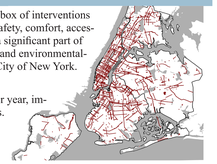
NEW YORK CITY DOT

Street Improvement Projects

Street Improvement Projects (SIP) utilize a broad toolbox of interventions to reengineer city streets with the goal of improving safety, comfort, accessibility, and mobility for all roadway users. They are a significant part of NYC DOT's mission to provide for the safe, efficient and environmentally responsible movement of people and goods in the City of New York.



NYC DOT implements more than 100 SIP projects per year, implemented by 8 different units, each with unique goals.

Traffic Calming, Transit Prioritization

Traffic Calming, Bike Infrastructure Development

Traffic Calming, Bike Infrastructure, & Plaza

Street Closure, Pedestrian Plaza implementation

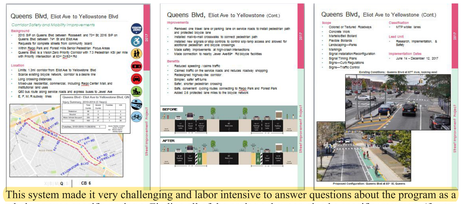
Historic Tracking

Historically SIP projects were tracked for the program in a master tracking sheet and at the project level in a summary document.

Excel tracking sheet	PDF project description
Maintained centrally by program manager	Maintained by project manager
Project name	Project background
One-line project description	High level description
Implementation dates	High level treatment descriptions
Project manager name and unit	Project images and map

Problems:

- Not query-able
- No spatial data
- Imprecise project extents (often traced over Google Maps)
- No treatment geography
- Treatment data limited to high-profile treatments



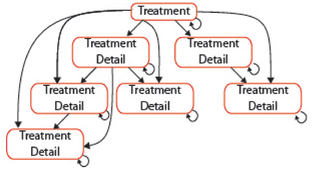
This system made it very challenging and labor intensive to answer questions about the program as a whole or even specific projects. Finding all of the projects that contained a specific treatment (for example) became an exercise in archeology and institutional memory. Programmatic analysis was nearly impossible.

NYC DOT decided to design and build a new system to track the SIPs that would utilize distributed data entry process.

Database Model

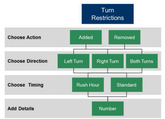
SIP project tracking system requirements:

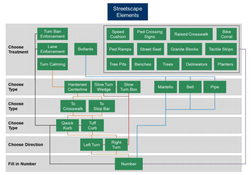
- Record all **project** and **treatment details**
- Account for **different project types**
- Allow for diversity of treatment details (different **treatments have differing levels of details**)
- **Standardize treatment attributes** and related geographic information
- Facilitate the adoption of **new treatments and modifications** to existing treatment options
- Data entry must be possible by the Project Manager and **not require specialized skills or software**
- Data must be **query-able and accessible** to analysts



Solution hierarchical model called Closure:

- Hierarchical **tree structure** representation of the data
- Stores **relationships** between each node to each of its descendants (including itself)
- Data is stored in **two tables** (data and relationships)
- Allows for detail and flexibility to store **treatments with differing levels of detail** in one schema





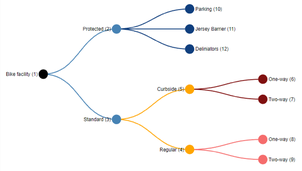
Implementation

Implementation:

The underlying design of the new system is based on the concept that **projects are a collection of treatments** and the **treatment attributes are entered by the user by making a series of decisions**. This design allows us to standardize the data entry for each specific treatment and all of its details. This required us to reimagine our treatment details as decision trees. Each node and each decision path is unique, this allow us to only store the last decision the user made. This allows the full details of any treatment to be stored in a single cell using only the ID number of the decision node in the tree. Treatments that require an additional data entry field for user inputs are provided as the last decision node and stored in a supplementary attribute table.

