non-full-fare passengers remained stable (Table 2; Figures 2 and 3). For the Wayne and Troy terminals, both the number and percentage of non-full-fare passengers fell slightly from period to period. As for the Pontiac terminal, about 300 non-full-fare passengers were carried before the millage election, and about 200 afterwards. Again, loss of service area (opt-out communities) caused a decrease in passengers for this terminal.

Table 3. Mean Number of Non-Full-Fare Passengers per Day.

	Macomb	Wayne	Troy	Pontiac
Period 1	338 (94%)*	638 (96%)	477 (87%)	332 (74%)
Period 2	349 (73%)	575 (90%)	458 (83%)	170 (60%)
Period 3	324 (64%)	543 (86%)	445 (81%)	206 (60%)

* The numbers in parentheses are the percentage of all passengers that are non-full-fare passengers.

Figure 2. Number of Non-Full-Fare Passengers (29-Day Moving Average).

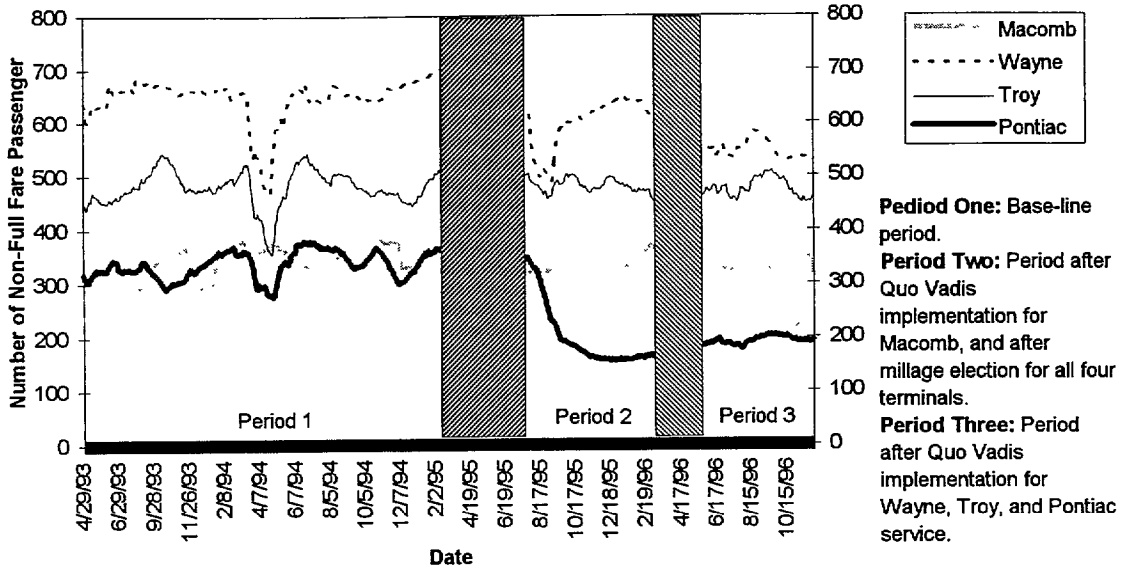
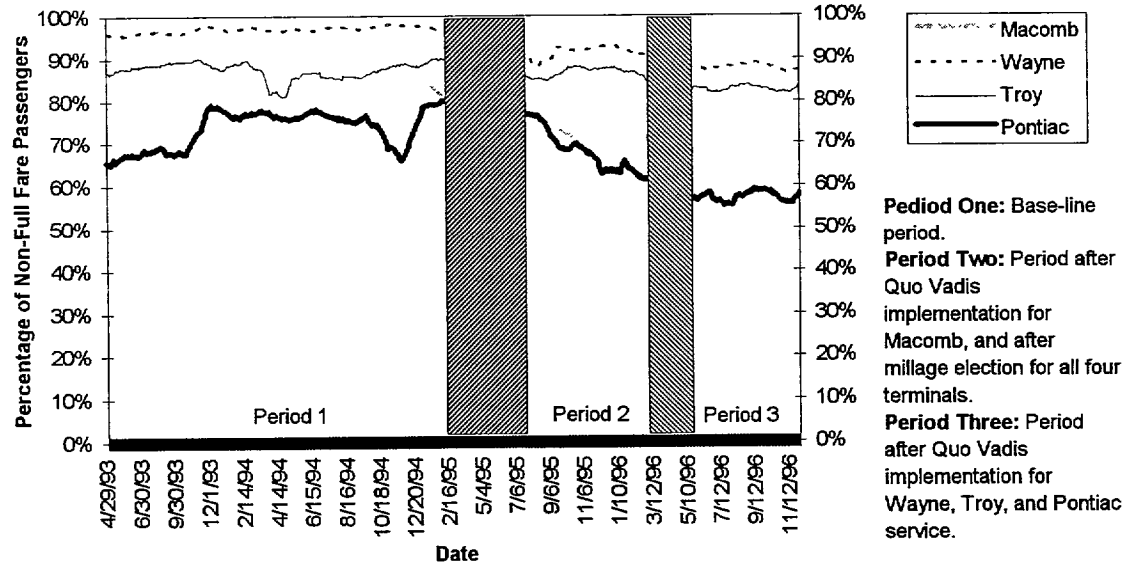


Figure 3. Percentage of Non-Full-Fare Passengers (29-Day Moving Average).



