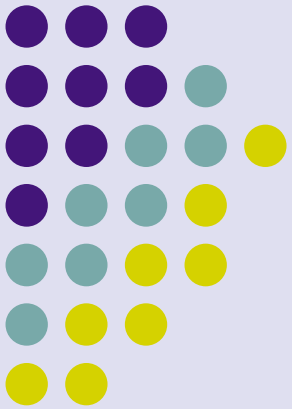
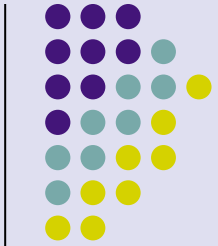
Newark-Elizabeth Rail Link

Bill Woodford
AECOM



Newark-Elizabeth Rail Link

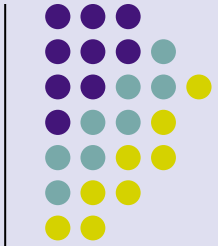
The Big Picture



- Full data archive of input data, control files, modeling software, and operating system allow analysis of results
- Discrepancy between forecasted and actual ridership largely explained by (thus far) partial implementation of operating plans
- Model was carefully calibrated to individual markets and resulted in forecasts patterns (with actual operating plan) that largely match observed patterns
- Forecasters benefit from revelation that models were generally accurate

Newark-Elizabeth Rail Link

The Overall Program

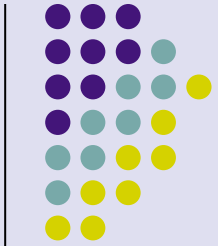


- An element of the NJ Urban Core Program
  - Exempt from New Starts evaluation
  - Subject to NEPA
  - Emphasis on conservative (high) assessment of environmental impacts
- Two projects
  - Hudson-Bergen LRT
  - Newark-Elizabeth Rail Link
- Two forecasting models
  - Hudson River Waterfront Model
  - Newark Elizabeth Rail Link Model

Hudson-Bergen LRT

- Segment 1: Hoboken South to 34th Street in Bayonne
- Segment 2: Hoboken North to Tonnelle Avenue and 34th Street South to 22nd Street