Questions	
Question ID	Question
1	Bike Facility
2	Protected
3	Standard
4	Regular
5	Curbside
6	One-way
7	Two-way
8	One-way
9	Two-way
10	Parking
11	Jersey Barrier
12	Deliniators

Question Path		
Ancestor	Descendant	Depth
1	1	0
1	2	1
1	3	1
1	4	2
1	5	2
1	6	3
1	7	3
1	8	3
1	9	3
1	10	2
1	11	2
1	12	2
2	2	0
2	10	1
2	11	1
2	12	1
3	3	0
3	4	1
3	5	1
3	6	2
3	7	2
3	8	2
3	9	2
4	4	0
4	8	1
4	9	1
8	8	0
9	9	0



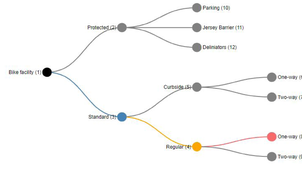
Data retrieval:

This data structure is simple to work with in the database. It provides a lot of flexibility for querying at different levels of granularity or recreating the full treatment details from the last decision node.

Queries **down the tree** return all of the choices below a given node. This is useful for finding everything that is in some category of treatments. For example, to find all protected bike paths regardless of the specific types.

```
SELECT q.*
FROM sip_questions q
JOIN (
    SELECT descendant d, depth
    FROM sip_questions_path
    WHERE ancestor = 2
    -- All treatments with some form of
    -- protected bike facility
) AS p ON q.qid = p.d
ORDER BY p.depth;
```

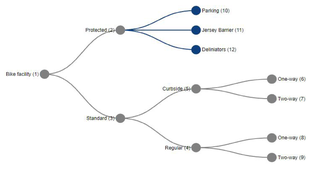
qid integer	question text
1	2 Protected
2	10 Parking
3	11 Jersey Barrier
4	12 Deliniators



Queries **up the tree** (using descendant) recreate the decision path. Because only the final decision node is stored for each treatment, a query up the tree is needed to understand the full treatment details.

```
SELECT q.*
FROM sip_questions q
JOIN (
    SELECT ancestor a, depth
    FROM sip_questions_path
    WHERE descendant = 8
    -- All treatments with a one-way
    -- standard bike facility
) AS p ON q.qid = p.a
```

qid integer	question text
1	1 Bike Facility
2	3 Standard
3	4 Regular
4	8 One-way



Data Entry

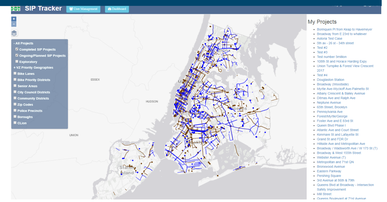
The primary purpose of the application is to facilitate the collection and storage of the project and treatment attributes. Data entry is intended to be done by the project .

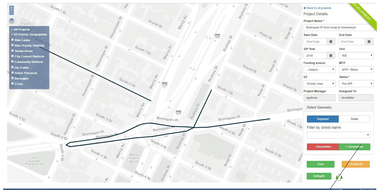
Landing page includes a list of the user's projects and a map with a number of reference layers that can be toggled on and off including:

1. All other projects (planed, ongoing, and implemented)
2. Vision Zero Priority Areas
3. Bike facilities
4. Bike Priority Districts
5. Senior Focus Areas
6. Political and administrative boundaries

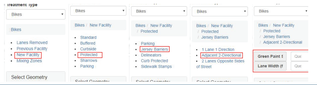
The data entry process is straightforward and consists of two levels, project and treatment.

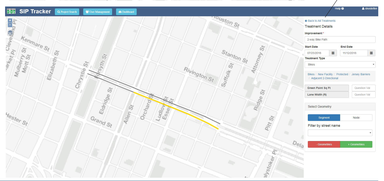
1. Enter project level attributes
   a. Project name
   b. Implementation dates
   c. Program year
   d. Unit responsible
   e. Founding source
   f. Vision Zero attributes
   g. Current status (under development, in constructions, complete, on hold)
2. Delegate project to another user (share ownership)
3. Select project geography





1. Enter treatment level attributes
   a. Treatment name
   b. Treatment installation dates (if different from full project installation dates)
   c. Navigate through question tree
2. Select treatment geography