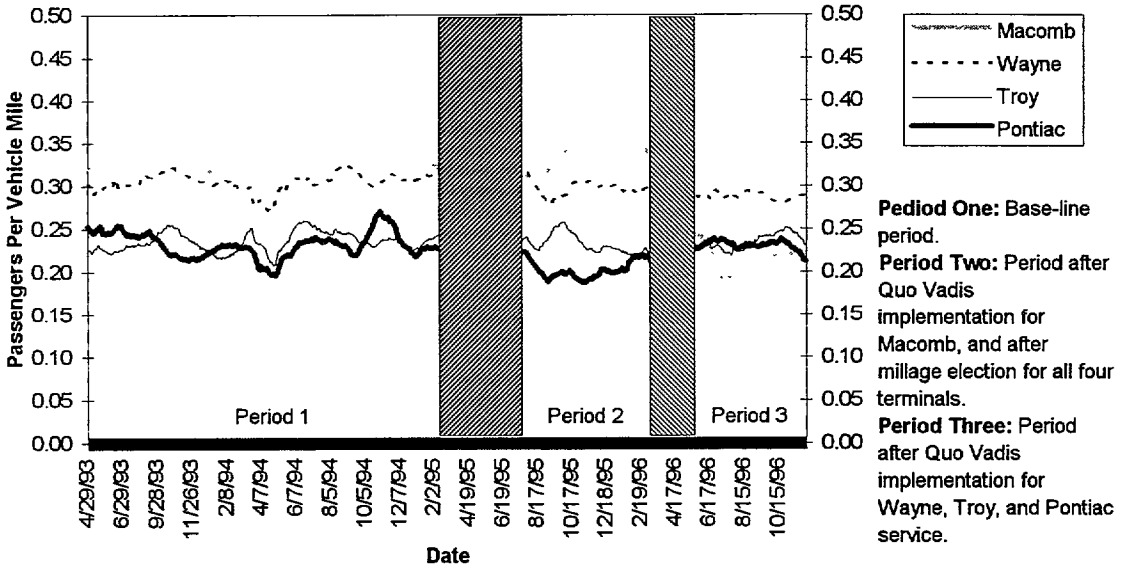
3. Passengers per operated vehicle mile: Total passengers per day is a measure that does not take into account operated vehicle miles or hours. Therefore, passengers per operated vehicle mile is for many purposes a better measure of productivity. Hence, it is an indicator that can show if the number of passengers per operating "unit" has been increasing or decreasing. For periods one and two, the Macomb and the Wayne terminals had the higher numbers of passengers per vehicle mile (about 0.30 passengers per mile) compared to the other two terminals (about 0.23 passengers per mile) (Table 4; Figure 4). This remained so until about April, 1996, when additional Community Transit service was added in North Macomb. After this additional service was added, this terminal's number of passengers per mile dropped to about 0.21, because North Macomb is a

very rural, low density area. Other important events, Job Express, the millage elections, and Quo Vadis, did not have a significant influence on passengers per operated vehicle mile at any of the terminals.

Table 4. Mean number of Passengers per Operated Vehicle Mile per Day.

	Macomb	Wayne	Troy	Pontiac
Period 1	0. 33	0. 30	0. 23	0. 23
Period 2	0. 33	0. 29	0. 23	0. 22
Period 3	0. 21	0. 29	0. 23	0. 21

Figure 4. Passengers per Operated Vehicle Mile (29-Day Moving Average).

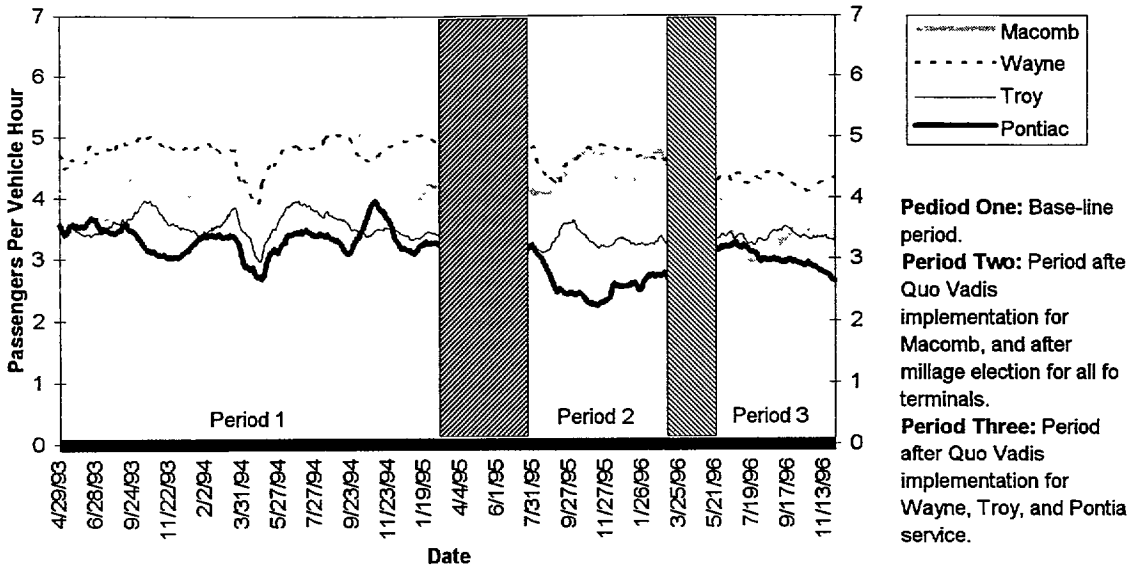


4. Passengers per operated vehicle hour: Like passengers per operated vehicle mile, passengers per operated vehicle hour is a "density" indicator of the number of passengers served. For all four terminals, this indicator resembled the results shown above for passengers per operated vehicle (Table 5; Figure 5). For the Macomb terminal, the number of passengers per vehicle hour was around 4.5 in the first two periods, but fell to 3.2 after the addition of the new Community Transit service. For the remaining three terminals, this indicator slightly decreased from period one to three. In addition, since the number of passengers per vehicle mile for these three terminals was quite stable during these periods, the decrease appears to be caused by lower on-board speed. This inference is explored further in the "Speed" section presented later.

Table 5. Mean Number of Passengers per Operated Vehicle Hour per Day.

	Macomb	Wayne	Troy	Pontiac
Period 1	4.41	4.69	3.47	3.27
Period 2	4.50	4.47	3.30	2.87
Period 3	3.23	4.33	3.23	2.65

Figure 5. Passengers per Operated Vehicle Hour (29-Day Moving Average).