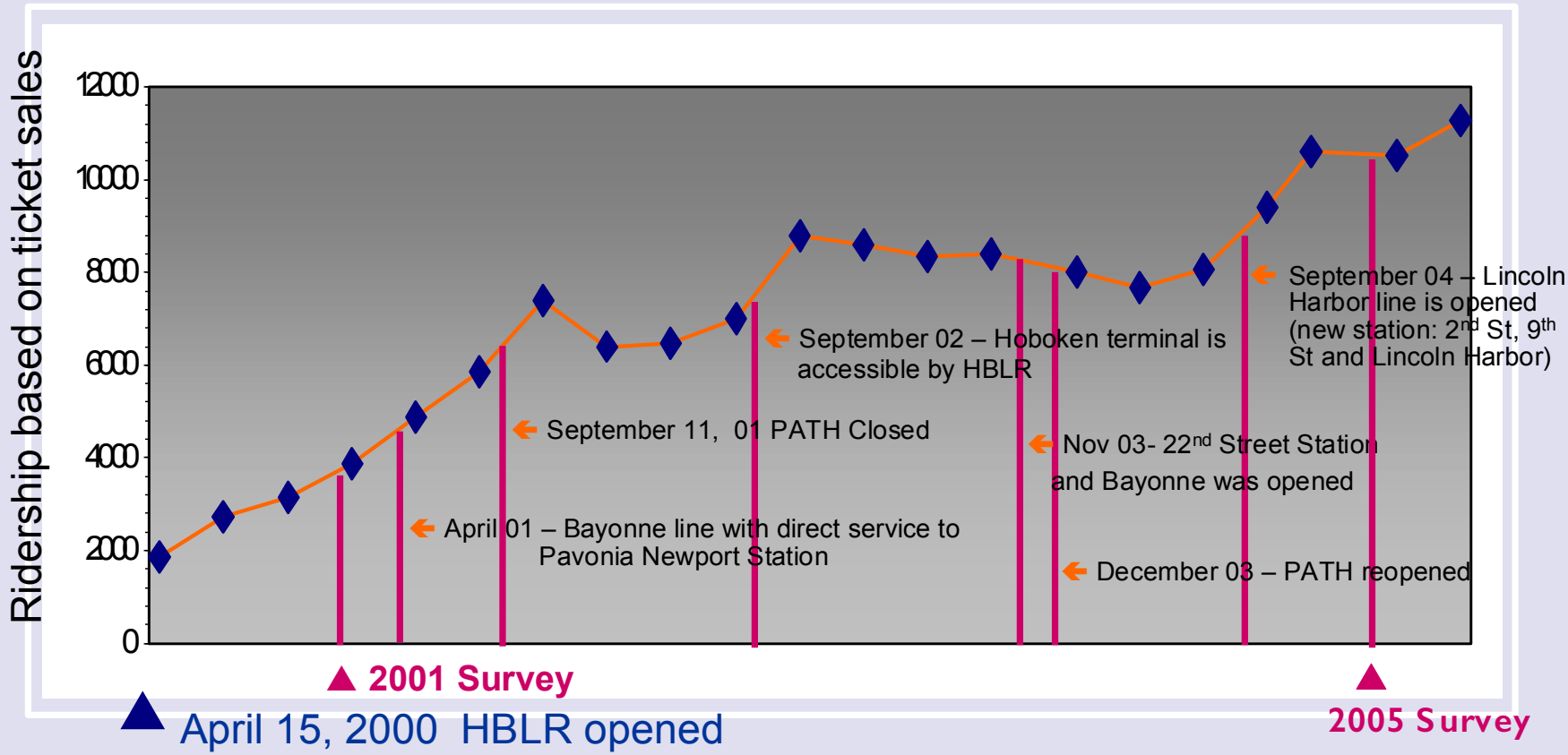
Hudson-Bergen LRT



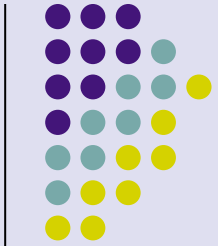
- Segment 1
  - Full operation began September 2002
  - Percent of 2010 weekday ridership achieved: 60%
- Segment 2
  - Full operation began February 2006
  - Percent of 2010 weekday ridership achieved: 50%
- Factors affecting ridership
  - Loss of 115,000 jobs in Lower Manhattan
  - Private carriers not providing feeder service
  - Underground connection to Newport station not build
  - Actual peak frequency: 10 minutes (vs. 6 minutes in model)
- Outlook
  - Redevelopment of Lower Manhattan spurred by Freedom Tower
  - New Staten Island to LRT feeder route
  - Strong Jersey City residential growth

