

## Using a Web-Based Longitudinal Panel to Measure Customer Satisfaction

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## ABSTRACT

The benefits of using web-based longitudinal panels for customer satisfaction studies are described based on the experience of such a study for NJ TRANSIT's rail customers. The paper notes numerous benefits of this method over cross sectional studies, including more robust statistics, better understanding of customer satisfaction, and the ability to analyze customer satisfaction trends.

A variety of innovative internet technologies are also described that add value to the study by ensuring data quality, timeliness, reductions in respondent burden, less random error in respondent answers, and techniques to pair qualitative data to quantitative analysis. Online geocoding of respondents' origins and destinations is also described as another aspect of the survey which provides NJ TRANSIT more value from the study.

The paper describes the details of how the study was implemented for NJ TRANSIT and reports on some results as an example of the beneficial aspects of the study design.

## INTRODUCTION

Customer satisfaction studies are conducted by many major organizations, including those who provide transportation services. Typically, customer satisfaction studies are carried out using repeated cross-sectional sampling of customers. Satisfaction scores are compared across these repeated cross-sections. Differences in satisfaction scores resulting from perceived changes in service are measured, but the measurement is confounded in part by differences between the cross-sectional samples. Demographic differences can be accounted for by weighting the samples so that they are equivalent, but there are significant differences in satisfaction scores between individuals that are not explained by demographic or other easily-measured characteristics. The result is that relatively large samples are required to measure changes in customer satisfaction over time.

Longitudinal panels offer a potentially attractive alternative to repeated cross-sections for measuring customer satisfaction. Measuring changes in satisfaction of the same individuals from one period of time to another eliminates the confounding caused by variations between the different individuals in repeated cross-sectional samples (*1*). The result is that the sample sizes required to measure differences in customer satisfaction can be much lower in panel surveys. In addition, panels provide opportunities to directly determine the reasons for those changes.

Longitudinal panels can be administered using a variety of methods. For transportation studies, intercept recruiting is an efficient approach to assembling panels. Although telephone and mailout/mailback instruments are commonly used, web-based instruments can be a highly cost-effective alternative for many applications. Web access has increased significantly across the population and it is possible to construct demographically-representative panels from among those who have web access. In addition to their cost-effectiveness, an important advantage of using web instruments with panels is that the time required to complete and analyze data from a survey wave can be dramatically reduced.

The work described in this paper is a web-based longitudinal panel survey developed for NJ TRANSIT's commuter rail customers. It was designed to be a continuous survey, providing monthly data on customer satisfaction. It uses web-based technologies to invite respondents from one of three panels each month and to administer a customer satisfaction survey. The resulting survey data monitor customers' concerns on a monthly and even daily basis, as study data are continually being received from respondents throughout each month.

Web-based survey technology allows for great flexibility in obtaining both quantitative customer satisfaction responses, such as typical satisfaction scores, and qualitative responses, such as written answers to open-ended questions which are used to explain why quantitative scores have changed. This is a critical part of the study because the reasons for change in satisfaction scores can be quickly understood when they are paired directly to responses from open-ended questions.

Advanced web-based survey technologies also allow for a number of innovative features that improve data integrity and currency. These features include online geocoding of origin and destination data, automatic updating and querying of train schedule data so that respondents can select only valid trains in their surveys, and full validation of responses to questions. Web-based longitudinal panel survey instruments can be designed in ways that minimize respondent fatigue. This is accomplished using a number of techniques that, for example, require respondents only to confirm that various aspects of their travel have not changed since their previous survey.

## **BACKGROUND**

The NJ TRANSIT ePanel Customer Satisfaction Study was conducted to provide continuous monthly and quarterly tracking of NJ TRANSIT commuter rail riders' satisfaction along 65 satisfaction measures. These measures had previously been tracked in surveys conducted less than annually using cross-sectional sampling with handout/handback paper questionnaires.

The ePanel study measures rail customers' satisfaction scores in what NJ TRANSIT calls "functional areas," which include questions related to parking, boarding stations, destination stations, train scheduling, and customer service. The survey also measures "key-driver areas," which include on-time performance, personal security, employee performance, fares, and mechanical reliability. The study provides the ability to segment the customer satisfaction measures based on different train lines, destination markets, customer demographics, stations, etc.

NJ TRANSIT's ePanel was designed to answer specific questions about commuter rail customers on a continuing basis:

- What are the trends in customer satisfaction and what factors influence these trends?
- On which train lines within the NJ TRANSIT system is customer satisfaction changing? In what direction are these changes, how big are the changes, and why are they occurring?
- What are customers' main concerns? Where does NJ TRANSIT need to improve?
- Where are customers satisfied? What performance does NJ TRANSIT need to maintain?

To address these questions, a longitudinal panel study plan was developed in July 2002 that was driven by a monthly survey that began in September 2002. This survey collected customer satisfaction data every month from one of three separate customer panels (Table 1), which were each comprised of approximately 4,000 participating respondents. Each panel respondent was surveyed four times a year at three-month intervals, giving NJ TRANSIT new monthly customer satisfaction data throughout the year and allowing them to track customer satisfaction trends and customer origin and destination patterns. Respondents were asked to take a survey only once every quarter, reducing respondent fatigue and also giving respondents enough time between survey waves to notice service changes.

