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Maintaining Key Transit Services While Retaining National Core Values: New York City Transit's Title VI and Environmental Justice Strategies in a Recession

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Abstract

In a recession, transit agencies aim to provide key services while retaining national core values. Transit agencies receiving Federal funding are prohibited from discriminating on the basis of race, color, or national origin in their service changes, as per Title VI of the Civil Rights Act (1964). Additionally, Presidential Executive Order 12898 requires 'identifying and addressing disproportionately high and adverse human health or environmental effects of its programs, policies and activities on low-income populations.' Thus, for transit agencies, service changes must not place undue burden on Environmental Justice (EJ) populations. In 2010, New York City Transit (NYCT) proposed 50 service rationalization initiatives. To ensure compliance, NYCT developed analytical methodologies to identify impacts during planning stages, allowing proactive deployment of mitigation strategies. Each major service change was classified as either span or route change. For span changes, load factor analysis compared extent of empty seats across social and income categories during periods of service elimination. On 38 affected routes, analysis demonstrated that service reduction impacts were equitably shared. For route changes, impacts were measured using trip time-and-cost analysis using shortest path trip planning tools, journey-to-work-matrix, and Census data. The M Train modification that eliminated the V Train, and Co-op city bus restructuring (BX25 elimination) illustrates analysis of complex service changes as packages, capturing mitigating effects of adjacent route restructurings. These service changes reduced costs and our analysis showed that Title VI and EJ communities were not disproportionately affected in terms of travel options, journey time, and costs.

Introduction

Finding millions of dollars worth of savings in a public transit authority requires shared sacrifice amongst stakeholders. In 2010, the financial outlook for New York State was deteriorating. Funding from taxes and subsidies that New York City Transit (NYCT) was expecting did not materialize. State government was cutting service and Transit needed to do the same to remain solvent. The goals were to keep key public services functioning while seeking budgetary savings. At the same time, guidance from United States Department of Transportation (Circular FTA C 4702.1A) requires funding recipients to (a) ensure level and quality of service without regard to race, color and nationality (b) identify and address, as appropriate, disproportionately high and adverse human health and environmental effects, including social and economic effects of programs and activities on minority populations and low income populations.

The Federal Transportation Administration (FTA) provides guidance to Transit operators on methods of compliance and allows room for flexibility. The responsibility of the operator is to develop its own Title VI and Environmental Justice (EJ) programs, which comply with the Federal Transit Administration (FTA) and any local standards, set by the agency. At this time EJ issues are at the forefront of Federal rulemaking as FTA has released two Proposed Circulars (C 4702.1B and C 4703.1) for public comment. The proposal separates Title VI and EJ considerations and reiterates the requirements for service and fare change analysis. There is understandably widespread concern amongst the transit practitioner's community.

This paper demonstrates some of the methods used at NYCT and may serve as an example for other properties concerned with Federal compliance when changing route and service span. The purpose of these changes is to seek long term budgetary savings while minimizing the impact on the community and to retain Federal funding by remaining in compliance with Title VI and Executive Order 12898. This is achieved through analytical methods detailed in this paper.

Strategic Elements of EJ/Title VI

Title VI analysis can be useful as a gauge on community relations. Being a good social steward brings positive attention to the business during a difficult time. Transportation infrastructure directly affects job access, property values and livelihoods. Transit executives need to know the effects of their decisions. Thorough impact analysis provides the facts operators need to provide the key transit services while maintaining national core values.

This information shows its worth when government officials and elected leaders invite transit executives to address the concerns of their constituency. The Oakland Airport Connector project raised concerns by three San Francisco community groups who then brought the issue to the FTA (*1*). In 2009, the operator was found to be in violation of Title VI and lost $50 million in Federal funding. Ensuring that actions taken by the transit operator are non-discriminating requires proactive data analysis because outside groups are likely doing this already in order to influence the outcome. In 1996, Los Angeles County was pressed by a Federal court decision to spend over a billion dollars on their bus system when external groups proved disproportionate investments on light rail in wealthy neighborhoods compared to the bus network used by the majority of their customers (*2*). Strategic analysis, therefore, allows the operator to take the initiative in matters of decision making, public relations, funding, and control of their finances.

Complying with Title VI and Environmental Justice requirements is the law, and the right thing to do. However, having first and foremost fulfilled the legal and moral imperatives, taking

a proactive approach to Title VI provides the additional benefit of helping to maintain open channels of communication and a good working relationship with community stakeholders and regulators alike. Having a track record of going above and beyond builds an understanding that the operator is well managed. Satisfying stakeholders consistently indicates the operator is on the right track in service delivery.

Literature Review

A literature search for different strategies and analyses yield a diversity of topics. Some of these reports are unique such as the analysis done on American Indian tribal territories and transportation in relations to housing and demographics (*3*). One paper described how a transit agency was found to be non compliant with Title VI and strived to become compliant once again by reviewing the strategies of other operators (*4*). Another paper profiles a list of legal complaints pertaining to alleged Title VI violations (*5*). Others are more holistic covering fare analysis, Americans with Disabilities Act compliance and Civil Rights. Recently, papers have been published using statistical significance testing to analyze Title VI data (*6*). This is a logical development since it was already done in many areas of quality control in industrial engineering as well as in the social sciences such as crime data mining. Many agencies at the New York Metropolitan Transportation Authority (MTA) have adopted this method of analysis. The contribution of NYCT's experience in 2010 will provide focus on a particular case study where a large transit operator faced a financial situation and navigated itself to a fiscally stronger position using detailed internal analysis as guide.

Background

In 2005 the MTA reduced fares by half for all riders during certain times in the holiday season to share with the public an unexpected budgetary surplus (*7*). Towards the end of 2007, the world economy entered a recession. Unemployment would rise close to 10% (*8*). Nationally those numbers were higher for minority (*9*) and young workers especially for those with no college degrees and even worse for those without high school diplomas (*10*). Gas prices would remain historically high and had made its way past $4 per gallon (*11*). Transit provided an alternative means of dealing with cost of auto operation.

Transit had funding challenges too due to the falling tax revenue and rising expenses on resources such as fuel and labor. In October 2010 the MTA board approved fare increases and service cuts for 2011. An $89 monthly Unlimited pass increased to $104. Weekly passes increased from $27 to $29. Single rides increased by 25 cents to $2.25. The decision was to minimize the impact on customers least able to pay. Title VI analysis found monthly MetroCard holders tend to be more affluent than other fare media users (*12*). Service changes were made to reflect ridership and return on investment but before any route was cut impact analysis were done to minimize, mitigate or offset negative affects towards minority and low income riders with the goal of maintaining service parity with non-minority and above poverty riders (*6*).

Mass transit plays a vital role to those least able to afford private automobiles and its associated upkeep. A recent study done by the American Public Transportation Association (APTA) revealed that maintaining private auto ownership can cost over $10,000 per annum and close to $15,000 in New York City (*14*). In the year 2011 of which this APTA study was done, "At or Below Poverty" is defined as a yearly income of $22,350 for a family of four and $10,890 for an individual according to the United States Department of Health and Human Services (*15*). The poverty rate in New York City has been hovering around 20% (*16*). Despite the fare

increase, the average cost per year to use transit is a fraction of automobile ownership and can mean the difference between making ends meet or not.

Selection of Analytical Techniques

There were fifty service rationalization initiatives in 2010 (*17*). Figure 1 shows a selection of initiatives and their corresponding Title VI/EJ analysis types. According to guidelines adopted by the MTA in 1988, analysis is not needed if changes are less than 25% of the net route or less than one hour of the service span. Fourteen initiatives out of the fifty did not surpass thresholds that would prompt a Title VI Analysis. The remainder initiatives needed a change analysis for route or span. The table below lists a sample of initiatives, affected segments and the type of analysis needed (Span or Route). It is not applicable (N/A) if it doesn't require a Title VI analysis. The net change in route was calculated but it only prompts a Title VI analysis if it is above 25%.

Span Change Analysis

It is efficient to reduce bus in-service hours when few people are riding. This formula finds number of seats occupied:

$$\textit{Load Factor} = (\textit{Average Riders / Trip}) / \textit{Bus Seats}$$

Standard buses have 40 seats and articulated has 62. A load factor of 20% on a standard bus means on average only 8 seats are occupied at the peak load point during a span of time. A span change analysis is conducted when proposed cuts to service are considered "Major," defined as exceeding more than 1 hour. Three different span reduction actions were proposed in 2010. Express buses were not affected. (a) Span Reduction by Hour: Up to two hours of service at the beginning or end of the day, (b) Overnight Service Elimination: (1:00am to 5:00am), (c) Off-peak & Weekend Service Elimination: service may be reduced to Weekdays or to Peak hours only.