Hudson-Bergen LRT

Ridership History



Hudson-Bergen LRT
After Analysis

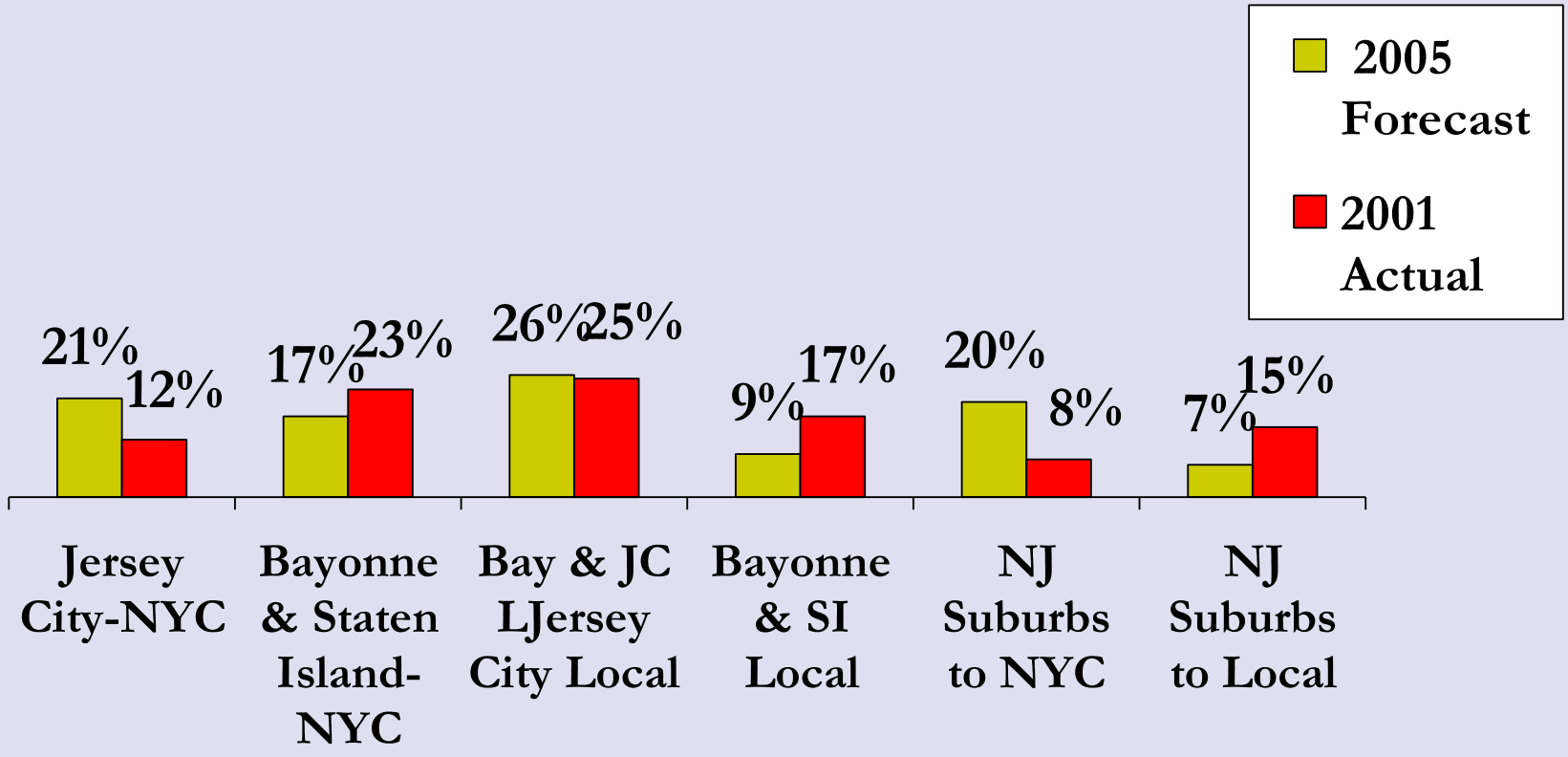


- Based on 2001 and 2005 rider surveys
- Key finding is the HBLR service two different markets:
  - Local Hudson County trips to downtown Jersey City and Manhattan accounted for 70% of riders in January 2001
  - Regional park-ride acting as remote parking for suburban area trips primarily destined to downtown Jersey City and Lower Manhattan accounted for 30% of rides in January 2001
- Share of market to Manhattan declined from 2001 to 2005:
  - Lower Manhattan impacts of 9/11
  - Growth in service to intra-New Jersey markets

Most of regional park-ride occurs at Liberty State Park, some (Staten Island) at 34th street.