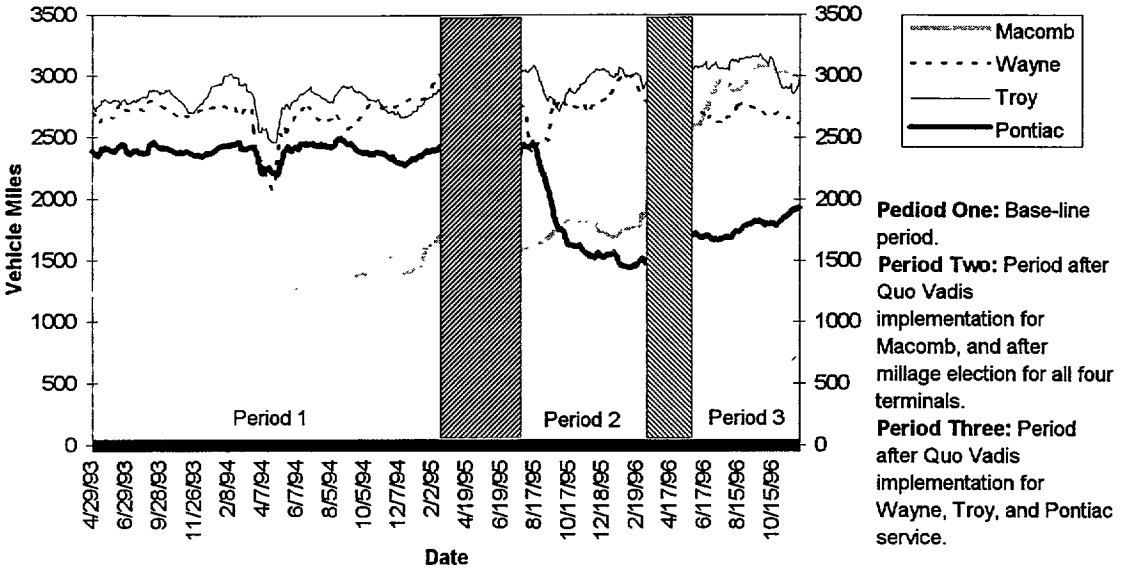
Vehicle-Operation Indicators

5. Total operated vehicle miles: The Macomb terminal had the lowest total operated vehicle miles per day in the first period, but this number continued to increase through period two. With the addition of the new Community Transit service in North Macomb, it jumped quickly, and at the very end of 1996, Macomb became the highest among the four terminals along this dimension (Table 6; Figure 6), though Troy seems poised to retake the top spot. The Wayne and the Troy terminals were quite stable during the study period and had the highest number of operated vehicle hours. As for the Pontiac terminal, it was stable before the millage election, but after the millage election, it dropped substantially due to the opt-outs, only to rise slightly with the addition of Job Express to Auburn Hills and the implementation of Quo Vadis. Probably, Job Express is the main cause of this increase, as it increased the number of vehicles on the road from this terminal.

Table 6. Mean Number of Total Operated Vehicle Miles per Day.

	Macomb	Wayne	Troy	Pontiac
Period 1	1321.7	2696.6	2812.1	2361.8
Period 2	1759.0	2719.3	2987.2	1577.5
Period 3	2969.5	2600.3	2998.6	2002.0

Figure 6. Total Operated Vehicle Miles (29-Day Moving Average).

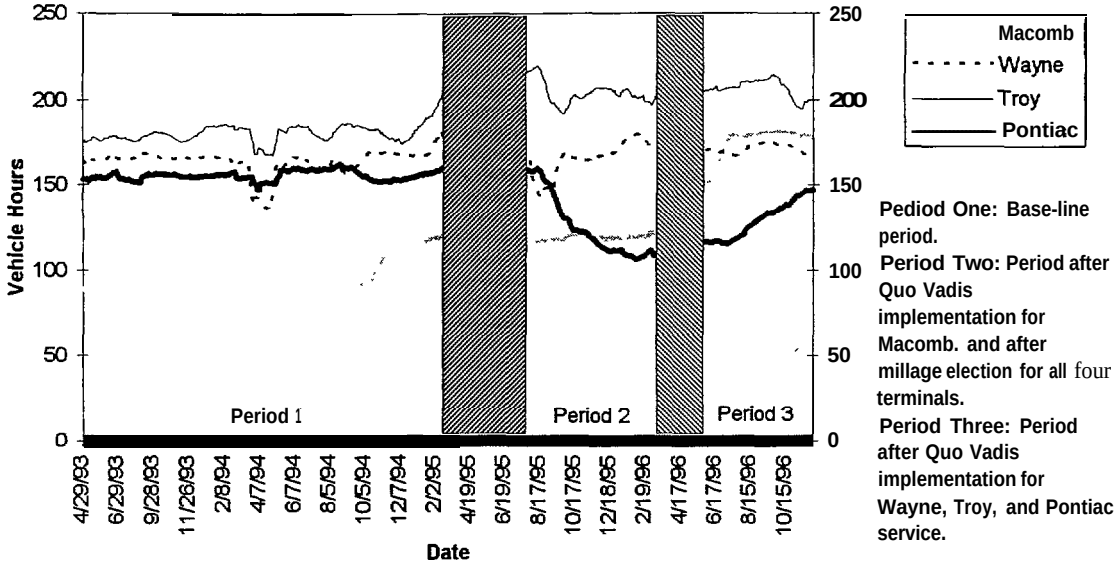


6. Total operated vehicle hours: The difference between total operated vehicle miles and total operated vehicle hours is that the former considers the factor of speed. For example, if Macomb and Wayne have the same total operated vehicle hours, while the former has a higher operating speed, then its total operated vehicle miles will be greater. For the Macomb terminal, there were two time points when total operated vehicle hours jumped. One occurred at the addition of Job Express, and the other was the addition of new Community Transit service in North Macomb (Table 7; Figure 7). As a result, Macomb jumped from last in the first period among the four terminals to second in period three. For the Wayne terminal, there was no significant change in total operated vehicle hours during the study period. As for the Troy terminal, Job Express had a positive impact, meaning that total operated vehicle hours increased after the appearance of Job Express. For the Pontiac terminal, after the millage election the total operated vehicle hours decreased from about 150 to about 100 (again, due to opt-outs). This downward trend lasted for nearly all of period two. After the addition of Job Express to Auburn Hills and the implementation of Quo Vadis, however, total operated vehicle hours at Pontiac rose almost to its original level.

Table 7. Mean Number of Total Operated Vehicle Hours per Day.

	Macomb	Wayne	Troy	Pontiac
Period 1	93.1	165.3	184.7	154.8
Period 2	118.8	168.5	202.4	111.8
Period 3	178.7	166.7	202.8	149.7

Figure 7. Total Operated Vehicle Hours (29-Day Moving Average).