Equitability of span reduction is determined by comparing load factors during the period proposed for span reduction on impacted routes classified as Minority or Non-Minority routes (for Title VI), and as At or Below Poverty (Low Income), or Above Poverty (High Income), for EJ analysis. A route is defined as Minority if at least one-thirds of its total route mileage is in a Minority Census tract. The ⅓ rule was promulgated in Urban Mass Transportation Administration Circular C4702.1 (*20*) and was retained by NYCT despite the current FTA Circular C4702.1A that allowed each entity to develop their own standards. This ⅓ rule is also used to define "At or Below Poverty" routes. One can conclude from Figure 2 that the routes picked for span reduction are low performing and sensible candidates for rationalization.

The average load factors in Figure 3 are less than 50% any day of the week for any socio-economic category. That means at least half of the bus seats are empty on weekends, overnight and the first few hours of service at the beginning of the day and the last few hours at the end. When comparing Minority and Non-Minority on a weekday the difference in average load factors is 1%. The difference between High and Low Income is 2%. The *t*-test shows "No Disparity" amongst these groups. Statistically speaking the differences between groups is not significant.

The load factor analysis acts on the systemwide level with each route being a unit of analysis. This analysis is applicable when many routes are having their service spans reduced and essentially tests to see if span reductions are over-represented amongst certain routes, to

detect unintentional discrimination, if any. In contrast, route change analysis, discussed in the next section, is a route-by-route method that focuses on equity within the route, with Census tracts being the unit of analysis.

Figure 1 Choosing Type of Analysis for a Sample List of Services to be Modified (*18*)

Route	Segment	Route or Span	% Net Change	Above 25%?	Notes
Q	Queens Extension	Route	+32	Yes	Extend to Astoria
N	Manhattan Local	N/A	0	No	Replace W in North
W	All	Route	–100	Yes	Eliminated
V	Queens Elimination	Route	–100	Yes	Eliminated
M	Queens Extension	Route	+71	Yes	Rerouted to replace V
	Brooklyn Elimination	N/A	–62	Yes	Discontinued south of Delancey-Essex
G	Queens Elimination	Route	–51	Yes	Discontinued East of Court Sq.
	Brooklyn Extension	N/A	+14	No	24hr operation South of Court Sq.
SIR	Stadium Service	N/A	–100	Yes	Not a regularly scheduled service
BX25	Co-op City	Route	–100	Yes	Elimination
BX26	Co-op City	Route	–33	Yes	Rerouted
BX28	Co-op City	Route	–29	Yes	Rerouted
BX30	Co-op City	Route	–3	No	
BX38	Co-op City	Route	+100	Yes	New route
BX55	Bronx	N/A	–23	No	
BX15	Bronx	N/A	+8	No	
BX20	Bronx	Span	–63	Yes	
B1	Brooklyn	Route	–21	No	
B8	Brooklyn	Route	–15	No	
B64	Brooklyn	Route	+41	Yes	
B70	Brooklyn	Route	+31	Yes	
B4	Coney Island Av. East	N/A	–17	No	Modified to operate via Avenue Z
B2	Brooklyn	Span	–28	Yes	Weekend discontinued
B24	Brooklyn	Span	–30	Yes	Weekend discontinued
M22	West of City Hall	N/A	0	No	Changes recinded due to public hearing
M8	Manhattan	Span	–32	Yes	Weekend discontinued
M50	Manhattan	Span	–51	Yes	Weekend discontinued
S40/90	Staten Island	N/A	–5	No	Discontinued to Howland Hook
S54	Staten Island	Span	–25	Yes	
S76	Staten Island	Span	0	No	
Q74	Queens	Span	–100	Yes	Eliminated
Q75	Queens	Span	–100	Yes	Eliminated
Q79	Queens	Span	–100	Yes	Eliminated
X6	Hylan Blvd	Route	–100	Yes	Express Bus X6 eliminated

Figure 2 Bus Routes Analyzed for Service Span Reduction – Load Factor Analysis (*18*):

(a) Span Reduction by Hour

Non-Minority				Minority			
Route	Day Type	Loads* / Trip	Load Factor	Route	Day Type	Loads* / Trip	Load Factor
B64	ALL	4	10%	BX34	ALL	3	8%
B67	ALL	3	7%	BX32	WKD	12	29%
B2	WKD	4	10%	BX33	WKD	4	11%
B9	WKD	4	10%	BX33	SAT	7	18%
B16	WKD	6	15%	BX33	SUN	6	15%
B9	SAT	4	9%	BX17	SUN	5	12%
B9	SUN	3	8%	B7	ALL	6	14%
B16	SUN	3	8%	B31	ALL	3	7%
M8	ALL	1	3%	B45	ALL	4	10%
M16	ALL	3	6%	B57	ALL	6	15%
M50	ALL	2	6%	B65	ALL	5	13%
M66	ALL	2	5%	B11	WKD	4	10%
M11	WKD	7	18%	B13	WKD	4	9%
M20	WKD	6	16%	B24	WKD	10	24%
M21	WKD	8	20%	M1	ALL	2	6%
M20	SAT	6	15%	M22	ALL	1	3%
Q30	ALL	3	9%	M22	SAT	3	8%
S54	WKD	4	11%	M22	SUN	2	6%
S57	WKD	5	13%	M100	SAT	6	14%
S66	WKD	12	29%	M116	SAT	7	16%
S57	SAT	3	7%	Q48	SUN	3	7%
S57	SUN	4	9%				

(b) Overnight Service Elimination

Above Poverty				At or Below Poverty			
Route	Day Type	Loads* / Trip	Load Factor	Route	Day Type	Loads* / Trip	Load Factor
B67	ALL	3	7%	B64	ALL	4	10%
B2	WKD	4	10%	B9	WKD	4	10%
M8	ALL	1	3%	B16	WKD	6	15%
M50	ALL	2	6%	B9	SAT	4	9%
M66	ALL	2	5%	B9	SUN	3	8%
M20	WKD	6	16%	B16	SUN	3	8%
M20	SAT	6	15%	M16	ALL	3	6%
Q30	ALL	3	9%	M11	WKD	7	18%
S54	WKD	4	11%	M21	WKD	8	20%
S57	WKD	5	13%	BX34	ALL	3	8%
S66	WKD	12	29%	BX32	WKD	12	29%
S57	SAT	3	7%	BX33	WKD	4	11%
S57	SUN	4	9%	BX33	SAT	7	18%
B31	ALL	3	7%	BX33	SUN	6	15%
M1	ALL	2	6%	BX17	SUN	5	12%
Q48	SUN	3	7%	B7	ALL	6	14%
				B45	ALL	4	10%
				B57	ALL	6	15%
				B65	ALL	5	13%
				B11	WKD	4	10%
				B13	WKD	4	9%
				B24	WKD	10	24%
				M22	ALL	1	3%
				M22	SAT	3	8%
				M22	SUN	2	6%
				M100	SAT	6	14%
				M116	SAT	7	16%

(c) Weekend & Off Peak Service Elimination

Non-Minority				Minority			
Route	Day Type	AFC Loads /Trip	Load Factor	Route	Day Type	AFC Loads /Trip	Load Factor
B2	SAT	12	31%	BX20	SAT	13	32%
B2	SUN	9	23%	BX20	OFF PEAK	15	38%
M8	SAT	11	29%	BX34	SAT	17	43%
M8	SUN	10	24%	BX34	SUN	17	43%
M50	SAT	8	20%	B24	SAT	22	55%
M50	SUN	6	16%	B24	SUN	16	41%
Q76	SAT	28	70%	Q26	OFF PEAK	13	31%
S54	SAT	11	28%	Q31	SAT	31	78%
S54	SUN	8	20%	Q31	SUN	23	57%
S76	SAT	32	79%	Q84	SAT	19	48%
S76	SUN	24	59%	Q84	SUN	16	41%

Above Poverty				At or Below Poverty			
Route	Day Type	AFC Loads /Trip	Load Factor	Route	Day Type	AFC Loads /Trip	Load Factor
B2	SAT	12	31%	BX20	SAT	13	32%
B2	SUN	9	23%	BX20	OFF PEAK	15	38%
M8	SAT	11	29%	BX34	SAT	17	43%
M8	SUN	10	24%	BX34	SUN	17	43%
M50	SAT	8	20%	B24	SAT	22	55%
M50	SUN	6	16%	B24	SUN	16	41%
Q76	SAT	28	70%	Q84	SAT	19	48%
S54	SAT	11	28%	Q84	SUN	16	41%
S54	SUN	8	20%				
S76	SAT	32	79%				
S76	SUN	24	59%				
Q26	OFF PEAK	13	31%				
Q31	SAT	31	78%				
Q31	SUN	23	57%				