Table 1--Panel/Wave Structure

Month	Panel			Wave
	1	2	3	
Sep-02	Survey			1
Oct-02		Survey		
Nov-02			Survey	
Dec-02	Survey			2
Jan-03		Survey		
Feb-03			Survey	
Mar-03	Survey			3
Apr-03		Survey		
May-03			Survey	
Jun-03	Survey			4
Jul-03		Survey		
Aug-03			Survey	

The panel structure shown in Table 1 enables the study to provide longitudinal satisfaction analysis of the same respondents every four months. This is a very powerful aspect of the study because the changes over time for each respondent vary only due to that respondent's change in satisfaction, and not due to cross sectional differences or use of different personal rating scales between respondents. This is called a "matched pairs" statistical design and can only be used in longitudinal studies by definition:

Pairing involves matching up individuals in two samples so as to minimize their dissimilarity except in the factor under study. For example, in pre-test/post-test studies, each subject is paired (matched) with himself, so that the difference between the pre-test and post-test responses can be attributed to the change caused by taking the test, and not to differences between the individuals taking the test (2).

The above definition describes the type of sampling design used for this web-based longitudinal study; in this case the "test" is the experience of riding NJ TRANSIT trains for the previous three months.

The actual study process consisted of recruiting respondents into a central database using a variety of methods. Once respondents' names, email addresses, and sample information (boarding station, alighting station, frequency of use) were in the main database, they were assigned to one of the three panels discussed above and sent a survey invitation at the appropriate time for each of their four surveys.

## THE WEB-BASED SURVEY INSTRUMENT

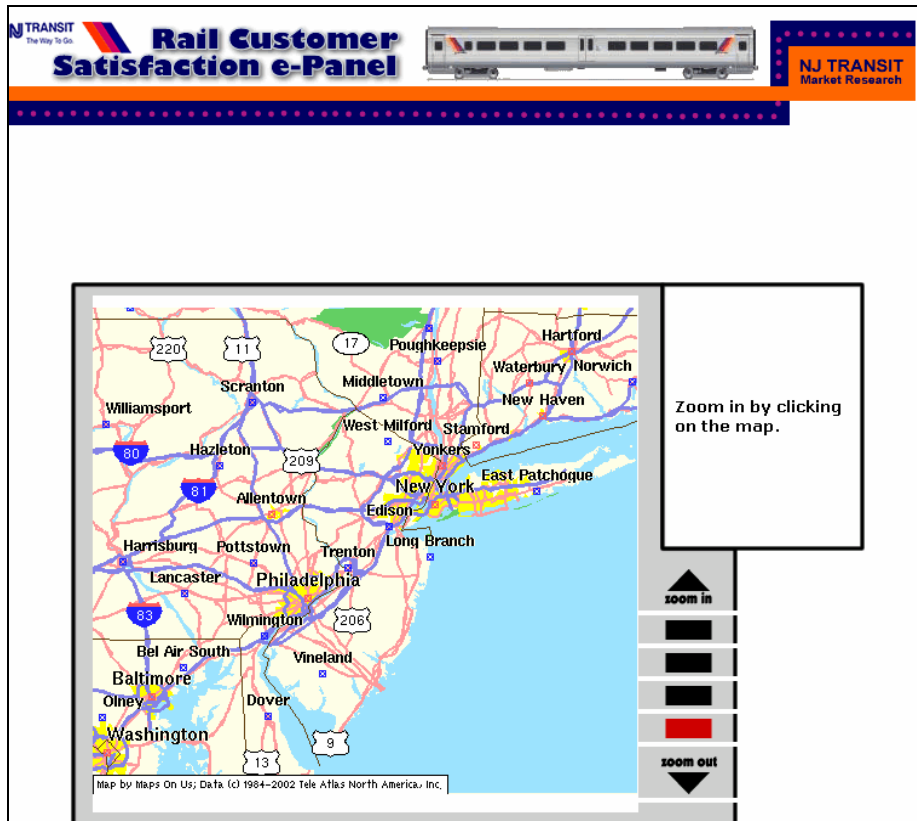
The survey uses a web-based, multi-paneled, and multi-waved customer satisfaction questionnaire which has a number of sections. The questionnaire first obtains background information about respondents' current NJ TRANSIT travel, then the survey presents 65 customer satisfaction attributes for respondents to rate. It continues by asking general customer satisfaction questions (would you recommend NJ TRANSIT to a friend, etc.) and also determines respondents' origin and destination locations, and ends by asking additional background questions and demographics.



## Origin-Destination Data Collection

An important part of the study for NJ TRANSIT was to obtain origin and destination data. To accomplish this, respondents are asked to geo-locate their origin address by using a point-and-click map, a street address, a business name, or an intersection search. A screen shot of the map search is shown below (Figure 2).