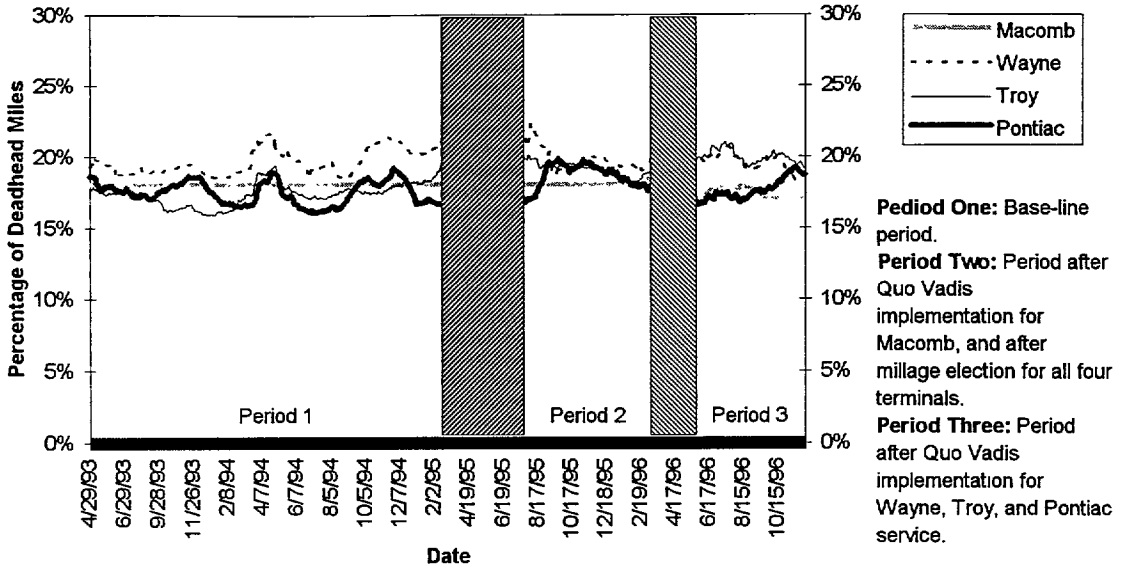
Vehicle-Efficiency Indicators

7. Percentage of deadhead miles: The ratio of deadhead miles to total operated vehicle miles multiplied by 100 is defined as the percentage of deadhead miles for this analysis. This measure fluctuated very little for all four terminals during the study period (Table 8; Figure 8). In all three periods, the mean percentage of deadhead miles remained between 18 and 20 percent. Furthermore, no significant impacts due to Job Express, the millage elections, or Quo Vadis are apparent.

Table 8. Mean Percentage of Deadhead Miles per Day.

	Macomb	Wayne	Troy	Pontiac
Period 1	18%	20%	18%	17%
Period 2	18%	20%	19%	18%
Period 3	18%	19%	19%	18%

Figure 8. Percentage of Deadhead Miles (29-Day Moving Average).

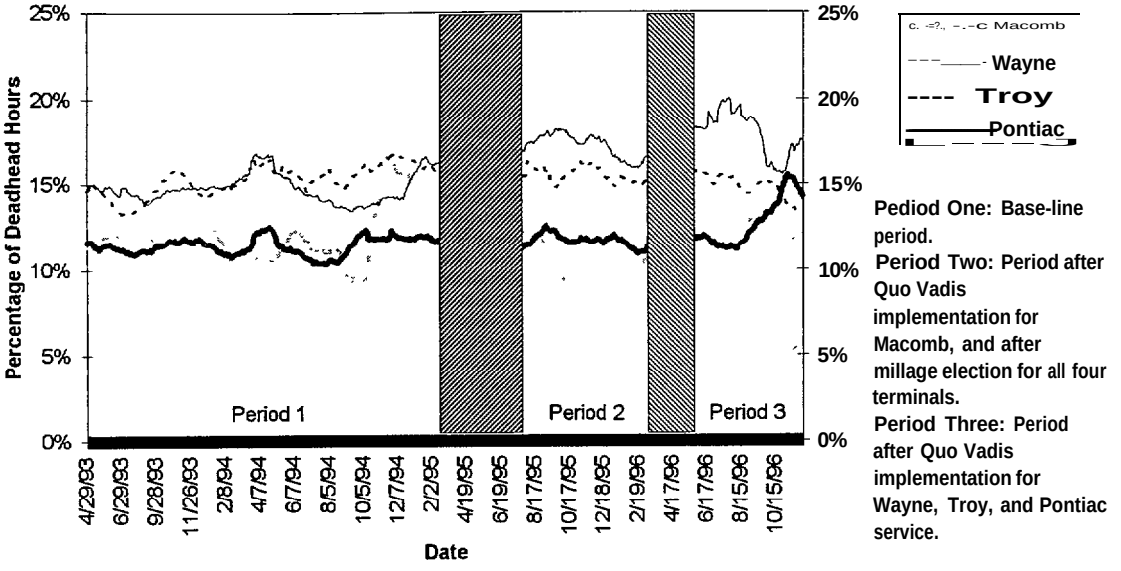


8. Percentage of deadhead hours: For all four terminals, the percentage of deadhead hours (i.e., the ratio of deadhead hours to total operated vehicle hours multiplied by 100) was quite stable for the entire study period, though there were some small fluctuations (Table 9; Figure 9). For the Macomb terminal, this measure hovered at about 12 percent, with a noticeable increase at the time of the addition of Job Express in period 1, but afterwards it decreased to the original level. At the implementation of Quo Vadis for the Troy terminal, the percentage of deadhead hours increased and then a few months later decreased to the original level. For the Pontiac terminal, the percentage of deadhead hours had been very stable until mid-1996, then it increased. No significant related reasons were found for this phenomenon, and at the end of the study period Pontiac showed sign of returning to historical levels.

Table 9. Mean Percentage of Deadhead Hours per Day.

	Macomb	Wayne	Troy	Pontiac
Period 1	12%	15%	15%	11%
Period 2	10%	16%	17%	12%
Period 3	12%	15%	18%	13%

Figure 9. Percentage of Deadhead Hours (29-Day Moving Average).