Hudson-Bergen LRT

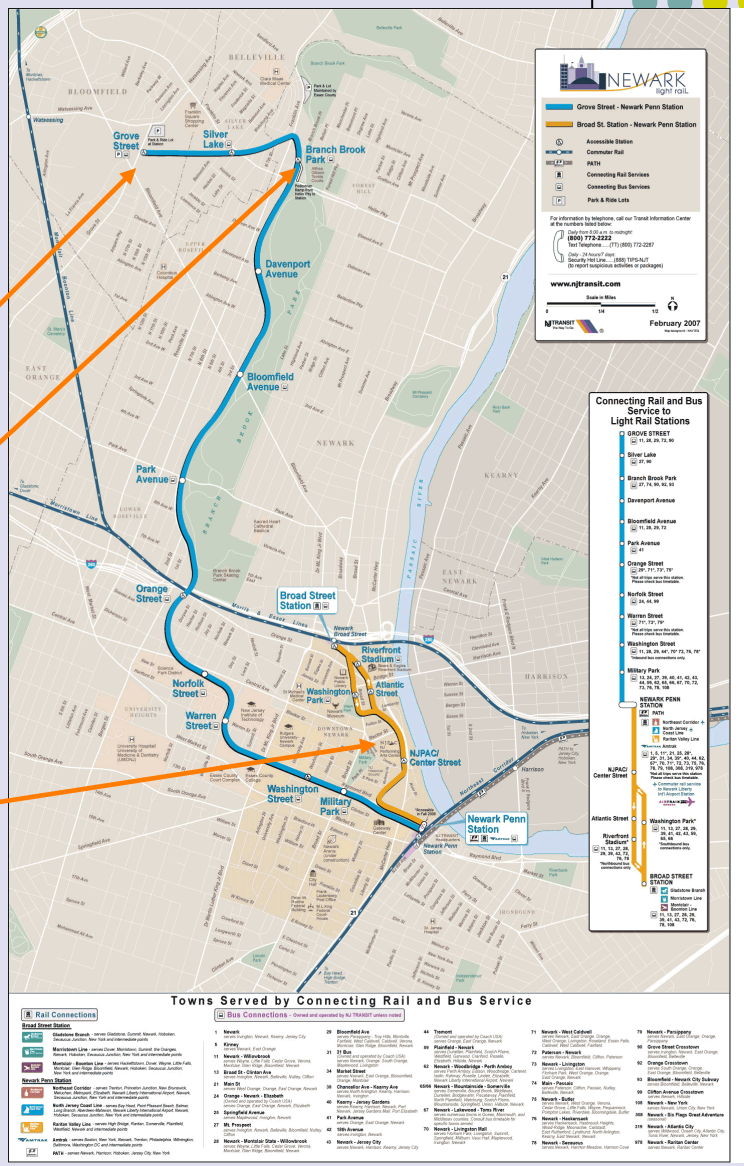
Comparison of Forecasted and Actual Ridership



Newark-Elizabeth Rail Link

The Project

- Replace PCC cars with modern LRT vehicles
- Extend Line to new maintenance facility and station at Grove Street
- Replace Heller Parkway and Franklin Avenue Stations with new Branch Brook Park Station
- Extend Line from Penn Station to Broad Street Station

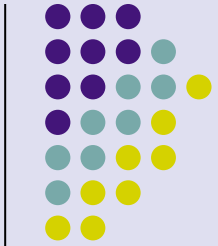


Newark-Elizabeth Rail Link

Before

Newark-Elizabeth Rail Link

Data Collection



- Project development in 1995… before Before/After study requirement
- Extensive before data collected to support model development
  - 1990 On-Board Surveys
    - NJT Commuter Rail
    - PATH
    - Interstate Bus
    - Intrastate Bus (including Newark City Subway)
  - Supplemental surveys of competing/complementary services
    - 1992 surveys of 302/303 Airlink, O-N-E Route 24, Route 31
    - 1994 survey of Newark City Subway

Newark-Elizabeth Rail Link

1994 NCS Ridership Patterns

1994 Newark City Subway

		LRT Only or Rail/PATH to LRT			LRT/Bus			All		
		Walk Access	Drive Access	Total	Walk Access	Drive Access	Total	Walk Access	Drive Access	Total
HBW	Peak	3,168	1,064	4,232	1,221	588	1,809	4,389	1,652	6,041
	Off-Peak	2,382	301	2,683	774	240	1,014	3,156	541	3,697
	Total	5,550	1,365	6,915	1,995	828	2,823	7,545	2,193	9,738
HBShop	Peak	57	0	57	90	0	90	147	0	147
	Off-Peak	390	39	429	110	43	153	500	82	582
	Total	447	39	486	200	43	243	647	82	729
HBOther	Peak	715	207	922	347	23	370	1,062	230	1,292
	Off-Peak	1,124	220	1,344	529	82	611	1,653	302	1,955
	Total	1,839	427	2,266	876	105	981	2,715	532	3,247
NHB	Peak	1,111	267	1,378	538	99	637	1,649	366	2,015
	Off-Peak	1,105	130	1,235	373	60	433	1,478	190	1,668
	Total	2,216	397	2,613	911	159	1,070	3,127	556	3,683
Total	Peak	5,051	1,538	6,589	2,196	710	2,906	7,247	2,248	9,495
	Off-Peak	5,001	690	5,691	1,786	425	2,211	6,787	1,115	7,902
	Total	10,052	2,228	12,280	3,982	1,135	5,117	14,034	3,363	17,397

Key observations:

- 80% of LRT riders use walk access mode (50% walk-to-LRT, 30% walk-to-bus-to-LRT)
- ½ of LRT riders are making work trips; rest divided evenly between HBO and NHB