Figure 3 Comparing Load Factors Between Community Groups and Determining Disparity Using *t*-Tests (Dataset in Figure 2)

		Title VI		Environmental Justice	
		Minority	*Non-Minority*	*At or Below Poverty*	*Above Poverty*
Weekday Analysis	*Average Load Factor*	12%	11%	12%	10%
	Variance	0.0038	0.0036	0.0034	0.0039
	t-*Test*	-2.02 < -0.60 < 2.02		-2.04 < -1.32 < 2.04	
	Comparison Results	No Disparity		No Disparity	
Weekend Analysis	*Average Load Factor*	46%	36%	43%	40%
	Variance	0.018	0.049	0.0046	0.0529
	t-*Test*	-2.12 < -1.32 < 2.12		-2.11 < -0.34 < 2.11	
	Comparison Results	No Disparity		No Disparity	

Subway Route Change

Towards the goal of saving $4 million per annum, planners at NYCT proposed eliminating the "V" Train and replacing it with a rerouted and extended "M" Train (Figure 4). The "V" Train had relatively low ridership. The neighborhoods that lost and gained service had parity in demographics thus equity was preserved. Public hearings were held and comments collected in March 2010. The route change offers a new direct Midtown service for riders originating from Middle Village, Ridgewood, and Fresh Pond in Queens, and Bushwick and Williamsburg in Brooklyn. This modification was considered major because it changed at least 25% of the "M" Train route length and thus prompted Title VI analysis (*19*). The results from an Equity Analysis using a *t*-test showed that average travel times in affected Minority and Non-Minority areas showed no significant difference.

Route Analysis Methods

For routes that are being modified (elimination or extension), or those that have greater than 25% of the total revenue miles being changed, NYCT conducts a travel time and cost analysis. All Census tracts that are within ¼ mile of the route are reviewed. A Census tract is considered to be "Minority" if the minority population is equal to or greater than the Year 2000 Citywide average of 65.02%; otherwise it is defined as "Non-Minority." A Census tract is considered to be "At or Below Poverty" if the population is equal to or greater than the Year 2000 Citywide average of 21.25%; otherwise it is defined as "Above Poverty."

Figure 4 "M" and "V" Train Service Changes: (a) Description from 2010 Service Reduction Proposal; (b) Schematic Map (*17*)

[Figure on following page]

Proposal Modified
March 19, 2010

NYC Transit 2010 Service Reduction Proposals
Profile of Elements

Extend M to Replace the V Between Broadway-Lafayette St and Forest Hills-71st Av, Discontinue M Between Essex St and Bay Pkwy, Discontinue V Between Broadway-Lafayette St and 2nd Av

Description of Action:

This proposal has been modified based on public comments. The V designation has been changed to the M with the orange color designating the route (6th Avenue) in Manhattan. This proposal would extend M service to Forest Hills-71st Av, replacing V service between Bway-Lafayette St and Forest Hills-71st Av. The M would operate on the current V route from Forest Hills-71st Av to Broadway-Lafayette, then on tracks not currently used to Essex St and onto the current M route to Metropolitan Av (as a result, the V would no longer serve 2nd Av station). M service between Essex St and Bay Pkwy would be discontinued, and current J Z skip-stop service would be unaffected. The new M trains would be shorter than current V trains (480 feet, instead of 600 feet long) to accommodate shorter platforms on the current M route. Weekend and late night M service between Metropolitan and Myrtle Aves would be unchanged.

Neighborhoods/Trips Affected: Myrtle Corridor to Lower Manhattan, West End and 4th Av Corridor to Lower Manhattan, Queens Blvd.

Customer Impact:

South Brooklyn: 10,000 weekday riders from South Brooklyn to Lower Manhattan M stations would require an extra transfer to the R 2 3 4 5 serving nearby stations and/or a longer walk. 16,000 weekday riders traveling between the West End line and 4th Av local stations/ Downtown Brooklyn stations would have an extra transfer. 22,000 weekday riders would wait longer for local trips along the West End/4th Av line (1.1 extra minutes).

North Brooklyn: 17,000 weekday riders from the Myrtle corridor (including Hewes St, Lorimer St, and Flushing Av stations) to Lower Manhattan would require a cross-platform transfer. 22,000 weekday riders are projected to take the new M, benefiting from direct service to Midtown.

Manhattan: 19,000 northbound riders at 2nd Av station would wait an average of 0.75 additional minutes. 17,000 riders between Essex St and Broad St would wait an average of 0.6 additional minutes.

Queens: Queens Blvd and 6th Av M riders would experience more riders per car due to shorter trains than with the current V (though within existing and proposed loading guidelines).

Initial Net Annual Savings: $4.0 million (No Change in Savings)

NYC Transit 2010 Service Reduction Proposals
Profile of Elements

Proposal Modified March 19, 2010

Extend M to Replace the V Between Broadway-Lafayette St and Forest Hills-71st Av, Discontinue M Between Essex St and Bay Pkwy, Discontinue V Between Broadway-Lafayette St and 2nd Av

An Origin-Destination table (O-D) was created from the Year 2000 Census Journey-to-Work Matrix, separately for Minority and Non-Minority originating Census tracts. The top 5 tracts in terms of passenger origination within ¼ mile of the route are selected. From these top 5 origin tracts, the top 3 destinations within NYCT's service area are selected, making a selection of 15 O-D pairs with heavy traffic on NYCT's services, on which travel time and cost analysis will be conducted.

1. The shortest path using the route being proposed for elimination is selected as the 'before' travel time. The shortest path without the use of that route is the 'after' travel time. The shortest path is recommended by a generic web-based shortest path journey planning tool.
2. If the shortest path is to walk between the origin and destination Census tracts, the walk time is entered and $0 is entered for the fare.
3. In some cases, it is necessary to find the shortest path by forcing a transfer at an intermediate transfer point, as trip planner is not always able to pick a path using the route in question. Paths are rejected for being unreasonable if it involves circuitous changes of direction (e.g. travel south on a bus in order to go back north on an express bus.)
4. If there is no way to use the subject route (e.g., the Census tract is at the northern end of the subject route, and the O-D pair requires the traveler to travel north, thus every path involving the subject route results in a 'go south to go north' condition), then the shortest path travel time is used for both before and after condition (i.e. elimination of route will have no impact for that O-D pair.)

The travel times and costs are found for each O-D pair before and after route modification. The average difference is calculated. A *t*-test is conducted to determine if the changes in travel times and cost are equitable.

Application and Results

This method was applied to the "M" Train modification from Lower Manhattan to South Brooklyn. Prior to the major revamp of the subway map the "M" Train from Broad St. in Manhattan to Bay Parkway in Brooklyn was a dotted line indicating that it is a part-time extension. It ran only during rush hours Monday to Friday 6:30AM to 9:30AM and in the afternoon from 3:30PM to 8:00PM. There was no service available during midday, evenings, weekends, and late nights. Between Broad St., Manhattan and 36 St., Brooklyn it shared the Montague St. Tubes and 4 Avenue Subway local tracks with "R" Trains. Then it shared the West End Line tracks with "D" Trains as far as Bay Parkway. The redundancy reduced the impact of its elimination. Figure 5 illustrates the top 5 origins and top 3 destinations for the "M" Train. The results are graphed in Figure 6 to show the average difference in travel time and cost affecting four demographic categories before and after the "M" Train was modified.

Figure 5 The O-D Centroid Pairs Come From Census Year 2000 Journey-to-Work Matrix. These Tracts are Adjacent to the Affected Routes. The Top 5 Origins and Top 3 Destinations are Selected (*18*): (a) Title VI—Minority/Non-Minority Analysis; (b) Environmental Justice—At or Below Poverty/Above Poverty Analysis.