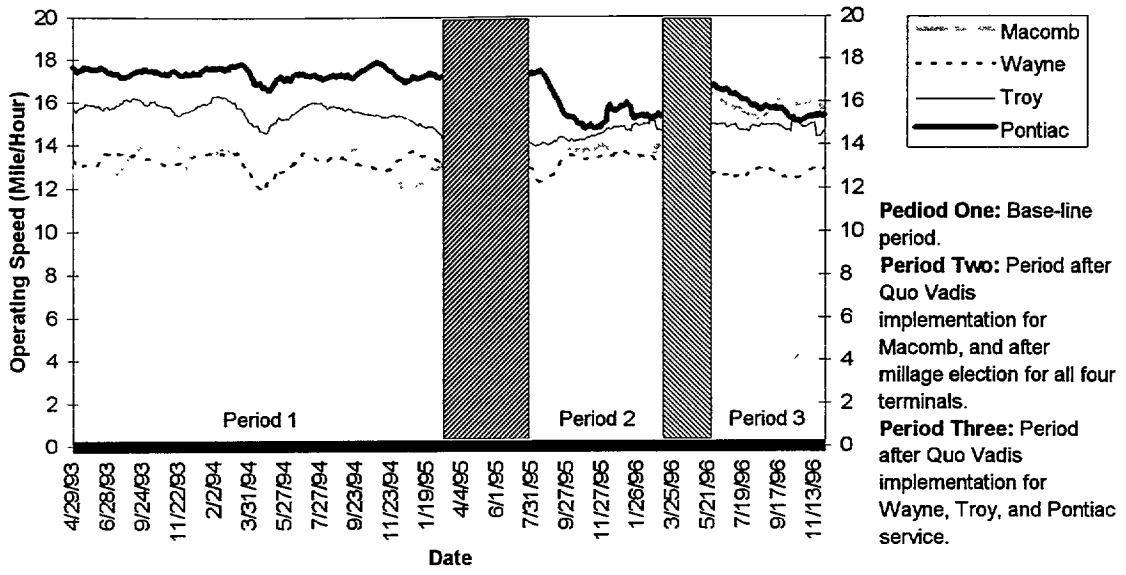


9. *Operating* speed: For this analysis, operating speed is defined as the ratio of revenue vehicle miles to revenue vehicle hours. Because revenue vehicle hours contains both travel time and waiting time, speed as defined in this analysis is the on-board speed, but not the actual travel speed when the bus is moving. In general, shorter trips and more riders will lead to lower operating speed, as more stops will be made. As for the operating speed of each terminal, operating speed at the Macomb terminal remained at about 13.5 miler per hour during period one and two (Table 10, Figure 10). After the addition of Community Transit service to North Macomb, it increased to about 15.6 miles per hour. At the Wayne and Troy terminals, operating speeds for the entire study period remained steady at about 13 and 15 miles per hour, respectively. For both terminals, however, operating speed decreased slightly from period one to three. As for the Pontiac terminal, it experienced the highest operating speeds at about 17.2, 15.9, and 15.3 miles per hour for periods one, two, and three, respectively. For the entire study period, the trend of the operating speed was downward. After the millage election the operating speed decreased immediately from about 17 miles per hour, but later remained stable above 15 miles per hour. With the Quo Vadis implementation, the operating speed increased for a short while, but later decreased to the original level near 15 miles per hour.

Table 10. Mean Daily Operating Speed (Miles per Hour).

	Macomb	Wayne	Troy	Pontiac
Period 1	13.2	13.1	15.2	17.2
Period 2	13.5	12.9	14.7	15.9
Period 3	15.6	12.9	14.8	15.3

Figure 10. Operating Speed (29-Day Moving Average).



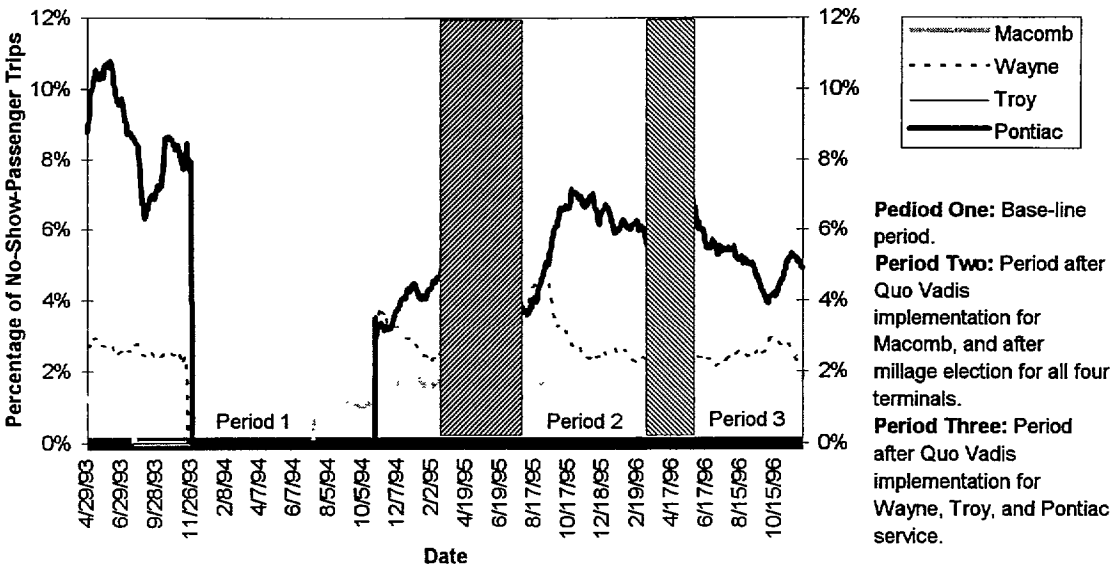
Lost Service Indicators

10. No-show-passenger trips: This indicator refers to passengers that do not show up when the bus arrives to pick them up. For the Macomb terminal, the ratio of no-show-passenger trips to total passengers plus no-show-passenger trips was stable (about one to two percent) during the whole study period (during the period from June/93 to June/94, the data are lacking) (Table 11; Figure 11). For the Wayne terminal, no-show-passenger trips averaged about three percent during the entire study period. The Pontiac terminal recorded the highest percentage of no-show passenger trips, about five to six percent, during the entire study period. Pontiac also proved the most unstable -- at the beginning of 1996, no shows were as high as about ten percent, then it fell. After the millage election, no shows climbed to as high as about seven percent. Since mid-period two, the number of no shows has decreased continuously. (Data for the Troy terminal are lacking.)

Table 11. Mean Percentage of No-Show-Passenger Trips.

	Macomb	Wayne	Troy	Pontiac
Period 1	1.3%	2.9%	N/A	6.4%
Period 2	1.4%	2.6%	N/A	6.0%
Period 3	1.6%	2.6%	N/A	5.1%

Figure 11. No-Show-Passenger Trips (29-Day Moving Average).