Figure 2--Map Search Screen in the Rail ePanel Survey



The location of the respondent's final destination is collected by similar means. Regardless of the type of geo-location search used (map, address, business, or intersection), a latitude and longitude for each origin and destination is determined. These are then automatically coded into the proper NJ TRANSIT transportation analysis zones ("TAZs") using an online point-in-polygon routine. Therefore, NJ TRANSIT receives immediate real time access to fully coded origin-destination data with TAZs already attached to the data.

Another important function of the survey is determining what train the respondent rides. This task is more difficult than it might appear, because information about the respondent's current trip must be obtained in order to know what schedule to display. Respondents are asked the appropriate questions to classify them into four categories: frequent weekday rider, frequent weekend rider, infrequent weekday rider, and infrequent weekend rider. Once the respondent type is known, the survey then asks the respondent what train they used and then displays only the relevant trains for their station and day of week (Figure 3).

Figure 3--Schedule Page in the Rail ePanel Survey

**TRANSIT**  
The Way To Go

**Rail Customer Satisfaction e-Panel**

**NJ TRANSIT**  
Market Research

Which train do you usually board at Woodcliff Lake Station for a typical weekday trip?

(Please select from the list below. If you can't find your train in the list below, pick the train nearest the time you travel. You may need to scroll down to see the whole list.)

	Departure Time	Train Number
<input type="radio"/>	5:54 AM	1600
<input type="radio"/>	6:26 AM	1602
<input type="radio"/>	6:55 AM	1604
<input type="radio"/>	7:22 AM	1606
<input type="radio"/>	7:39 AM	1608
<input type="radio"/>	7:51 AM	1610
<input type="radio"/>	8:18 AM	1612

next

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or email [epanel@rsginc.com](mailto:epanel@rsginc.com)

How can 2 cents improve our transit system?  
When it's your 2 cents!

### Anchoring

The differences between a respondent's first survey and their subsequent surveys are subtle, but important, and serve three main purposes: 1) to deliver respondents more efficient second, third, and fourth surveys by asking them only to confirm answers from their previous surveys when the answers are unchanged (Figure 4); 2) to use "anchoring" so respondents know how they rated satisfaction measures in the previous survey wave, helping them make new judgments based on their previous answers; and 3) to ask respondents "drill down" questions that request a written explanation of rating differences between the previous and current survey.

Figure 4--Example of Confirmation Page in the Rail ePanel Survey

**NJ TRANSIT**  
The Way to Go

**Rail Customer Satisfaction e-Panel**

**NJ TRANSIT**  
Market Research

The last time you were in e-Panel, you described the following weekday trip:

- Departure time: **6:23 AM**
- Departure station: **Park Ridge**
- Destination station: **Teterboro**
- Line: **Pascack Valley Line**
- Direction: **Towards Hoboken**

Before we continue, do you currently make the same kind of trip?

Yes

No, I still ride NJ Transit trains, but my travel patterns have changed  
Please specify why your travel patterns have changed:  
 (e.g., changed jobs, moved, etc.)

No, the information about my trip is incorrect

No, I have stopped riding NJ Transit trains

**next**

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How can 2 cents improve our transit system?  
When it's your 2 cents!

“Anchoring” is a technique used in the second, third, and fourth survey waves to enable respondents to see how they previously rated their customer satisfaction attributes (Figure 5). Anchoring is used to ensure that a changed answer is in response to a change in service, and not because the respondent has forgotten how they previously rated the service. Respondents are focused on the change in service, reducing the random error in the measurement of this change.

Figure 5--Example Screen showing "Anchoring" functionality: Arrows indicate the rating given in the previous survey wave

**indicates what you answered the last time you were in e-Panel.**  
**How do you rate your parking experience at Park Ridge Station?**

	N/A	0	1	2	3	4	5	6	7	8	9	10
Parking space availability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Parking lot lighting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Parking fees	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ease of parking payment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
OVERALL RATING OF PARKING	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

next

### Drill Down Questions

“Drill downs” are open-ended questions that are asked to determine the reasons for a respondent’s change in satisfaction ratings. Drill downs provide the unique longitudinal ability to ask respondents a qualitative question that is directly related to a changed rating score. The differences between the 65 satisfaction scores from each respondent’s previous survey and their current survey are calculated and the ten largest differences in satisfaction scores are determined (differences can be both positive and negative, so absolute value is used). If there are ties, then enough satisfaction questions to obtain up to ten are randomly selected. If there are fewer than ten differences (i.e. if the respondent did not change their answer in ten or more questions from their previous survey), then only those differences that do exist for that respondent are shown. Once the ten questions with the highest absolute differences are determined, respondents are asked why they changed their answers to these questions using open-ended comment boxes (Figure 6). Again, changes can be either positive or negative, as NJ TRANSIT wants to understand both what is working and what is not.

Figure 6--Drill Down Questions Screen in Rail ePanel Survey

**TRAINSIT** **Rail Customer Satisfaction e-Panel** **NJ TRANSIT**  
 Please tell us why you feel differently about the 10 issues listed below. Click 'next' when you are ready to continue. PLEASE NOTE, you may need to scroll down to the 'next' button.