[Figure on following page]

M (Elimination)

TITLE VI BUS TRAVEL ANALYSIS

MINORITY

Census Tract(s)						Travel Time (Minutes)				Total Cost per Trip**			
Origin	Origin Centroid	Destination	Destination Centroid	Originating Riders in Census Tract	Riders in the O-D Market	Before Route Elimination		After Route Elimination		Before Route Elimination		After Route Elimination	
61001800	Allen St at Delancey St, New York, NY	61004100	Mott St at Grand St, New York, NY	1,494	305	8		8		$1.50		$1.50	
61001800	Allen St at Delancey St, New York, NY	61001800	Allen St at Delancey St, New York, NY	1,494	290	0		0		$0.00		$0.00	
61001800	Allen St at Delancey St, New York, NY	61004500	Crosby St at Grand St, New York, NY	1,494	260	9		8		$1.50		$1.50	
61001600	Eldridge St at Canal St, New York, NY	61001600	Eldridge St at Canal St, New York, NY	1,424	435	0		0		$0.00		$0.00	
61001600	Eldridge St at Canal St, New York, NY	61002900	Kent Pl at Cardinal Hayes Pl, New York, NY	1,424	175	10	w	10	w	$0.00	w	$0.00	w
61001600	Eldridge St at Canal St, New York, NY	61004100	Mott St at Grand St, New York, NY	1,424	130	8	w	8	w	$0.00	w	$0.00	w
61000800	Madison St at Market St, New York, NY	61000800	Madison St at Market St, New York, NY	1,374	360	0		0		$0.00		$0.00	
61000800	Madison St at Market St, New York, NY	61004500	Crosby St at Grand St, New York, NY	1,374	230	15	*	15		$1.50	*	$1.50	
61000800	Madison St at Market St, New York, NY	61001600	Eldridge St at Canal St, New York, NY	1,374	165	5	w	5	w	$0.00	w	$0.00	w
61004100	Mott St at Grand St, New York, NY	61004100	Mott St at Grand St, New York, NY	1,298	435	0		0		$0.00		$0.00	
61004100	Mott St at Grand St, New York, NY	61004500	Crosby St at Grand St, New York, NY	1,298	240	4	w	4	w	$4.00	w	$0.00	w
61004100	Mott St at Grand St, New York, NY	61003100	Worth St at Lafayette St, New York, NY	1,298	160	9		7		$1.50		$1.50	
61002900	Kent Pl at Cardinal Hayes Pl, New York, NY	61002900	Kent Pl at Cardinal Hayes Pl, New York, NY	898	310	0		0		$0.00		$0.00	
61002900	Kent Pl at Cardinal Hayes Pl, New York, NY	61004100	Mott St at Grand St, New York, NY	898	165	11	*	11		$1.50	*	$1.50	
61002900	Kent Pl at Cardinal Hayes Pl, New York, NY	61004500	Crosby St at Grand St, New York, NY	898	105	10		10		$1.50		$1.50	

NON-MINORITY

Census Tract(s)						Travel Time (Minutes)				Total Cost per Trip**			
Origin	Origin Centroid	Destination	Destination Centroid	Originating Riders in Census Tract	Riders in the O-D Market	Before Route Elimination		After Route Elimination		Before Route Elimination		After Route Elimination	
47000500	Pierrepont St at Henry St, Kings, NY	47000500	Pierrepont St at Henry St, Kings, NY	1,480	305	0		0		$0.00		$0.00	
47000500	Pierrepont St at Henry St, Kings, NY	61000700	Wall St at Hanover St, New York, NY	1,480	155	7	*	7		$1.50	*	$1.50	
47000500	Pierrepont St at Henry St, Kings, NY	61009200	E 45th St at Lexington Ave, New York, NY	1,480	135	28	*	28		$1.50	*	$1.50	
47000301	Pierrepont St at Willow St, Kings, NY	47000301	Pierrepont St at Willow St, Kings, NY	1,330	290	0		0		$0.00		$0.00	
47000301	Pierrepont St at Willow St, Kings, NY	61000700	Wall St at Hanover St, New York, NY	1,330	225	10	*	10		$1.50	*	$1.50	
47000301	Pierrepont St at Willow St, Kings, NY	47001100	Pearl St at Willoughby St, Kings, NY	1,330	130	11		13		$1.50		$1.50	
61004900	Wooster St at Prince St, New York, NY	61004900	Wooster St at Prince St, New York, NY	1,245	675	0		0		$0.00		$0.00	
61004900	Wooster St at Prince St, New York, NY	61010200	Madison Ave at E 53rd St, New York, NY	1,245	90	22	*	22		$1.50	*	$1.50	
61004900	Wooster St at Prince St, New York, NY	61000900	Stone St at Broad St, New York, NY	1,245	85	15	*	15		$1.50	*	$1.50	
61003300	W Broadway at Franklin St, New York, NY	61003300	W Broadway at Franklin St, New York, NY	1,185	600	0		0		$0.00		$0.00	
61003300	W Broadway at Franklin St, New York, NY	61012500	7th Ave at W 48th St, New York, NY	1,185	95	15	*	15		$1.50	*	$1.50	
61003300	W Broadway at Franklin St, New York, NY	61031701	N End Ave at Vesey St, New York, NY	1,185	70	10	*	10		$1.50	*	$1.50	
47000100	Cranberry St at Hicks St, Kings, NY	47000100	Cranberry St at Hicks St, Kings, NY	1,070	260	0		0		$0.00		$0.00	
47000100	Cranberry St at Hicks St, Kings, NY	61000700	Wall St at Hanover St, New York, NY	1,070	130	9	*	9		$1.50	*	$1.50	
47000100	Cranberry St at Hicks St, Kings, NY	47000900	Livingston St at Court St, Kings, NY	1,070	105	9	*	9		$1.50	*	$1.50	

Notes:

w - Walking only (No transit usage involved)

"0" - Same Census Tract, travel occurs within the census tract, no transit service used

- LIRR

* - Riders not using bus proposed for elimination

** - Based on current fare structure (doesn't include future increase)

EQUITY ANALYSIS RESULT (t-test)

	Total Travel Time		Total Cost per Trip	
	Minority	Non-Minority	Minority	Non-Minority
Average Travel Time after route elimination	5.73	9.20	0.60	1.00
Average Travel Time before route elimination	5.93	9.07	0.87	1.00
Average difference	-0.20	0.13	-0.27	0.00
Variance	0.31	0.27	1.07	0.00

Total Travel Time : Using a two-tailed test of hypothesis with a 5% error (95% confidence), the resulting t-statistic = -1.69. The t-critical values are +/- 2.05. Since -1.69 > –2.05 and < +2.05, we can therefore conclude that there is no significant difference in the total travel time before and after eliminating the proposed route between minority and non-minority population.

Total Cost per Trip : Using a two-tailed test of hypothesis with a 5% error (95% confidence), the resulting t-statistic = -1.00. The t-critical values are +/- 2.14. Since -1.00 > –2.14 and < +2.14, we can therefore conclude that there is no significant difference in the total cost per trip before and after eliminating the proposed route between minority and non-minority population.

(M) (Elimination)

TITLE VI BUS TRAVEL ANALYSIS

BELOW OR AT POVERTY

Census Tract(s)						Travel Time (Minutes)		Total Cost per Trip**	
Origin	Origin Centroid	Destination	Destination Centroid	Originating Riders in Census Tract	Riders in the O-D Market	Before Route Elimination	After Route Elimination	Before Route Elimination	After Route Elimination
61001800	Allen St at Delancey St, New York, NY	61004100	Mott St at Grand St, New York, NY	1,494	305	8	8	$1.50	$1.50
61001800	Allen St at Delancey St, New York, NY	61001800	Allen St at Delancey St, New York, NY	1,494	290	0	0	$0.00	$0.00
61001800	Allen St at Delancey St, New York, NY	61004500	Crosby St at Grand St, New York, NY	1,494	260	9	8	$1.50	$1.50
61001600	Eldridge St at Canal St, New York, NY	61001600	Eldridge St at Canal St, New York, NY	1,424	435	0	0	$0.00	$0.00
61001600	Eldridge St at Canal St, New York, NY	61002900	Kent Pl at Cardinal Hayes Pl, New York, NY	1,424	175	10 w	10 w	$0.00 w	$0.00 w
61001600	Eldridge St at Canal St, New York, NY	61004100	Mott St at Grand St, New York, NY	1,424	130	8 w	8 w	$0.00 w	$0.00 w
61000800	Madison St at Market St, New York, NY	61000800	Madison St at Market St, New York, NY	1,374	360	0	0	$0.00	$0.00
61000800	Madison St at Market St, New York, NY	61004500	Crosby St at Grand St, New York, NY	1,374	230	15 *	15	$1.50 *	$1.50
61000800	Madison St at Market St, New York, NY	61001600	Eldridge St at Canal St, New York, NY	1,374	165	5 w	5 w	$0.00 w	$0.00 w
61004100	Mott St at Grand St, New York, NY	61004100	Mott St at Grand St, New York, NY	1,298	435	0	0	$0.00	$0.00
61004100	Mott St at Grand St, New York, NY	61004500	Crosby St at Grand St, New York, NY	1,298	240	4 w	4 w	$0.00 w	$0.00 w
61004100	Mott St at Grand St, New York, NY	61003100	Worth St at Lafayette St, New York, NY	1,298	160	9	7	$1.50	$1.50
47000100	Cranberry St at Hicks St, Kings, NY	47000100	Cranberry St at Hicks St, Kings, NY	1,070	260	0	0	$0.00	$0.00
47000100	Cranberry St at Hicks St, Kings, NY	61000700	Wall St at Hanover St, New York, NY	1,070	130	9 *	9	$1.50 *	$1.50
47000100	Cranberry St at Hicks St, Kings, NY	47000900	Livingston St at Court St, Kings, NY	1,070	105	9 *	9	$1.50 *	$1.50