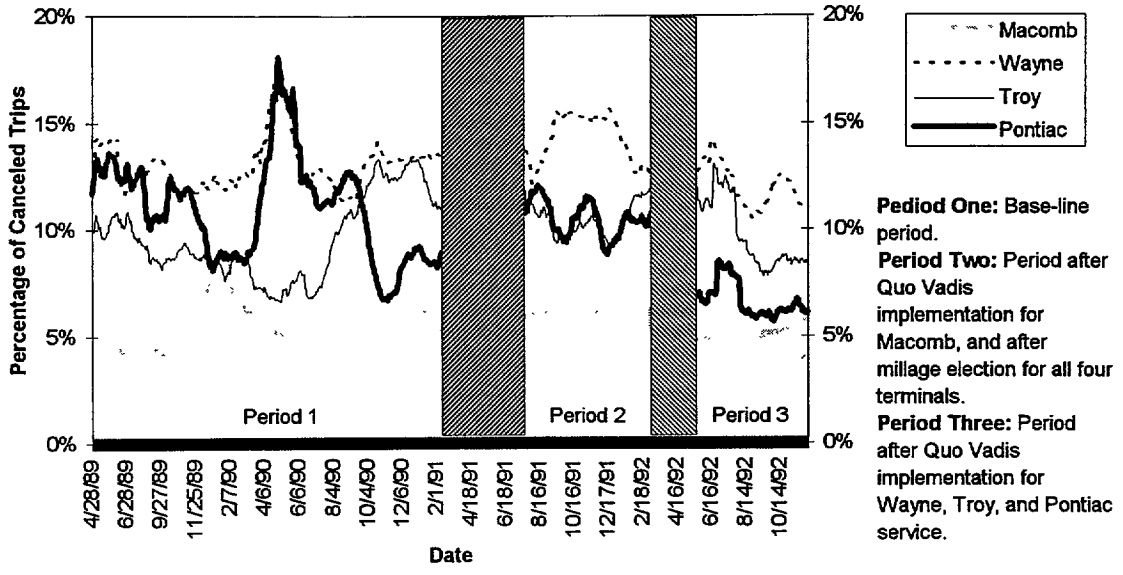


11. Cancellations: Cancellations refer to trips that customers cancel before the bus arrives. The percentage of canceled trips is defined as multiplication of 100 and ratio of canceled trips to the sum of total passengers, no-shows-passenger trips, and canceled trips. During the study period, the Macomb terminal had the lowest percentage of canceled trips, about five to six percent, and it was the most stable of the four terminals (Table 12; Figure 12). The Wayne terminal had the most cancellations -- about 13.1, 13.6, and 1.8 percent for periods one, two, and three, respectively. In period one and two, Wayne was stable, but after the appearance of the Quo Vadis, cancellations fell to some eleven percent by the end of 1996. For the Troy terminal, after the implementation of Quo Vadis cancellations fell and eventually kept stable at about eight percent. Pontiac proved to be the most unstable terminal, but at this terminal cancellations were decreasing over the long run. Clearly, Quo Vadis implementation appears to have lowered the percentage of cancellations.

Table 12. Mean Percentage of Canceled Trips.

	Macomb	Wayne	Troy	Pontiac9
Period 1	5.2%	13.1%	10.2%	11.0%
Period 2	5.9%	13.6%	11.1%	9.0%
Period 3	5.2%	10.8%	9.8%	6.1%

Figure 12. Percentage of Canceled Trips (29-Day Moving Average).



Impact Analysis

In the above time-series analyses, operating conditions after the millage election and Quo Vadis implementation were examined one measure at a time. Different from the time-series analysis, impact analysis is a comparative analysis that examines differences in important measures after the implementation of Quo Vadis. These measures include most of those discussed above in the time-series section, including total passengers per day and passengers per operated vehicle hour.

The impact analysis employs the statistical tool of multivariate linear regression analysis. The main difficulty with this analysis lies in separating the net impact of Quo Vadis from a variety of other events, such as the millage election and the addition of North Macomb service. Fortunately, regression analysis allows the researcher to control statistically for a variety of factors, meaning that results indicate the effect of Quo Vadis after first accounting for other considerations.

The SMART millage election is the primary secondary event that confounds the Quo Vadis impact analysis. As shown above, the millage election was an important factor in defining the three analysis periods. Period one is considered as a base line, because it is prior to the SMART millage elections. As defined previously, period one runs from January 1993 to February 26, 1995. Periods two and three both lie after the millage election. Period two begins on July 9, 1995, and ends on March 14, 1996; period three runs from June 23, 1996 to December 31, 1996. Complicating matters, at the Macomb terminal, the dates of the millage election and the implementation of Quo Vadis are very close to each other, so it is difficult to separate their individual effects on service operations.

For the most part, our techniques for addressing this confounding are twofold. First, we assume that the effects of the millage election can be captured by variables that address operational changes at each terminal. Thus, our analyses will include vehicle hours of operation as a control (under the logic that SMART reacted to the millage by altering the amount of

scheduled paratransit service), along with dummy variables for the four terminals to account for a variety of other changes at the terminals whether or not they were caused by the millage election.

Second, we seek to control for long-term trends in the data by including time in the analyses. That is, if a measure is headed steadily downward (or upward) along a straight line over time, then Quo Vadis should not be viewed as the cause of changes to the mean over periods. In addition to these long-term trends, there also exists the possibility of seasonal effects and other abrupt changes over time that are not captured by long-term *hear* trends; in fact, changes of this nature may even reverse direction from period to period, making them invisible to trend analysis. To account for changes of this variety, we also include a set of period variables in the analysis.

Finally, our main predictor variable of interest is the absence or presence of Quo Vadis. For all analyses that follow, our null hypothesis is that Quo Vadis had no effect on the dependent variables after accounting for vehicle hours of service, long-term trend, etc. Wishing to judge each regression model (one for each dependent variable) as a whole, we will not set an absolute significance level for the Quo Vadis coefficients, but in general will be most interested in coefficients meeting the 0.05 significance level.

The following two tables (Tables 13a and 13b) summarize the results of our regression analyses. Each of these tables displays results for the dependent variables of interest in columns, with the effects of the predictors shown in rows. Furthermore, for each predictor we have translated the meaning of the statistical coefficients into common English. These descriptions should be viewed as the effect of the predictor controlling for all the other predictors in the models.

Among the most interesting findings, the regression analyses show that Quo Vadis has had a positive effect on total passengers per day, passengers per operated hour, and the percentage of deadhead hours. Quo Vadis also is associated with a decline in total operated vehicle miles, which can be taken as an improvement if it implies more efficient scheduling and routing. Thus, all of these measures indicate more efficient use of vehicle resources in the post-Quo Vadis period, especially given that total operated vehicle hours is controlled for in the analyses. Thus, for a given number of operated vehicle hours, Quo Vadis is associated with an increase in productivity during those hours. Focusing on passengers per operated hour, for example, controlling for all other factors, Quo Vadis is associated with an overall increase of 0.44 per terminal-day.