Your rating for *Parking space availability at Mountain View Station* went from 1 to 7. Please tell us why your answer has changed so we can continue to work on improving service.

Your rating for *Overall rating of Mountain View Station* went from 3 to 9. Please tell us why your answer has changed so we can continue to work on improving service.

Your rating for *Overall safety* went from 1 to 6. Please tell us why your answer has changed so we can continue to work on improving service.

Your rating for *Overall personal security* went from 1 to 5. Please tell us why your answer has changed so we can continue to work on improving service.

Your rating for *Parking fees at Mountain View Station* went from 1 to 5. Please tell us why your answer has changed so we can continue to work on improving service.

Your rating for *Cleanliness on-board NJ TRANSIT's trains* went from 4 to 0. Please tell us why your answer has changed so we can continue to work on improving service.

Your rating for *Frequent, timely announcements at Mountain View Station* went from 3 to 7. Please tell us why your answer has changed so we can continue to work on improving service.

Your rating for *Overall rating of NJ TRANSIT's public communication* went from 0 to 4. Please tell us why your answer has changed so we can continue to work on improving service.

Your rating for *Overall rating of NJ TRANSIT's trains* went from 5 to 9. Please tell us why your answer has changed so we can continue to work on improving service.

Your rating for *Parking lot lighting at Mountain View Station* went from 1 to 5. Please tell us why your answer has changed so we can continue to work on improving service.

The results of the drill down questions are revealing as they are related directly to the changes in satisfaction scores. For example, it was noted in the data that a significant drop in on-time performance occurred during the months of December 2002 to February 2003 on the Northeast Corridor Line, likely due to a scheduling change from the addition of the Montclair-Boonton Line. Using one of the many web reporting tools in the study, NJ TRANSIT staff could understand why respondents indicated this drop in score. This tool can be used to segment drill-down answers by peak/off-peak, line, train number, wave number, and origin or destination stations (Figure 7). It should be noted that on-time performance improved from wave 2 to wave 3 in the study, rebounding after NJ TRANSIT corrected the problem (the understanding of the problem was developed, in part, from this study) (Figure 8).

Figure 7--Drill Down Results Screen, On-time Performance Comments on NEC Wave 2

The screenshot shows the NJ TRANSIT Rail Customer Satisfaction e-Panel interface. At the top, there is a header with the NJ TRANSIT logo and 'Market Research'. Below the header, a dropdown menu is set to 'wave 2 (Dec 02 - Feb 03)'. A search field is labeled 'SEARCH COMMENTS FIELD:' with a 'Search' button. Below this is a 'QUERY DATABASE:' section with filters for 'Question', 'Line', 'Peak/OffPeak', 'Boarding', 'Destination', and 'Train #'. The 'Question' filter is set to 'On-time performance at boarding station', 'Line' is 'NEC', and 'Peak/OffPeak' is 'ALL'. The 'Boarding' filter is 'ALL', 'Destination' is 'ALL', and 'Train #' is 'ALL'. A 'Search' button is at the bottom right of the filter section.

Change from last survey	Current score	Drill Comment
-10	0	service delays
-8	0	Since before Thanksgiving 7:46 train is late almost every day, often as much as 20 minutes late. I haven't made it into work on time for 2 months now. I noticed a lot of commuters from the 7:46 now have to catch the earlier 7:22
-8	1	Because most services from NYP to Hamilton after 6 pm are late by 5-10 mins on the average.
-7	0	During Nov. and Dec. it has been a rare day when that train is not at least 10 minutes late and on a few occasions it has been 45 minutes late. We went from leaf problems to just not running at all. You can bet your money that the train is late 4 out of 5 days. This is not acceptable.
-7	0	Trains run far behind schedule every day of the week.
-6	0	This past 2 to 3 weeks, all the train was late 5-10 minutes almost every single day. Once train comes, slow going especially in bound train before the tunnel.
-6	2	During morning rush hour in cold weather trains are almost always delayed. This puts more pressure on seat availability and longer wait times on the platform. While on-time performance during cold weather may be subject to switchgear

A callout box points to the 'Drill Comment' column with the text: *These are specific NEC comments for on-time performance*

Done

*More positive comments in this wave for NEC on-time performance*

**Figure 8-Drill Down Comments for On-time Performance on NEC Wave 3**

5	5	Because trains are no longer consistently late.
5	6	Recently I have noticed that the train I take at 8.58 am is on time most of the time and it is reaching Penn station, NY at the scheduled time of arrival. This has improved my commute.
5	8	The on time performance has improved for my train over the last couple of month at Princeton Junction
5	5	The morning train (8:00am leaving MetroPark) is about 80% on time
5	6	The trains are coming more on time now. Still a few minutes late, but better than 6 months ago. However, this answer might be scewed due to the fact that it is good weather now.
5	5	Most of the days, the trains run on time and arrive destination without significant delays. The delays are usually rare these days.
5	8	The 4:36 train is now changed to 4:31 and is almost always on time. The change helps the commute
5	8	In the last few months, the trains have rarely been delayed
5	8	Trains have lately been arriving and departing from Princeotn Junction, at least from my observations, right on time. I have noticed that there are still delays for peak direction travel, however.
5	7	The trains have actually been on time lately. Maybe 1 or 2 instances of minor delays.
5	10	YOU TELL ME? TRAINS ARE RUNNING LIKE CLOCKWORK! GOOD JOB!
6	9	Majority of arrivals and departures are on time compared to too many in delays the past.
7	8	on time performance has dramatically improved since the last survey. trains have only been late may be twice in the past month due to singal issue.
9	9	The 7:48 a.m. departure went from almost always late to almost always on-time