Newark-Elizabeth Rail Link

1994 Survey - Key Geographic Markets

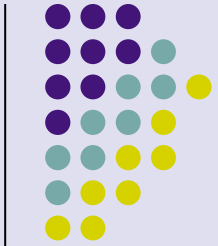
Production Location	LRT Submode	Access Mode	Survey Attraction Locations Newark	New York	Other	Total
Newark	LRT/Bus	Walk	1,576	258	902	2,736
		Drive	-	-	100	100
		Total	1,576	258	1,002	2,836
	LRT only	Walk	3,520	2,519	1,435	7,474
	or	Drive	232	229	170	631
	LRT/Rail	Total	3,752	2,748	1,605	8,105
	All	Walk	1,808	487	1,072	3,367
		Drive	3,752	2,748	1,705	8,205
		Total	5,560	3,235	2,777	11,572
Other	LRT/Bus	Walk	1,245	166		1,411
		Drive	555	473		1,028
		Total	1,800	639	-	2,439
	LRT only	Walk	1,003	881		1,884
	or	Drive	916	516		1,432
	LRT/Rail	Total	1,919	1,397	-	3,316
	All	Walk	2,161	682	-	2,843
		Drive	2,474	1,870	-	4,344
		Total	4,635	2,552	-	7,187
Total	LRT/Bus	Walk	2,821	424	902	4,147
		Drive	555	473	100	1,128
		Total	3,376	897	1,002	5,275
	LRT only	Walk	4,523	3,400	1,435	9,358
	or	Drive	1,148	745	170	2,063
	LRT/Rail	Total	5,671	4,145	1,605	11,421
	All	Walk	7,344	3,824	2,337	13,505
		Drive	1,703	1,218	270	3,191
		Total	9,047	5,042	2,607	16,696

Notes: 1. Includes just trips occurring entirely within modeled area

- Intra-Newark circulation
  - 1,600 walk-bus
  - 3,700 LRT trips (mostly walk access)
- Newark to New York jobs via rail/ PATH
  - 2,700 trips, mostly walk access
- Regional trips to Newark jobs via rail/PATH/bus
  - 4,600 trips

Newark-Elizabeth Rail Link

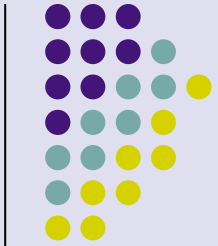
Forecasting Model Used for 1995 EIS Forecasts



- Incremental pivot point model focused on Essex and Union Counties, NJ based on NJT on-board surveys
- Separate nests for walk and drive access for
  - Bus-only
  - Bus-LRT
  - Commuter Rail
  - Commuter Rail-LRT
- No constants to favor LRT paths
- Calibrated to match existing Newark City Subway volumes

Newark-Elizabeth Rail Link

1995 to 2015 Forecasts of Growth



- Newark population drops by 11 percent and employment drops by 7 percent
- Newark CBD employment largely stable but:
  - NJPAC area: adds 1,600 employees
  - NJT Headquarters adds 2,300 employees
  - NJ Legal Center adds 700 employees
- Other Essex County population to decline slightly. Other suburban areas expected to grow by 30-40 percent

Newark-Elizabeth Rail Link
1995 EIS Forecast Results

2015 EIS Model - Daily Trips

Segment	Walk Access/ Egress	Drive Access/ Egress	Total Trips	Parked Vehicles
Grove Street Extension	2,126	1,130	3,256	745
Newark City Subway	16,457	867	17,324	572
Broad Street Extension	10,685	0	10,685	
Total	29,268	1,997	31,265	1,317

Incremental daily LRT trips: 12,500

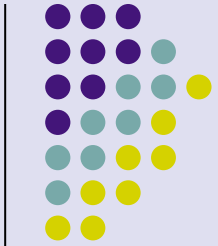
Incremental daily transit trips: 6,400

Newark-Elizabeth Rail Link

After

Newark-Elizabeth Rail Link

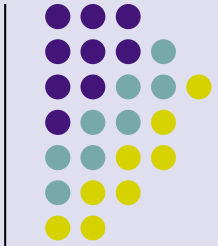
Implementation Progress



- Fleet replacement complete
- Heller Parkway and Franklin Avenue station replacement complete
- Grove Street extension complete but with lower service frequencies
- Broad Street extension in operation but not at full service levels:
  - Broad Street Station reconstruction still underway, reducing current service levels
  - Traffic engineering improvements still being studied to achieve anticipated running times