ABOVE POVERTY

Census Tract(s)						Travel Time (Minutes)		Total Cost per Trip**	
Origin	Origin Centroid	Destination	Destination Centroid	Originating Riders in Census Tract	Riders in the O-D Market	Before Route Elimination	After Route Elimination	Before Route Elimination	After Route Elimination
47000500	Pierrepont St at Henry St, Kings, NY	47000500	Pierrepont St at Henry St, Kings, NY	1,480	305	0	0	$0.00	$0.00
47000500	Pierrepont St at Henry St, Kings, NY	61000700	Wall St at Hanover St, New York, NY	1,480	155	7 *	7	$1.50 *	$1.50
47000500	Pierrepont St at Henry St, Kings, NY	61009200	E 45th St at Lexington Ave, New York, NY	1,480	135	28 *	28	$1.50 *	$1.50
47000301	Pierrepont St at Willow St, Kings, NY	47000301	Pierrepont St at Willow St, Kings, NY	1,330	290	0	0	$0.00	$0.00
47000301	Pierrepont St at Willow St, Kings, NY	61000700	Wall St at Hanover St, New York, NY	1,330	225	10 *	10	$1.50 *	$1.50
47000301	Pierrepont St at Willow St, Kings, NY	47001100	Pearl St at Willoughby St, Kings, NY	1,330	130	11	13	$1.50	$1.50
61004900	Wooster St at Prince St, New York, NY	61004900	Wooster St at Prince St, New York, NY	1,245	675	0	0	$0.00	$0.00
61004900	Wooster St at Prince St, New York, NY	61010200	Madison Ave at E 53rd St, New York, NY	1,245	90	22 *	22	$1.50 *	$1.50
61004900	Wooster St at Prince St, New York, NY	61000900	Stone St at Broad St, New York, NY	1,245	85	15 *	15	$1.50 *	$1.50
61003300	W Broadway at Franklin St, New York, NY	61003300	W Broadway at Franklin St, New York, NY	1,185	600	0	0	$0.00	$0.00
61003300	W Broadway at Franklin St, New York, NY	61012500	7th Ave at W 48th St, New York, NY	1,185	95	15 *	15	$1.50 *	$1.50
61003300	W Broadway at Franklin St, New York, NY	61031701	N End Ave at Vesey St, New York, NY	1,185	70	10 *	10	$1.50 *	$1.50
47000700	State St at Garden Pl, Kings, NY	47000700	State St at Garden Pl, Kings, NY	979	290	0	0	$0.00	$0.00
47000700	State St at Garden Pl, Kings, NY	61000700	Wall St at Hanover St, New York, NY	979	85	14 *	14	$1.50 *	$1.50
47000700	State St at Garden Pl, Kings, NY	61009200	E 45th St at Lexington Ave, New York, NY	979	75	30 *	30	$1.50 *	$1.50

Notes:

w - Walking only (No transit usage involved)

"0" - Same Census Tract, travel occurs within the census tract, no transit service used

* - Riders not using bus proposed for elimination

** - Based on current fare structure (doesn't include future increase)

EQUITY ANALYSIS RESULT (t-test)

	Total Travel Time		Total Cost per Trip	
	BELOW OR AT POVERTY	ABOVE POVERTY	BELOW OR AT POVERTY	ABOVE POVERTY
Average Travel Time after route elimination	5.53	10.93	0.60	1.00
Average Travel Time before route elimination	5.73	10.80	0.60	1.00
Average difference	-0.20	0.13	0.00	0.00
Variance	0.31	0.27	0.00	0.00

Total Travel Time : Using a two-tailed test of hypothesis with a 5% error (95% confidence), the resulting t-statistic = -1.69. The t-critical values are +/- 2.05. Since -1.69 > –2.05 and < +2.05, we can therefore conclude that there is no significant difference in the Total travel time before and after eliminating the proposed route between below or at poverty and above poverty routes.

Total Cost per Trip : The average difference in total cost per trip between minority and non-minority riders are equal; therefore there is no potential Title VI disparity.

The bar graph shows the differences before and after the "M" Train modification ("M" Elimination). In terms of average travel times for minorities there is a fraction of a minute difference. The same is true for non-minorities. The comparison is between the average difference of minorities and non-minorities. The change was equitably small. The two tailed test of hypothesis (*t*-test) confirms this conclusion of "No Significant Disparity." The average total cost to minorities actually dropped by 27 cents after the modification. The *t*-test shows that there is no significant difference. The average difference for Above Poverty and At or Below Poverty is also insignificant according to *t*-test results.

The new orange "M" Train ("M" Extension) runs from Broadway-Lafayette St., Manhattan to Forest Hills, Queens. This extension completely replaces—and thus eliminates in name only—the "V" Train. The neighborhoods the "M" now travels through (all former "V" stops) traverses a largely non-minority and above poverty population in Manhattan. Once the "M" Train crosses underneath the East River and enters Queens the population becomes quite diverse in terms of race and income.

The methodology used to analyze the "M" Extension and the "V" Elimination is based on the route change analysis done on the "M" modification in Lower Manhattan to South Brooklyn. There are geographic differences between the eliminated segment of the "M" Train and the extended portion going into Queens. Brooklyn has higher transit density providing more options for transfers.

Discussion

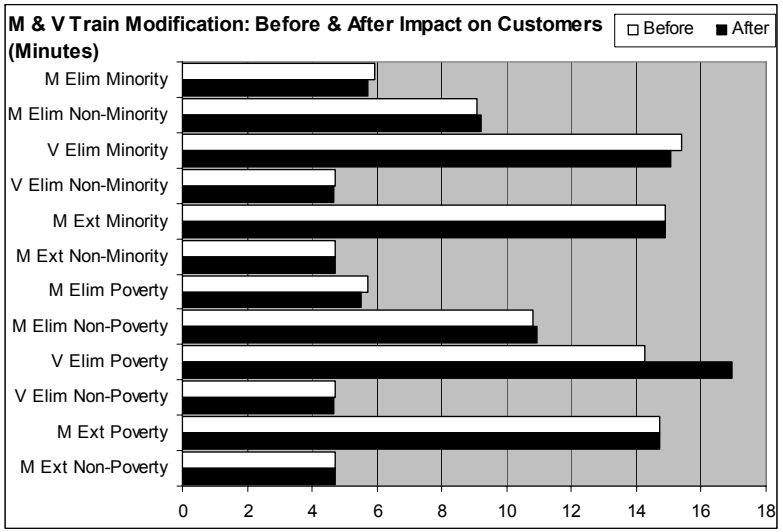
The methodology takes into account people who walk distances up to a quarter mile of which there could be several stops in between. The distance between Allen St. at Delancey St. and Crosby St. at Grand St. is easily 4-5 minutes walking but has four separate subway stations within its vicinity. The variance in these O-D pair comparisons (Figure 5) jump to 52.81 when you add in trips between 31 Ave. at 34 St. in Queens and Stone St. at Broad St. in Manhattan. The distance between these two points is approximately 7 miles and requires at minimum a transfer between two train routes. The difference in travel time could range from four to forty four minutes.

The trip planner method has its limitations and this can be seen when analysis was done on total cost per trip for the "V" Train elimination. The journey planner generates the top 3-5 shortest travel paths for each given O-D pair. On two occasions, it recommended use of the Long Island Rail Road (LIRR)—if no "V" Train were available—to travel between 35 Ave. at 71 St., Queens and Midtown Manhattan, which is a distance of about five miles. The LIRR is a viable if not more expensive mode of transport for that trip. However, the trip planner (at time of analysis) could not take into account the fact that the new "M" Train will replace the "V" Train in its entirety and that in reality a subway option continues to be available. The journey planner data could not be modified until these proposals are adopted and MTA releases appropriate timetable data. One can make an exception but in this study the method was strictly followed, to ensure that NYCT has a consistent and defensible Title VI/EJ analytical method.

As a result of the "V" Train elimination being analyzed separately from the "M" Train re-route, the methodology makes the data appear that At or Below Poverty riders are paying almost twice as much as Above Poverty riders. In actuality the fare did not change before or after the elimination of the "V". Based on new package analysis methodology submitted for FTA review, NYCT will analyze route changes like the "M" Train and the "V" Train together in the future.