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### SURVEY SAMPLING AND ADMINISTRATION

The survey sample was designed to be representative of NJ TRANSIT’s commuter rail customers. Previous research had indicated that web availability among those customers was over 90%. While it would have been possible to provide web kiosks in the train stations to allow universal access to the survey, sample weighting was used instead to ensure that the sample was representative of the customer population.

The sample was recruited using rail station intercepts. A marketing campaign was conducted in August 2002 by NJ TRANSIT in advance of the field intercept work. The purpose of the marketing was to develop interest among riders in the study and to attract respondents. NJ TRANSIT publicized the study with posters on the trains and in stations, “seat drops” of informational materials on trains, crew announcements made on trains and in stations, and a press release to local newspapers. NJ TRANSIT’s communication department developed the marketing campaign called “2-cents” and produced graphics that were included in the posters and seat-drop pamphlets with web site contact information (Figure 9).

**Figure 9-- Marketing Graphic for the Study**



### **Sample Plan**


The entire study recruitment database was split into three panels, consisting of approximately 9,000 recruits each, from across the entire NJ TRANSIT rail system. The sample plan was developed using ridership data from a 1999 study of rail riders conducted by NJ TRANSIT. These ridership data were adjusted to provide weekend ridership and to account for stations added since 1999.

Based on the ridership and variance data from this 1999 study, the number of completes required per station to obtain 95% confidence plus or minus 5% error for satisfaction measures for each train line in the study was calculated. For most train lines with ridership over 5,000, a sample of 390 per panel was used. The 390 represented a sample that was known to obtain 95% confidence plus or minus 5% error based on the 1999 study's variance statistics. However, some lines with small ridership require smaller samples, such as the Atlantic City line and the Montclair-Boonton Line.

### **Sample recruitment methods**

Panel members were recruited throughout the entire NJ TRANSIT rail system covering all lines at all train stations and on-board trains during the first three weeks of August 2002. Potential panel members were recruited using targeted goals for respondents at each train station in the system, based on system ridership. The recruiters distributed 60,000 hand-out—hand-back recruitment surveys in stations, on the platforms, and on-board the trains. These short surveys asked for name, email address, day and evening telephone numbers, boarding station, frequency of NJ TRANSIT travel, and whether the traveler's destination station was New York Penn Station (Figure 10).

Figure 10--Hand-out—Hand-back Recruitment Survey



Market Research  
One Penn Plaza East, Newark, NJ 07105

**Dear Rail Customer,**

***If you would like to participate on our e-Panel please fill out this form and return it to the recruiting agent on-board this train....***

Name: \_\_\_\_\_ Email address: \_\_\_\_\_

Day phone: \_\_\_\_\_ Evening phone: \_\_\_\_\_

***(Please write clearly and give us complete information so we can contact you. Thank you.)***

How many round trip trips do you make on NJ TRANSIT trains?

4 or more round trips per week       1 round trip in 2 months

1-3 round trips per week       Less than 1 round trip in 2 months

1-3 round trips per month

From which station did you board this train? \_\_\_\_\_

Are you going to New York Penn Station?       Yes       No

**For information call: 1-866-3TAURUS, or, visit our website and click: [www.surveycave.com/epanel](http://www.surveycave.com/epanel)**

The recruiter noted the station and/or train number to verify the information. Anyone interested in joining the study could quickly fill out the brief survey and return it to the recruiter. These completed surveys were then input into the centralized project database via an online recruitment web site.

Direct online registration was also available for train riders through the study recruitment web site (<http://www.surveycave.com/epanel/>), whose web address was printed on all flyers, recruitment surveys, and posters on trains and in stations. Respondents could go online directly and complete a small screener/recruitment survey with questions similar to those on the flyer: name, email address, day and evening telephone numbers, boarding (Figure 11) and destination stations, frequency of NJ TRANSIT travel, train number based on NJ TRANSIT's schedule.

Figure 11: Study Recruitment Boarding Station Web Page



### NJ TRANSIT Employee Survey

All NJ TRANSIT employees were also invited to participate in the study in order to compare employees' attitudes and opinions to customers' attitudes and opinions. All NJ TRANSIT employees were sent a generic email which invited them to click on a web link. When they clicked on the link, they arrived at a screen which asked them their first name, last name, and email address (which did not have to be an NJ TRANSIT email address) and they proceeded through the survey. Anyone coming into the survey through this site was flagged as an NJ TRANSIT employee.