Newark-Elizabeth Rail Link

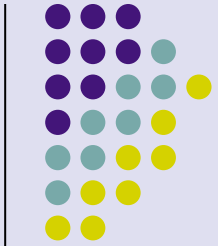
Grove Street Extension (opened 2002)



- EIS Assumptions:
  - Every train extended to Grove Street. Headways:
    - 3 minutes peak
    - 6 minutes off-peak
  - Running time: 16 min
  - Unlimited free parking capacity at Grove Street (assumed use of PNR lot and on-street parking)
- Implemented to date:
  - Every other train extended to Grove Street. Headways:
    - 7 minutes peak
    - 7 minutes off-peak
  - Running time: 20 min
  - PNR lot has capacity of 160 vehicles and costs $2/day (equivalent to ~5 minutes of extra access time)

Newark-Elizabeth Rail Link

Broad Street Extension (Opened 2006)



- EIS Assumptions:
  - Every train extended to Broad Street Station
    Headways:
    - 3 minutes peak
    - 6 minutes off-peak
  - Running time: 6.7 min
  - Peak hour connecting trains at Broad Street Station: 22
  - Broad Street transfer time: 2 minutes
- Implemented to date:
  - Separate shuttle to Broad Street Station.
    Headways:
    - 15 minutes peak
    - 15 minutes off-peak
  - Running time: 9 min
  - Peak hour connecting trains at Broad Street Station: 16
  - Broad Street transfer time: 3 minutes

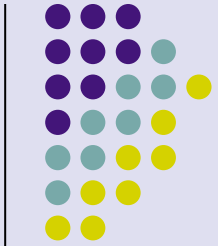
Newark-Elizabeth Rail Link

2008 Observed Ridership

October 2008 Observed Ridership

Segment	Daily Boardings
Grove Street Extension	1,586
Newark City Subway	20,248
Broad Street Extension	1,955
Total	23,789

Newark-Elizabeth Rail Link
Before/After Analysis



- Goal: Given progress towards full implementation, determine accuracy of forecast approach and suggest improved practice
- Approach: Re-run model with current operating plans and compare model results to counts and surveys

Newark-Elizabeth Rail Link

Challenges Rerunning 1995 Era Model

- What we did right…
  - Made complete backup
    - Input data sets
    - Model control files
    - Software
- What we did wrong…
  - Backup media—Exabyte Tape
- How we got lucky…
  - SDEIS forced us to reinstall model in 2000
  - 2000 model backed up to CD

Newark-Elizabeth Rail Link

Challenges Rerunning 1995 Era Model

- What we did right…
  - Kept a computer that could run MS-DOS Programs
    - QEMM Memory Extender

- What we did wrong…
  - Assumed that new peripherals would work with old computer

- How we got lucky…
  - Office pack rats kept old mice, keyboards, and monitors

What We Learned

Comparison of 2008 Observed and 2015 Modeled Trips
(modeled with actual operating plan and parking costs)

Segment	2008 Observed	2015 EIS Forecasts	Percentage Difference	2015 Model w/ actual op. plan	Percentage Difference
Grove Street Extension	1,586	3,256	105%	1,928	22%
Newark City Subway	20,248	17,324	-14%	15,581	-23%
Broad Street Extension	1,955	10,685	447%	1,916	-2%
Total	23,789	31,265	31%	19,425	-18%

- With actual operating plan:
  - Growth in downtown Newark in vicinity of NJIT and Prudential (near existing subway) higher than forecast
  - Smaller shift from existing subway to Grove Street extension than forecast
  - Overall Broad Street Extension closely matched