Travel Time Analysis

Group	Before	After	Avg Diff	Variance	t-Test	Result
M Elim Minority	5.93	5.73	-0.2	0.31	-2.05 < -1.69 < 2.05	No Disparity
M Elim Non-Minority	9.07	9.2	0.13	0.27		
V Elim Minority	15.4	15.07	-0.33	0.38	-2.09 < -1.54 < 2.09	No Disparity
V Elim Non-Minority	4.73	4.67	-0.07	0.07		
M Ext Minority	14.87	14.87	0	0	Not Required	No Disparity
M Ext Non-Minority	4.73	4.73	0	0	No Change	
M Elim Poverty	5.73	5.53	-0.2	0.31	-2.05 < -1.69 < 2.05	No Disparity
M Elim Non-Poverty	10.8	10.93	0.13	0.27		
V Elim Poverty	14.27	16.93	2.67	52.81	-2.14 < 1.46 < 2.14	No Disparity
V Elim Non-Poverty	4.73	4.67	-0.07	0.07		
M Ext Poverty	14.73	14.73	0	0	Not Required	No Disparity
M Ext Non-Poverty	4.73	4.73	0	0	No Change	



Travel Cost Analysis

Group	Before	After	Avg Diff	Variance	t-Test	Result
M Elim Minority	$0.87	$0.60	-0.27	1.07	-2.14 < -1.00 < 2.14	No Disparity
M Elim Non-Minority	$1.00	$1.00	0	0		
V Elim Minority	$1.23	$1.33	0.1	0.15	-2.14 < 1.00 < 2.14	No Disparity
V Elim Non-Minority	$0.90	$0.90	0	0		
M Ext Minority	$1.43	$1.43	0	0	Not Required	No Disparity
M Ext Non-Minority	$0.90	$0.90	0	0	No Change	
M Elim Poverty	$0.60	$0.60	0	0	Not Required	No Disparity
M Elim Non-Poverty	$1.00	$1.00	0	0	No Change	
V Elim Poverty	$0.90	$1.77	0.87	5.23	-2.14 < 1.47 < 2.14	No Disparity
V Elim Non-Poverty	$0.90	$0.90	0	0		
M Ext Poverty	$2.20	$2.20	0	0	Not Required	No Disparity
M Ext Non-Poverty	$0.90	$0.90	0	0	No Change	

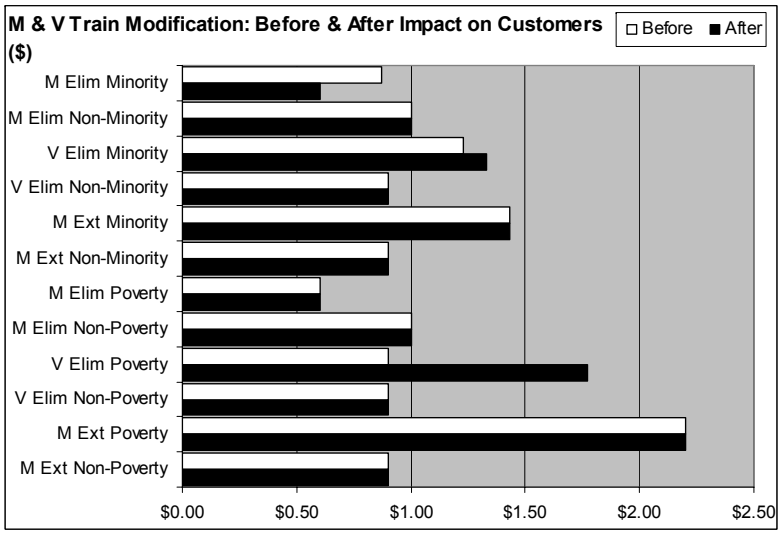


Figure 6 Travel Time and Cost Analysis: "M" and "V" Subway Restructuring

Bus Service Change: Co-op City

Co-op City is a middle-income housing development located on the North East peninsula of the Bronx privately built under New York's Mitchell-Lama limited-profit housing program. It is not a separate municipal jurisdiction but is the name of a neighborhood that contains a high density of co-operatively owned apartment situated on attractive parkland and with easy access to parking and state parkways but not rail rapid transit. Nearby amenities include a golf course, a beach, a shopping mall, and a municipal park. Per Census data, this neighborhood is Minority and Above Poverty.

Consider the Title VI analysis of restructuring four bus lines in Co-op City. The cessation of an entire bus line (BX25) is projected to save $2.8 million per annum. The other three buses (BX26, BX28, BX38) will be altered to absorb the ridership of BX25. e descriptions of changes are: to reroute the BX26 to match the eliminated BX25 path at all times (the BX25 designation would no longer be used). The BX28 would be split into two branches with one serving the northern section of Co-op City (which would be extended to Bay Plaza and numbered BX38) and one serving the southern section of Co-op City (which would be numbered BX28). BX38 will not enter Asch Loop. These buses serve as feeders to the ❷ and ❺ Trains going into Manhattan and Brooklyn. They also go to the Metro-North Williams Bridge commuter rail station.

BX25, BX26 and BX28 are considered Minority bus routes because at least ⅓ of their total route mileage is in Minority Census tracts. These Census tracts are defined as Minority when 65.02% or more of its population are minority as per the Year 2000 New York City minority population threshold. Even though 34.98% or less is Non-Minorities the entire Census tract is considered Minority. Thus non-minorities do exist there even though the methodology dictates these Census tracts to be one or the other. Despite the route being predominately minority, the analysis compares the experience of minorities and non-minorities within the route by comparing Census tracts. The income levels are also worth mentioning because Co-op City is well known for being a community of the urban middle class popular amongst minorities and émigrés. The income requirements to live in Co-op City starts at $23,160 for up to two people, which is just above poverty (*21*).

The method of analysis to determine Title VI compliance in Co-op City is similar to the "M" and "V" Train modification discussed earlier. The difference is the additional variables of four routes being modified as opposed to just the two for the "M" and "V". The graphs on Figure 7 show the change in travel time and cost before and after modification. The average differences amongst the four socio-economic categories are less than half a minute or zero.

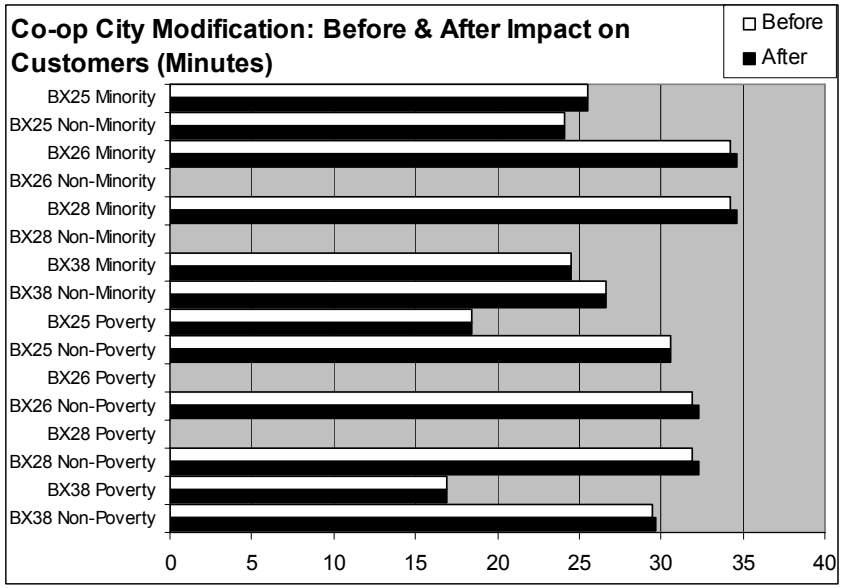
The top five origination method has a notable affects on the analysis. BX25 and BX26 travels along a similar path but the top 5 origins for each route falls on different Census tracts. BX25 has data to compare between minorities and non-minorities. BX26 top 5 origins does not fall on any Non-Minority Census tracts so there is no data to compare with Minority. BX26 top 5 origins do not fall on any At or Below Poverty Census tracts either so there is no data to compare with Above Poverty tracts (Figure 7).