### Tracking pages for sample quotas

A web-based quota-tracking site was created so that the recruiters and NJ TRANSIT staff could track the quotas for each station and line in real time (Figure 12). From August 25 to August 29 recruiters returned to field at various stations where response was below target. At the beginning of October the panel target figures were reviewed once more and on October 1, 7, 8, and 10, recruiters made the final effort to bring specific stations on the Raritan, M&E, and Atlantic City lines up to meet targets. Over 27,000 panel members were recruited and divided into three panels.

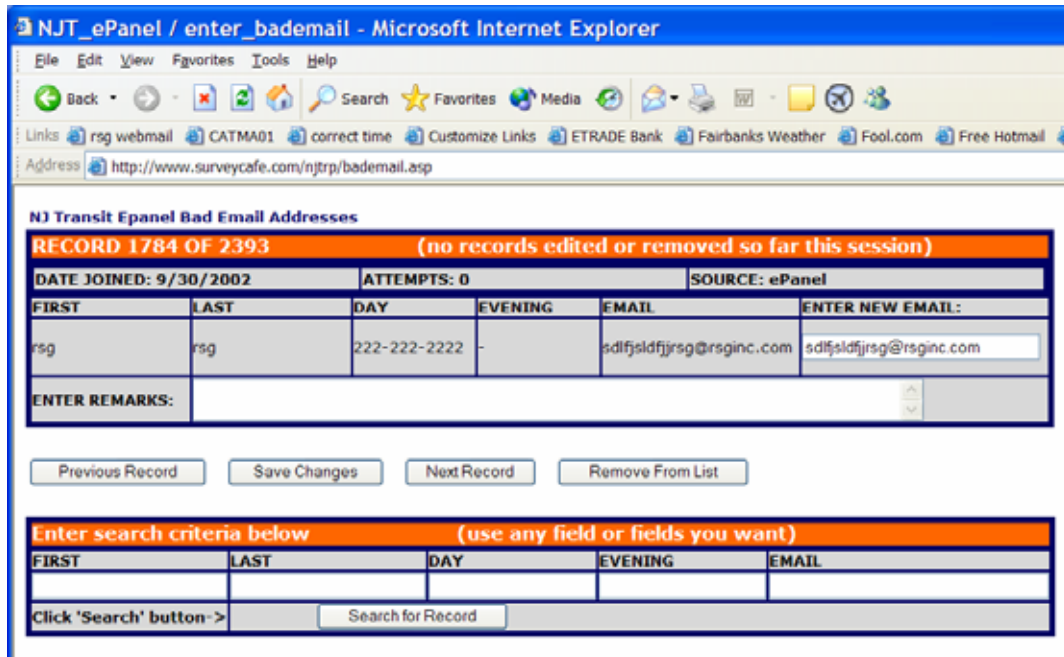
Figure 12: Recruitment Tracking Page (Market page)

	PEAK FREQUENT		PEAK INFREQUENT		OFF-PEAK FREQUENT		OFF-PEAK INFREQUENT		WEEKEND		TOTALS	
	To Date	Goal	To Date	Goal	To Date	Goal	To Date	Goal	To Date	Goal	To Date	Goal
Atlantic City Line All Destinations	96	367	57	72	72	407	115	275	190	436	530	1557
Morris & Essex to NYPS	1111	2029	189	78	491	440	263	261	137	702	2191	3510
Morris & Essex NOT to NYPS	664	2003	88	40	255	638	85	124	66	702	1158	3510
Bloomfield/Mountclair to NYPS	174	269	34	3	1	15	3	10	0	0	212	297
Bloomfield/Mountclair NOT to NYPS	570	1749	75	25	12	20	6	7	3	0	671	1800
Raritan Valley Line to NYPS	1045	1658	222	52	229	303	59	168	214	545	1829	2727
Raritan Valley Line NOT to NYPS	773	2212	119	38	150	443	34	114	119	702	1155	3510
NJ Coast Line to NYPS	1481	2079	316	73	443	368	192	287	369	702	2001	3510
NJ Coast Line NOT to NYPS	763	2326	108	32	248	359	40	91	105	702	1264	3510
Northeast Corridor to NYPS	3026	2719	839	144	1104	1098	796	719	1280	1170	7045	5850
Northeast Corridor NOT to NYPS	766	1890	199	50	392	633	218	235	214	702	1729	3510
Main Bergen-Pascack All Destinations	3227	3078	318	32	428	225	122	35	162	140	3267	3510
<b>TOTALS:</b>	<b>12787</b>	<b>22779</b>	<b>2576</b>	<b>639</b>	<b>3621</b>	<b>4949</b>	<b>1935</b>	<b>2328</b>	<b>2821</b>	<b>6503</b>	<b>24046</b>	<b>36801</b>

Sample recruitment management of email database

As soon as a panel member was added to the study database, an automated welcome email message was sent to that person. Some welcome messages were undeliverable due to inaccurate email addresses. Any returned emails were deemed “bad emails” and were automatically flagged in the project database for correction. During the month of September attempts were made to correct any “bad email” addresses by calling the telephone numbers provided by the panel members on their original flyers. An attempt was made to correct all “bad emails” for those respondents who did not include phone numbers by searching for obvious address problems. All records with failed email addresses could be accessed by using a “bad email” web page (Figure 13) that queried the database. Then, a revised address was input into the web page, the database was updated, and another attempt to contact the potential respondent with the new email address was made.