Our analyses also show that, all other things being equal, Quo Vadis is not associated with significant changes in the percentage of deadhead miles, operating speed, percentage of no-show passengers, and percentage of canceled trips. These latter results, however, probably are not surprising, as deadhead miles is largely a function of terminal location vis-a-vis customers and no-shows and cancellations are largely due to customer characteristics.

Besides Quo Vadis effects, the regression models also indicate that significant differences between terminals. For most measures, for example, the Pontiac terminal appears to operate least efficiently, which may well be a result of the concentration of ASAP trips provided from this terminal, and ASAPs cannot take advantage of the scheduling tools associated with Quo Vadis.

Looking at trends (as described by the date variable), these models indicate overall declines in most productivity measures over the study period. As used here, the increment between two days

is **86,400**[3]**,** thus the long-term trend is quite slight given that the coefficients on the date variable tend to be in the range of 10^{-7}. Examining period effects, which are highly affected by the millage election, we also see declines in periods two and three. The latter should be less effected by the millage, of course, but includes such events as the addition of relatively low productivity North Macomb service.

CONCLUSION

Considering both the trend and regression analyses, a clear picture of terminal operations emerges. First, as shown by the many trend lines, operating characteristics vary considerably from day to day and from terminal **to** terminal. This "noise" in the data, combined with a variety of non-APTS changes at SMART, especially the millage election, greatly complicated analysis of the effects of Quo Vadis. Nonetheless, through judicious use of control variables in multivariate regression analysis the evaluators have been able to isolate several positive impacts of Quo Vadis in terms of paratransit productivity measures.

While the results concerning Quo Vadis are hugely positive and statistically significant, a few words of caution are in order. Most importantly, compared to other factors such as total operated vehicle hours and terminal-specific variables, Quo Vadis accounts for relatively small percentages of variance in key dependent measures, such as total passengers.[4] Thus, Quo Vadis appears to have a limited capacity to effect performance changes, because other factors swamp these technological changes, as can be seen above in the widely oscillating shape of the time series curves. Therefore, the results contained in this report provide encouraging evidence about the potential for APTS-based improvements, but tempered by the reminder that APTS is just one of many factors affecting paratransit operations.

Future Directions for Evaluation

In Phase Two of the SMART evaluation, we will continue to track and analyze the key operations measures discussed in this report. For the most part, this additional data will allow us to examine the effects of the addition of automatic vehicle location (AVL) to paratransit operations. In addition, we plan to add linehaul measures to the evaluation, allowing us to examine the effects of APTS on linehaul operations, too.

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[3] Date is measured as a continuous variable, with zero set at midnight on January 1, 1900, and measured by the total number of seconds in a day. Thus, this variable is a continuous variable measured as the number of seconds elapsed since January 1, 1900. One day is 86,400 seconds.

[4] This observation is derived from noting changes to R^2 when the Quo Vadis variable is added to the regression model. For the analyses above, these changes tended to on the order of 0.01, or a one percent improvement in explanatory power.

Table 13a. Impact Analysis of Quo Vadis.

	Total Passengers Per day		**Non-Full-Fare Passengers per Day**		**Passengers per Operated Vehicle Mile**		**Passengers per Operated Hour**		**Total Operated Vehicle Miles**	
	Sig. t *1	**Coeff.*2**	**Sig. t *1**	**Coeff.*2**	**Sig. t*1**	**Coeff.*2**	**Sig. t *1**	**Coeff.*2**	**Sig. t *1**	**Coeff.*2**
Quo Vadis *3	<0.01	79.9	<0.01	35.5	<0.01	0.03	<0.01	0.44	0.07	-35.6
	Total passengers per day increases by 79.9		Non-full-fare passengers per day increases by 35.5.		Passengers per operated vehicle mile increases by 0.03.		Passengers per operated vehicle hour increases by 0.44.		Total operated vehicle miles decreases by 35.6.	
Total Operated Vehicle Hours	<0.01	3.3	<0.01	2.5	0.01	-8.2E-05	<0.01	0.004	<0.01	17.7
	Total passengers per day decreases by 5.6E-07.		Non-full-fare passengers per day decreases by		Passengers per operated vehicle mile increases by 9.1E-11.		Passengers per operated vehicle hour increases by less than 0.004		Total operated vehicle miles increases by 17.7.	
Date	<0.01	-5.6E-07	<0.01	2.5	0.01	-8.2E-05	<0.01	0.004	<0.01	17.7
	Total passengers per day decreases by 5.6E-07.		Non-full-fare passengers per day decreases by 4.2E-07.		Passengers per operated vehicle mile increases by 9.1E-11.		Passengers per operated vehicle hour decreases by –2.8E-09.		Total operated vehicle miles decreases by 3.2E-06.	
Period 2 *4	0.05	-11.3	<0.01	-45.5	<0.01	-0.02	<0.01	-2.8E-09	<0.01	-3.2E-06
	Total passengers per day during period two is lower than during period one by 116.2.		Non-full-fare passengers per day during period two is lower than during period one by 45.5		Passengers per operated vehicle mile during period two is lower than during period one by 0.02		Passengers per operated vehicle hour during period two is lower than during period on by 0.15.		Total operated vehicle miles during period two is higher than during period one by 123.4.	
Period 3 *4	<0.01	-116.2	<0.01	-129.3	<0.01	-0.08	<0.01	-0.89	<0.01	196.6
	Total passengers per day during period three is lower than during period one by 11.3.		Non-full-fare passengers per day during period three is lower than during period one by 129.3		Passengers per operated vehicle mile during period two is lower than during period one by 0.08.		Passengers per operated vehicle hour during period three is lower than during period one by 0.89.		Total operated vehicle miles during period three is higher than during period one by 196.6.	
Macomb *5	<0.01	103.9	<0.01	134.3	<0.01	0.08	<0.01	1.18	<0.01	135.9
	Total passengers per day at Macomb is higher than at Pontiac by 103.9		Non-full-fare passengers per day at Macomb is higher than at Pontiac by 134.3.		Passengers per operated vehicle mile at Macomb is higher than at Pontiac by 0.08.		Passengers per operated vehicle hour at Macomb is higher than at Pontiac by 1.18.		Total operated vehicle miles at Macomb is higher than at Pontiac by 135.9.	
Wayne *5	<0.01	185.1	<0.01	280.9	<0.01	0.08	<0.01	1.45	<0.01	176.6
	Total passengers per day at Wayne is higher than at Pontiac by 185.1.		Non-full-fare passengers per day at Wayne is higher than at Pontiac by 280.9.		Passengers per operated vehicle mile at Wayne is higher than at Pontiac by 0.08.		Passengers per operated vehicle hour at Wayne is higher than at Pontiac by 1.45.		Total operated vehicle miles at Macomb is lower than at Pontiac by 176.6.	
Troy *5	0.14	--	<0.01	74.6	<0.01	0.01	<0.01	0.15	<0.01	-77.8
	Not significant		Non-full-fare passengers per day at Troy is higher than at Pontiac by 74.6.		Passengers per operated vehicle mile at Troy is higher than at Pontiac by 0.01.		Passengers per operated vehicle hour at Pontiac is higher than at Pontiac by 0.15.		Total operated vehicle miles at Macomb is lower than at Pontiac by 77.8.	
R^{2*6}	0.76		0.82		0.51		0.55		0.91	