Public Reaction

The residents of Co-op City formed a "Coalition to Stop the MTA Cuts" and presented a petition to the MTA as well as their elected representatives in government signed by thousands (*22*). Nine months of meetings amongst the stakeholders yielded:

Travel Time Analysis

Group	Before	After	Avg. Diff.	Var.	t-Test	Result
BX25 Minority	25.53	25.53	0	0	Not Required - No change	No Disparity
BX25 Non-Minority	24.13	24.13	0	0	Not Required - No change	
BX26 Minority	34.2	34.6	0.4	0	No Comparison Data	No Disparity
BX26 Non-Minority	0	0	0	0	No Comparison Data	
BX28 Minority	34.2	34.6	0.4	0	No Comparison Data	No Disparity
BX28 Non-Minority	0	0	0	0	No Comparison Data	
BX38 Minority	24.53	24.53	0	0	Not Required - No change	No Disparity
BX38 Non-Minority	26.6	26.6	0	0	Not Required - No change	
BX25 Poverty	18.4	18.4	0	0	Not Required - No change	No Disparity
BX25 Non-Poverty	30.6	30.6	0	0	Not Required - No change	
BX26 Poverty	0	0	0	0	No Comparison Data	No Disparity
BX26 Non-Poverty	31.93	32.33	0.4	0	No Comparison Data	
BX28 Poverty	0	0	0.4	0	No Comparison Data	No Disparity
BX28 Non-Poverty	31.93	32.33	0.4	0	No Comparison Data	
BX38 Poverty	16.93	16.93	0	0	Not Required - No change	No Disparity
BX38 Non-Poverty	29.47	29.67	0.2	0.6	Not Required - No change	



Travel Cost Analysis

Group	Before	After	Avg. Diff.	Var.	t-Test	Result
BX25 Minority	$1.22	$1.22	0	0	Not Required - No change	No Disparity
BX25 Non-Minority	$1.32	$1.32	0	0	Not Required - No change	
BX26 Minority	$1.10	$1.10	0	0	No Comparison Data	No Disparity
BX26 Non-Minority	$0.00	$0.00	0	0	No Comparison Data	
BX28 Minority	$1.10	$1.10	0	0	No Comparison Data	No Disparity
BX28 Non-Minority	$0.00	$0.00	0	0	No Comparison Data	
BX38 Minority	$1.51	$1.51	0	0	Not Required - No change	No Disparity
BX38 Non-Minority	$1.20	$1.20	0	0	Not Required - No change	
BX25 Poverty	$1.53	$1.53	0	0	Not Required - No change	No Disparity
BX25 Non-Poverty	$1.00	$1.00	0	0	Not Required - No change	
BX26 Poverty	$0.00	$0.00	0	0	No Comparison Data	No Disparity
BX26 Non-Poverty	$1.10	$1.10	0	0	No Comparison Data	
BX28 Poverty	$0.00	$0.00	0	0	No Comparison Data	No Disparity
BX28 Non-Poverty	$1.10	$1.10	0	0	No Comparison Data	
BX38 Poverty	$1.02	$1.02	0	0	Not Required - No change	No Disparity
BX38 Non-Poverty	$1.19	$1.19	0	0	Not Required - No change	

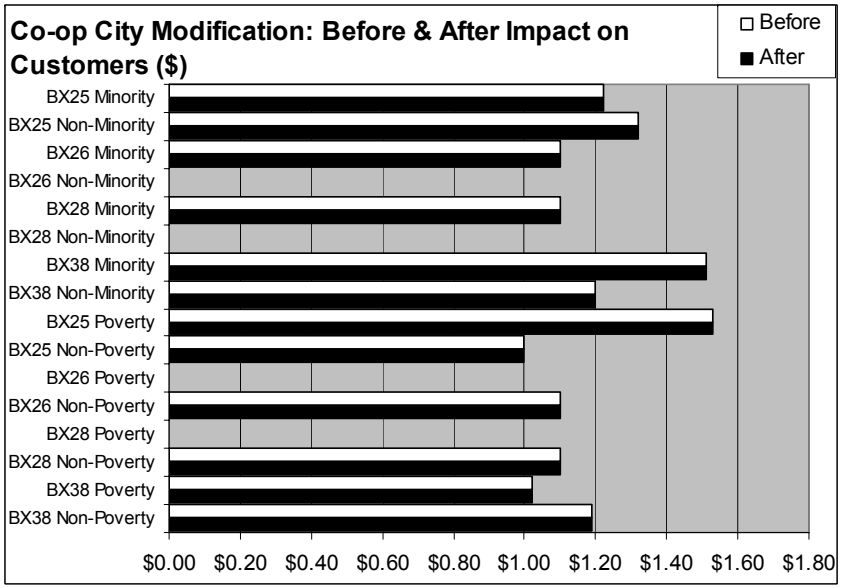


Figure 7 Travel Time and Cost Analysis: Co-op City

> "the relocating of a bus stop from under the I-95 overpass to a better lit location closer to Baychester Avenue. A request to add buses to the BX28 line serving the north section of the community during the over night hours was accepted." (*22*)

Still, the local city council member believes the concessions have not gone far enough. He called for the MTA [NYCT] to, "return to the drawing board and make sure the residents of Co-op City are not stranded."(*22*) Having learned that these cuts saves millions a year he claimed that, "Co-op city has received an unfair share of the cuts made system-wide and as such should be given some consideration for having some of the previous level of service restored."(*22*) The FTA auditors may be satisfied and is assured that the cuts have been necessary and fair. However, New York City Transit strives to be customer orientated and has maintained communications and negotiations with community leaders and their constituents. There may be no legal requirement to do so given the exhaustive Title VI and EJ analysis but it is a matter of working in good faith with stakeholders. One local media outlet reports: "Ridership data will be reviewed to determine if service adjustments need to be made. Bronx residents will be given opportunities to speak out at town hall meetings."(*23*)

Package Level Analysis

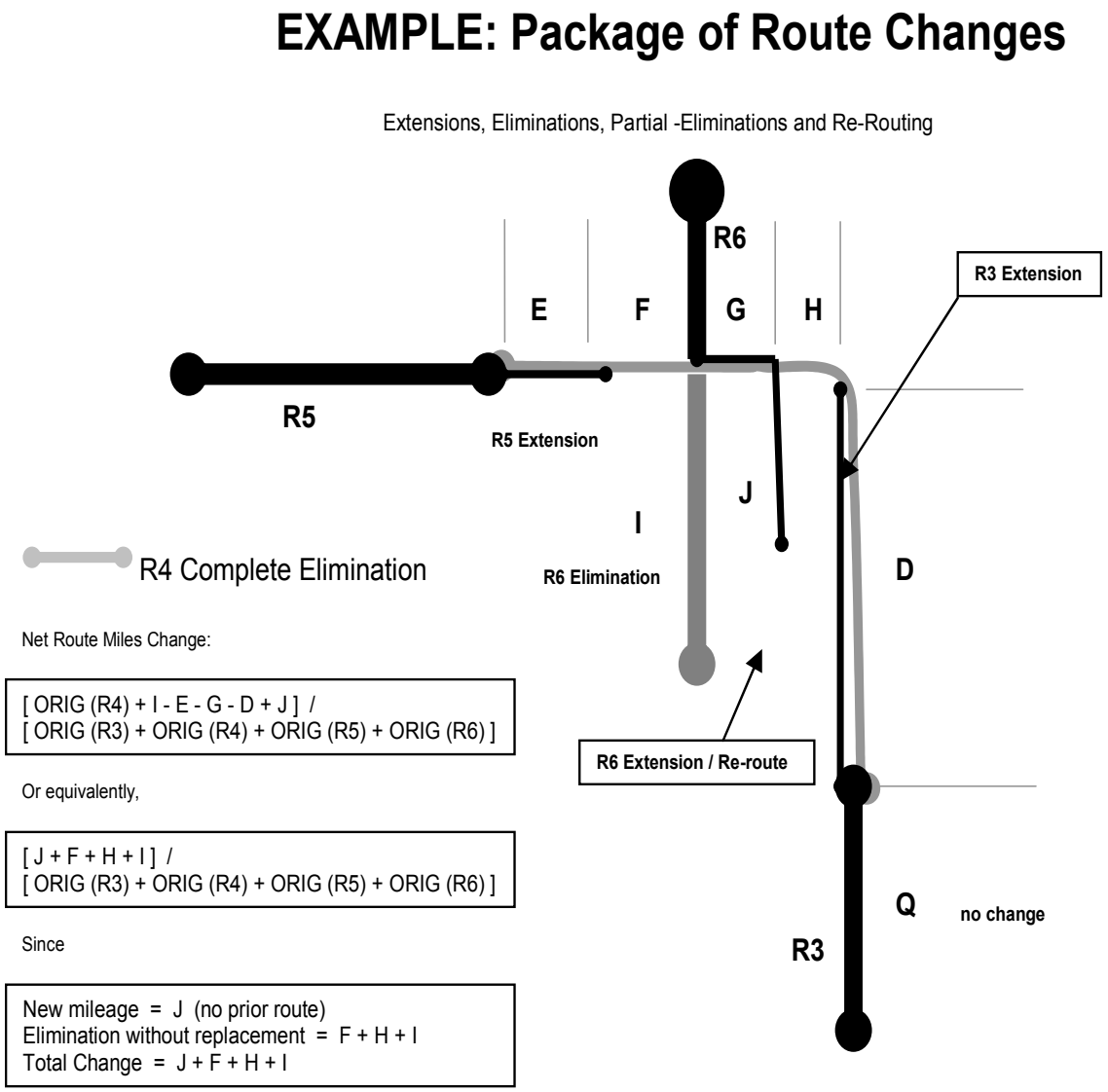
Route level analysis is cumbersome and can be misleading because it does not capture the mitigating effects of restructuring other adjacent routes. A segment of the "M" Train, in this study, was eliminated in one area of Census tracts that have route redundancy mitigating any impacts to riders there. The "V" Train was eliminated but only in the sense that the designation is no longer used. The Queens Boulevard Line local track that the "V" Train traveled did not physically get removed. Riders still have access to it with a different letter ("M") and in some sense can go further with fewer transfers than before. Yet analysis of the "V" Elimination absent of the "M" makes the result appear to impact one group more (albeit negligibly). Nevertheless, a route change has occurred and thus Title VI route level analysis must be done. The following formula summarizes when it is important to conduct an impact analysis as a package of changes.

$$\textit{Above X\% Net Route Miles Change} = \frac{\textit{(New Mileage + Eliminated Mileage)}}{\Sigma\ \textit{(Original Route Mileage)}}$$

The X% is for each operator to decide. At NYCT, if the X% Net Route Miles Change is greater than 25% then a package analysis should be performed. No action is required if it is under 25%. Future NYCT Title VI analysis involving a combination of changes will use the method of package analysis in cases like Co-op City. This method has been reviewed by FTA auditors and yields results that better represents the experiences of the riding public, not to mention making the analysis process easier.