Figure 13: Email Correction Page



Response to the survey was quite good. Of the 27,000 recruited names, well over half completed their first survey (51% response). The study is ongoing, but the total attrition rate is approximately 40% in total across all survey waves. This attrition rate compares favorably to other transportation panel studies of similar magnitude (1).

The sample was weighted and expanded to represent boarding counts by line at each station for the peak, off-peak, and weekend periods.

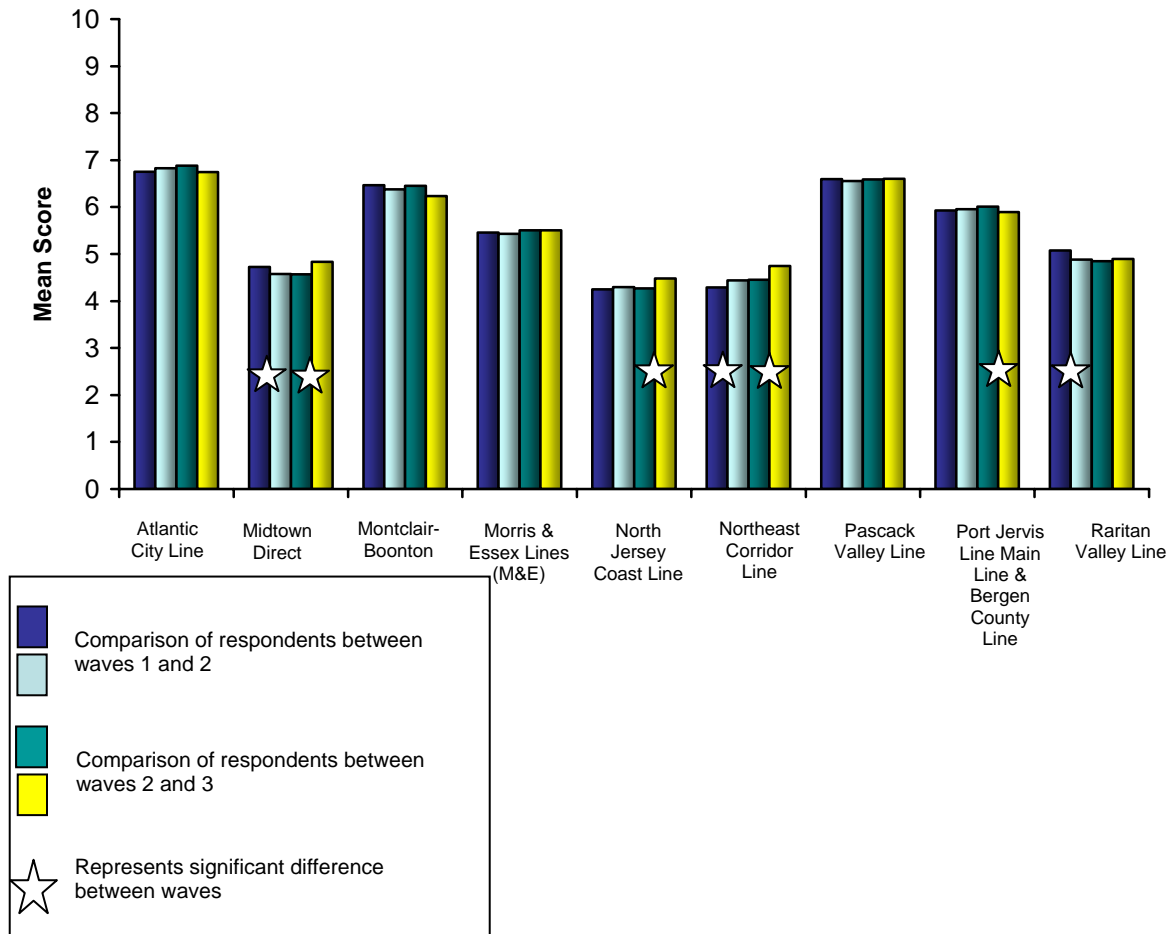
## ANALYSIS

There are many different statistical analyses one can conduct on customer satisfaction panel data. For the NJ TRANSIT rail system, these analyses included statistically comparing satisfaction levels by train line, comparing satisfaction attributes to each other to see which attributes have the lowest or highest satisfaction, performing quadrant analysis, perceptual mapping, and a host of other analyses.

However, the most important analysis for customer satisfaction for NJ TRANSIT's study is comparing the mean satisfaction scores of each line over time. This analysis leverages the matched pairs test that has been described earlier and uses the drill down comments to determine the causes of changes in satisfaction scores.

For example, the comparison of scores across lines by wave (over time) chart indicates that the satisfaction level for the Midtown Direct line's seating availability declined from wave 1 (September 2002 through November 2002) to wave 2 (December 2002 to February 2003). Based on this analysis, NJ TRANSIT could see that customers were becoming dissatisfied with the seating on the line, which was overcrowded (Figure 14).