Newark-Elizabeth Rail Link

2015 Modeled Ridership Patterns

2015 Modeled Newark LRT (As Operated)

		LRT Only or Rail/PATH to LRT			LRT/Bus			All		
		Walk Access	Drive Access	Total	Walk Access	Drive Access	Total	Walk Access	Drive Access	Total
HBW	Peak	3,175	1,969	5,144	1,160	531	1,691	4,335	2,500	6,835
	Off-Peak	2,255	872	3,127	689	189	878	2,944	1,061	4,005
	Total	5,430	2,841	8,271	1,849	720	2,569	7,279	3,561	10,840
HBShop	Peak	61	1	62	69	4	73	130	5	135
	Off-Peak	349	50	399	116	38	154	465	88	553
	Total	410	51	461	185	42	227	595	93	688
HBOther	Peak	734	345	1,079	369	45	414	1,103	390	1,493
	Off-Peak	1,167	485	1,652	525	66	591	1,692	551	2,243
	Total	1,901	830	2,731	894	111	1,005	2,795	941	3,736
NHB	Peak	1,027	341	1,368	504	75	579	1,531	416	1,947
	Off-Peak	1,099	228	1,327	344	54	398	1,443	282	1,725
	Total	2,126	569	2,695	848	129	977	2,974	698	3,672
Total	Peak	4,997	2,656	7,653	2,102	655	2,757	7,099	3,311	10,410
	Off-Peak	4,870	1,635	6,505	1,674	347	2,021	6,544	1,982	8,526
	Total	9,867	4,291	14,158	3,776	1,002	4,778	13,643	5,293	18,936

Incremental daily LRT trips: 960

Incremental daily transit trips: 997

Newark-Elizabeth Rail Link

1994 to 2015 Growth

Year 1994 to 2015 Growth

		LRT Only or Rail/PATH to LRT			LRT/Bus			All		
		Walk Access	Drive Access	Total	Walk Access	Drive Access	Total	Walk Access	Drive Access	Total
HBW	Peak	7	905	912	-61	-57	-118	-54	848	794
	Off-Peak	-127	571	444	-85	-51	-136	-212	520	308
	Total	-120	1,476	1,356	-146	-108	-254	-266	1,368	1,102
HBShop	Peak	4	1	5	-21	4	-17	-17	5	-12
	Off-Peak	-41	11	-30	6	-5	1	-35	6	-29
	Total	-37	12	-25	-15	-1	-16	-52	11	-41
HBOther	Peak	19	138	157	22	22	44	41	160	201
	Off-Peak	43	265	308	-4	-16	-20	39	249	288
	Total	62	403	465	18	6	24	80	409	489
NHB	Peak	-84	74	-10	-34	-24	-58	-118	50	-68
	Off-Peak	-6	98	92	-29	-6	-35	-35	92	57
	Total	-90	172	82	-63	-30	-93	-153	142	-11
Total	Peak	-54	1,118	1,064	-94	-55	-149	-148	1,063	915
	Off-Peak	-131	945	814	-112	-78	-190	-243	867	624
	Total	-185	2,063	1,878	-206	-133	-339	-391	1,930	1,539

- Principal expanded market: Drive-to-Rail-to LRT grew by 2,100 trips

Newark-Elizabeth Rail Link

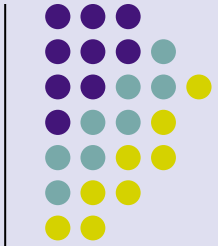
Comparison of Key Stations

Comparison of 2008 Observed and 2015 Modeled Trips at Newark Penn to Broad Street Stations
(modeled with actual operating plan and parking costs)

Segment	2008 Observed	2015 EIS Forecasts	Percentage Difference	2015 Model w/ actual op. plan	Percentage Difference
Penn Station	853	2,990	251%	700	-18%
Performing Arts Center	78	2,343	2904%	330	323%
Atlantic/Washington Park	388	2,290	490%	345	-11%
Broad Street Station	636	3,062	381%	541	-15%
Total	1,955	10,685	447%	1,916	-2%

- Even with actual operating plan, big missing piece is Performing Arts Center
  - Forecasted employment growth: 500 to 2,200 employees.
  - Actual employment growth: FBI Building sited across McCarter highway and nearer to Penn Station than projected.

Newark-Elizabeth Rail Link
Conclusions



- Models that are calibrated to match key markets segments essential
- Accurate forecasting of model inputs are critical:
  - Operating plans
  - Population and growth forecasts including specific locations
- Archived, operational version of the model is critical:
  - Backup model data, model scripts, forecasting software and OS
  - Test backup periodically to confirm that data can be restored and model re-run