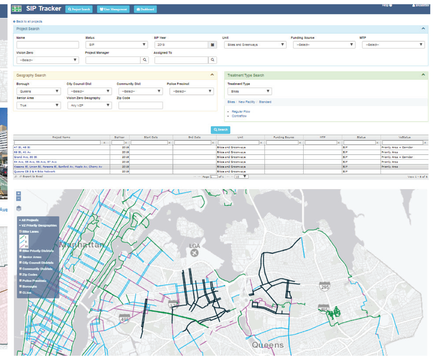
Data Exploration

The application provides planners, program managers, analysts and outreach/communications staff with the ability to quickly and easily explore the data is a powerful tool. Project managers need to know what other projects are being developed and/or implemented near their project (as well as what was done in the past). The reference layers in the map provide access to quickly overlay every project on the map, which link to the project page for full details.

For a more targeted search, the application provides a query tool that allows for searching by project, geography, and treatment attributes. Analyses that used to take days of investigation are now at all of the users fingertips.

Sample search:

- All competed 2016 projects
- And in the 25th City Council District
- And in a Senior Focus Area
- And in a Vision Zero Priority Area
- And that included new or upgraded crosswalk markings



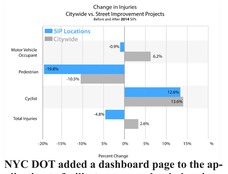
Applications

The availability of this data has facilitated a number of new initiatives that were not previously possible.

NYC DOT analyzed the full SIP work program's efficacy from a safety perspective. Previously, projects were analyzed individually to ensure they were improving safety, but a holistic analysis was not practical.

Since the start of Vision Zero in 2014, NYC DOT has completed more than 400 SIPs, focusing re-engineering efforts on areas with high rates of pedestrian severe injuries and fatalities. **The analysis confirmed that SIPs have been successful in reducing pedestrian injuries**.

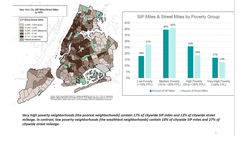
In areas where SIPs were installed, pedestrian injury rates fell at around twice the rate of change as citywide reductions in injuries.



NYC DOT analyzed the equitability of the SIP program as a whole to ensure all New Yorkers were being served. This analysis explored the geographic distribution of projects throughout the city across a number of different demographic metrics.

The analysis demonstrated that across all neighborhood demographic profiles the SIP program was proportionately distributed.

SIP Miles & Street Miles by Poverty Group



NYC DOT added a dashboard page to the application to facilitate program level planning and assist the unit directors measure their work. The dashboard tracks SIP projects work across time and the city by unit. This helps the unit directors ensure their group's work is appropriately distributed across the city and through time.

NYC DOT has begun to use the dashboard as a tool to plan future years work programs at a high level, with the ability to quickly get the full project proposal details and to ensure that communities were not over nor underrepresented in our work portfolio.

Next Seps

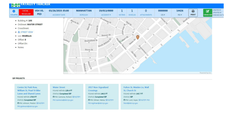
The next phases of development for this application will focus on connecting to other systems at NYC DOT, generating presentation materials, and adding project management workflow tools.

Connections:

The newly built traffic fatality data management application is the first to connect to the SIP portal. Now as new fatal traffic incidents are recorded, project managers are automatically notified if the fatality occurred on a street included their project.

Future connections will provide project managers with a wealth of additional data for planning and analysis of their projects:

- Crash analytics application
- Traffic count management system
- Traffic speed analytics application



Presentation materials:

High level project description documents are still part of the project lifecycle and are generated as part of the project proposal and updated as the project is implemented. Future versions of the SIP tracking application will track project images and include the workflow to generate this document.

Project management:

A new branch of the SIP portal is being planned and developed to help track the project management components of the SIPs. The project management tool will track information about timelines, approvals, data collection, outreach, and process related attributes. This will give program managers and analyst much finer grain insight into the projects implementation status.

Credits

Project Team:

Jason Fitzsimmons
Arthur Getman
Zhi Keng He
Seth Hostetter
Chandrima Pal
Sidney Salnave
Ramesh Vanjarapu

Technologies:

PostgreSQL / PostGIS
C# .Net
Geoserver v2.8
OpenLayers 3
(We are using an ESRI map service as well, published from our local