Figure 8 is a hypothetical package analysis on a series of changes made to four routes. The focus of change is on Route 4 (or R4) because it is being eliminated. The original routes are R3, R4, R5, R6. The gray horizontal line that makes a right angle turn is R4 and it stretches from segments E, F, G, H ending at D. The adjacent R5 is being extended to segment E covering a portion of the R4 elimination. Segment F would not be covered by any bus route and riders will have to walk to bridge that distance. The adjacent R6 used to run in a straight line but in order to cover a little more of the R4 elimination now has to make a turn to run through segment G before heading south again to segment J. The distance of segment H will not be covered by any bus

route either. The final segment to cover is D, which is taken over by extending R3. The modification of bus routes R5, R6 and R3 has now made bus route R4 no longer necessary. The percent of net route change is the quotient produced by the above formula. If the percentage is above 25% then a Title VI analysis will be necessary.



% Net Route Change = Length (J+F+H+I) / Length (R3+R4+R5+R6)

Figure 8 Net Route Change Example in a Package Analysis

This method of rationalization keeps the network relatively intact, which means people can still get to where they need to go but with some impact in connectivity. A rider may be accustomed to riding R5 to the end, transferring to R4 to get towards G. The transfer would be

within the same block. Eliminating R4 means the rider has to walk distance F to catch R6 in order to complete the journey.

Conclusion

It is the dynamic communication with the community and the analysis of the customer base that ensures the provision of the best level of service with the resources available. This effort makes every dollar count. Proving to the public that the impact on travel time for minorities in Co-op City is minimal frames the grievance they may have about losing an entire bus line and counters anecdotal experiences of poor service. Even if the impact can be measured by minutes it helps to show that statistically speaking—as a measure on the whole—the change is equal for minorities and non-minorities on that route. The effort and methods invested could save the operator from having to reverse their decisions, which in itself is costly.

Conducting analysis on these issues needs to evolve to meet the needs of the operator and the community. In the case of the "M" Train and the "V" Train, it could have been appropriate to analyze them as one route because the two were designed to be complimentary as parts of a package of service changes. Likewise, this method could also be used to do surface analysis in Co-op City. Although, the restructuring of routes in rapid transit is infrequent the future of these types of service planning will likely be analyzed as a combined "package" of changes to account for the complex and interlinked nature of such a system modification.

Despite the scientific methods there is still a qualitative element that operators must heed. Title VI analysis are just tools employed in a multi-lateral communication. It ensures that the operator, the riding public and the government are all on the same page in terms of the effects of service changes on the community.

These methods for analyzing service changes are being developed at a time when Federal government is tightening the Title VI and EJ enforcement machinery through more thorough and detailed audits, promulgation of new rules, and by requiring of transparency and accountability. The FTA has affirmed its position through its Proposed Circulars requiring all transit agencies to consider Title VI and EJ in service and fare changes which are becoming increasingly commonplace. Proper application and further developing the methods discussed in this paper will allow the transit industry to move forward and maintain the balance between providing socially necessary services and upholding fiduciary responsibility. Retaining national core values require transit operators to go back to the basics: listening to the customers that it serves.

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References

(1) Thomas, L.W. and McDaniel, J.B. Reductions in Transit Service or Increases in Fares: Civil Rights, ADA, Regulatory, And Environmental Justice Implications, Transit Cooperative Research Program. *Legal Research Digest 35*. March 2011. Pg 13-14

(2) Garcia, R. Transportation Equity in Los Angeles: The MTA and Beyond. Environmental Defense Fund. *http://www.edf.org/article.cfm?contentID=1238*
Accessed: June 10th, 2011

(3) Ward, B.G. Case Studies in Environmental Justice and Public Transit Title VI Reporting. National Center for Transit Research. University of South Florida. Aug 2005.

(4) Bender, J. and Bell, C. and Hill, B. Title VI: Implementing a Transit Equity Program. DMJM Harris and Maryland Transit Administration. 2007.

(5) Thomas, L.W. Civil Rights Implications of the Allocation of Funds between Bus and Rail. *TCRP Legal Research Digest*. 2007.

(6) Reddy, A.V., T. Chennadu, and A. Lu. Safeguarding Minority Civil Rights and Environmental Justice in Service Delivery and Reductions: Case Study of New York City Transit Authority Title VI Program. In *Transportation Research Records, No.2163*, Transportation Research Board of the National Academies, 2010. TRB Paper #10-1155.

(7) Chan, S. M.T.A. Board Approves Holiday Fares, But Only After Disagreement and Debate. *New York Times*, October 28, 2005.

(8) New York State Department of Labor. Employed, Unemployed, and Rate of Unemployed by Place of Residence for New York State and Major Labor Areas, May 2011. *http://www.labor.ny.gov/stats/pressreleases/prtbur.txt* Accessed: June 1st, 2011.

(9) Holt, A. Women and People of Color Down for the Count in Jobless Recovery. Huffington Post. October 13, 2009. *http://www.huffingtonpost.com/arlene-holt/women-and-people-of-color_b_318672.html* Accessed: June 1st, 2011

(10) United States Department of Labor. Bureau of Labor Statistics. Economic News Release. Employment status of the civilian population 25 years and over by educational *attainment. http://www.bls.gov/news.release/empsit.t04.htm* Accessed: June 1st, 2011

(11) United States Department of Energy. Gas Prices for Cities in New York. *http://www.fueleconomy.gov/feg/gasprices/states/NY.shtml* Accessed: June 1st, 2011

(12) Hickey, R.L., A.V. Reddy, and A. Lu. Using Quantiative Methods in Equity and Demographic Analysis to Inform Transit Fare Restructuring Decisions. In *Transportation Research Records*, Transportation Research Board of the National Academies, 2010. TRB Paper #10-0280.

(14) American Public Transportation Association. Double Digit Rise in Gas Prices Marks Largest Savings in Nearly Three Years - Giving Public Transit Riders Economic Edge. *http://www.apta.com/mediacenter/pressreleases/2011/Pages/110414_TSR_april.aspx* Accessed: June 1st, 2011

(15) United States Department of Health and Human Services. The 2011 HHS Poverty Guidelines *http://aspe.hhs.gov/poverty/11poverty.shtml* Accessed: June 1st, 2011

(16) Roberts, S. Calculating Poverty in New York: More by City Standard, and Less by Federal One. *New York Times*, March 2, 2010.

(17) MTA New York City Transit. *2010 NYC Transit Service Reductions—Revised*. New York, N.Y., March 19, 2010.

(18) MTA New York City Transit. *2010 NYC Transit Service Reductions (Post Public Hearing and Service Restoration)—Title VI and Environmental Justice Analyses*. New York, N.Y., March 24, 2010.

(19) MTA New York City Transit. MTA Guidelines—Service Change Procedures, NYCT Operations Planning Department, Revised June 1, 1985 (Report OP - X85006)

(20) U.S. Department of Transportation. Urban Mass Transportation Administration. Title VI Program Guidelines for Urban Mass Transportation Administration Recipients. May 26, 1988 Circular UMTA C4702.1 Section I-3.

(21) River Bay Corporation. 2011 Housing Application. Updated April 2011. *http://www.riverbaycorp.com/newrb/2011%20application%20effective%206-14-11.pdf* Accessed: June 1st, 2011

(22) Stuttig, B. Benedetto Invites MTA Chairman to Tour Co-op City. *Co-op City Times*. March 26th, 2011.

(23) BX28 Riders say Cuts are Hurting Service. *News 12 The Bronx*. 4/19/2011.