Figure 14-- Seating availability on-board NJ TRANSIT's trains



The comments from Midtown Direct line respondents clearly describe why this score went down from wave 1 to wave 2 (Figure 15).

Figure 15--Midtown Direct Wave 1 to Wave 2 Seating Availability Comments

<p>On the afternoon before the Thanksgiving holiday and for the last two weeks in December, the 3:17 train has frequently been standing room only. Several times, passengers had to stand in the vestibule because there was no room inside the cars. This is an off peak train. At the very least, a seat should be available for every passenger who wants one.</p>
<p>Standing room only on the way home on the 6:08 from Penn to Chatham.</p>
<p>New trains seats are not as wide or as comfortable</p>
<p>Not as many cars on the 8:41am leaving Summit</p>
<p>The car becomes overcrowded by the time we reach Penn Station.</p>
<p>It appears that the 7:29 AM Train from Summit to NY Penn has fewer cars now. This has caused overcrowding on the train and fewer seats for the riders. I hear complaints from passengers about this on a daily basis.</p>
<p>Trains have been more crowded</p>
<p>Although there are ample seats when I board the train in Morristown, the west-bound rush hour trains from NYP are getting increasingly crowded.</p>
<p>Trains have become more crowded. There have been new cars added to the trains but passengers are not always allowed to sit in them.</p>
<p>The 6:08 Express train leaving Penn NEVER has available seating. I find myself taking the 6:17 local because I don't want to have to stand for 40 minutes before arriving at the first stop. It's absolutely insane that my options are to take a later local train or pack in like a sardine on the express.</p>
<p>You can't even get a seat anymore on the 6:08 pm train out of Penn Station. Its ridiculous.</p>
<p>My rating of five was a mistake. The seating availability is AWFUL! There are never any seats on the train!</p>
<p>Practically every day, people are standing coming from New York. More trains are needed.</p>
<p>Seating availability has declined tremendously on both the inbound (8:02 am) train and on the out-bound. Any train departing Penn station has a minimum of 20-40 passenger standing at all times, while many inbound passengers on the 8:02 (Chatham departure) have to stand from South Orange and many more from Broad Street. It seems to me that there has been a general decline in service since the Montclair branch was added to the Midtown Direct service.</p>
<p>Increased competition for seats</p>
<p>Due to lateness of train arrivals, the trains have been very overcrowded. Several times I have stood the whole way and often in the vestibule. Trains have been so</p>

As can be seen, seating availability improved significantly from wave 2 to wave 3 (Figure 16). The drill down comments for wave 2 to wave 3 describe respondents' perceptions of the changes (Figure 16).

**Figure 16-- Midtown Direct Wave 2 to Wave 3 Seating Availability Comments**

Holding the last 2 cars for So. Orange passenger's has provided more reliable seating at this stop. Crowding to get onto these two cars is a problem but at least there are seats.
Seems as though I haven't had to stand as much lately - especially in the mornings. I seem to get a seat on most days - this is VERY important to me!
morning train does not have standees anymore - evening train is still crowded
Switched to old equipment with more seats
Whereas, i almost never got aseat on the morning train--the newer trains either have more seats or the seats they do have are configured differently. There seems to be more room in the morning and in the past month or so, I have been able to get a seat everyday which was nearly impossible prior to that.
Everything seems to be a little bit better these days.
I have noticed more seats available since additional cars have bee added to trains recently.
It would appear a car has been added on the inbound train.
Change seating preference from front to back
The trains I have been taking from Millburn to the city now have seating where they were standing room only. Outbound from the city off and early peak have also had seating with empty seats.
My morning train now begins at Summit. SInce I am the second stop I always get a seat.
Not using newer cars.
Same as above
See answer above
The *: 33 AM , which is now the 8:25AM has ample seating . The trip is much more comfortable. You get a gold star for this one.
Most of the time comming home lately I've been getting a seat on the train.
there happened to be more availability b/c there were less people on the trains at the times I was traveling.
I an able to find a seat most mornings now on the train.
There seemed to be more seats available on my past couple of trips into the city and back to NJ as well.
Theres seems to always be a seat but conducters only used to open some cars in front of train which sometimss ment you had to run to board the train or you

This example shows how the data can be used to take concrete actions in a timely manner. It uses both rating measurements and open-ended comments to both identify an issue and to determine the type of action that precipitated that issue. One can see in the comments how NJ TRANSIT addressed the problem and how this improved customer satisfaction (“I seem to get a seat on most days – this is VERY important to me!”).

**CONCLUSION**

Web-based longitudinal panel studies provide timely, statistically robust, and relevant data for customer satisfaction studies. They can use innovative techniques to minimize respondent fatigue and attrition and can provide a valuable data to customer-oriented transportation service organizations. Studies of this type monitor the pulse of customers on a continuing basis, and give transportation organizations the tools and analysis they need to make informed decisions and implement actions based on customer input.

## REFERENCES

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