*1 Significance level of the coefficient of the independent variable. In this analysis the significance level is set at 0.10.

*2 Coefficients of the independent variable.

*3 Quo Vadis is a dummy variable: 0 = No Qui Vadis; 1 = Quo Vadis.

*4 Period 2 and period 3 are dummy variables. The base line is period 1 of these two variables is period one.

*5 Macomb, Wayne, and Troy are dummy variables. The base line for these variables is Pontiac.

*6 R^2 of the regression model represents the percentage of the variance in the dependent variable explained by the model.

Table 13b. Impact Analysis of Quo Vadis (Continued).

	Percentage of Deadhead Miles		Percentage of Deadhead Hours		Operating Speed		Percentage of No-Show Passengers		Percentage of Canceled Trips	
	Sig. t *1	**Coeff.*2**	**Sig. t *1**	**Coeff.*2**	**Sig. t*1**	**Coeff.*2**	**Sig. t *1**	**Coeff.*2**	**Sig. t *1**	**Coeff.*2**
Quo Vadis *3	0.83	--	<0.01	-0.019	0.23	--	0.29	--	0.68	--
	Not significant		Percentage of deadhead hours decreases by 1.9 percent.		Not significant		Not significant		Not significant	
Total Operated Vehicle Hours	<0.01	-2.3E-04	<0.01	-7.7E-05	<0.01	0.02	0.46	--	<0.01	9.9E-05
	Percentage of deadhead miles decreases by 2.8E-02 percent.		Percentage of deadhead hours decreases by 7.7E-03 percent.		Operating speed increases by 0.02.		Not significant		Percentage of canceled trips increases by 9.9E-03 percent.	
Date	<0.01	2.8E-10	<0.01	2.4E-10	<0.01	-2.0E-08	<0.01	-3.0E10	0.02	9.5E-11
	Percentage of deadhead miles increases by 2.8-08 percent.		Percentage of deadhead hours increases by 2.4E-08 percent.		Operating speed decreases by 2.0E-08.		Percentage of no-show passengers decreases by 3.0E-08 percent.		Percentage of canceled trips decreases by 9.5E-09 percent.	
Period 2 *4	<0.01	-0.010	0.02	-0.004	<0.01	0.69	<0.01	0.013	0.10	-0.005
	Percentage of deadhead miles during period two is lower than during period one by 1.0 percent.		Percentage of deadhead hours during period two is lower than during period one by 0.4 percent.		Operating speed during period two is higher than during period one by 0.69.		Percentage of no-show passengers during period two is higher than during period one by 1.3 percent.		Percentage of canceled trips during period two is lower than during period one by 0.5 percent.	
Period 3 *4	<0.01	-0.016	<0.01	0.010	<0.01	1.25	<0.01	0.022	<0.01	-0.031
	Percentage of deadhead miles during period three is lower than during period one by 1.6 percent.		Percentage of deadhead hours during period three is higher than during period one by one percent.		Operating speed during period three is higher than during period one by 1.25.		Percentage of no-show passengers during period three is higher than during period one by 2.2 percent.		Percentage of canceled trips during period three is lower than during period one by 3.1 percent.	
Macomb *5	<0.01	-0.006	0.79	--	<0.01	-2.15	<0.01	-0.045	<0.01	-0.042
	Percentage of deadhead miles at Macomb is lower than at Pontiac by 0.6 percent.		Not significant		Operating speed at Macomb is lower than at Pontiac by 2.15 percent.		Percentage of no-show passengers at Macomb is lower than at Pontiac by 4.5 percent.		Percentage of canceled trips at Macomb is lower than at Pontiac by 4.2 percent.	
Wayne *5	<0.01	0.028	<0.01	0.038	<0.01	-4.06	<0.01	-0.035	<0.01	0.029
	Percentage of deadhead miles at Wayne is higher than at Pontiac by 2.8 percent.		Percentage of deadhead hours at Wayne is higher than at Pontiac by 3.8 percent.		Operating speed at Wayne is lower than at Pontiac by 4.06.		Percentage of no-show passengers at Wayne is lower than at Pontiac by 3.5 percent.		Percentage of canceled trips at Wayne is higher than at Pontiac by 2.9 percent.	
Troy *5	<0.01	0.019	<0.01	0.047	<0.01	-2.55	N/A	N/A	0.88	--
	Percentage of deadhead miles at Troy is higher than at Pontiac by 1.9 percent.		Percentage of deadhead hours at Troy is higher than at Pontiac by 4.7 percent.		Operating speed at Troy is lower than at Pontiac by 2.55.		N/A		Not significant	
R^{2} *6	0.20		0.48		0.64		0.60		0.38	

*1 Significance level of the coefficient of the independent variable. In this analysis the significance level is set at 0.10.
*2 Coefficients of the independent variable.
*3 Quo Vadis is a dummy variable: 0 = No Quo Vadis; 1 = Quo Vadis.
*4 Period 2 and period 3 are dummy variables. The base line is period 1 of these two variables is period one.
*5 Macomb, Wayne, and Troy are dummy variables. The base line for these variables is Pontiac.
*6 R^2 of the regression model represents the percentage of the variance in the dependent variable explained by the model.