GEORGIA TECH SIDEWALK RESEARCH LAB

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College of Engineering

David Boyer
MBA/MSCE
Fall 2018

Daniel Walls
MSCRP/MSCE
Summer 2018

Chelsea Dyess
MSCRP/MSCE
Spring 2018

Jeremy Greenwald
MSCRP/MSCE
Summer 2019

Dr. Randall Guensler
School of Civil and
Environmental Engineering

- **Walkable cities**
- **Sidewalks and the Americans with Disabilities Act**
- **Current state of sidewalks**
- **Sidewalk asset management**
- **Sidewalk prioritization index**
- **Implications for communities**
- **Future research**

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I bet you have....

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Sidewalks are shared transportation assets that promote safety, community, and well-being (with positive safety, social and health benefits in walkable neighborhoods)*:
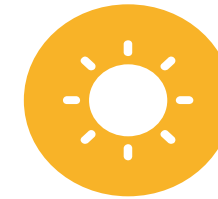
12 Studies

Positive safety benefits:
reduced vehicle conflicts
and increased street life
(crime deterrence)

11 Studies

Positive social benefits:
higher levels of social
interaction, place
attachment, and trust

50 Studies

Positive health benefits:
better health outcomes
(reduced obesity, heart disease,
high blood pressure, diabetes)

*Of the studies examined, only one indicated a negative net benefit (safety). All others found positive or no clear benefits.
Emily Talen and Julia Koschinsky (2014). *Compact, Walkable, Diverse Neighborhoods: Assessing Effects on Residents.*

What if you had a disability?

The Americans with Disabilities Act (1990) seeks to reduce the frequency of unemployment and isolation of persons with disabilities with goal of making society as a whole more accessible for people with disabilities.
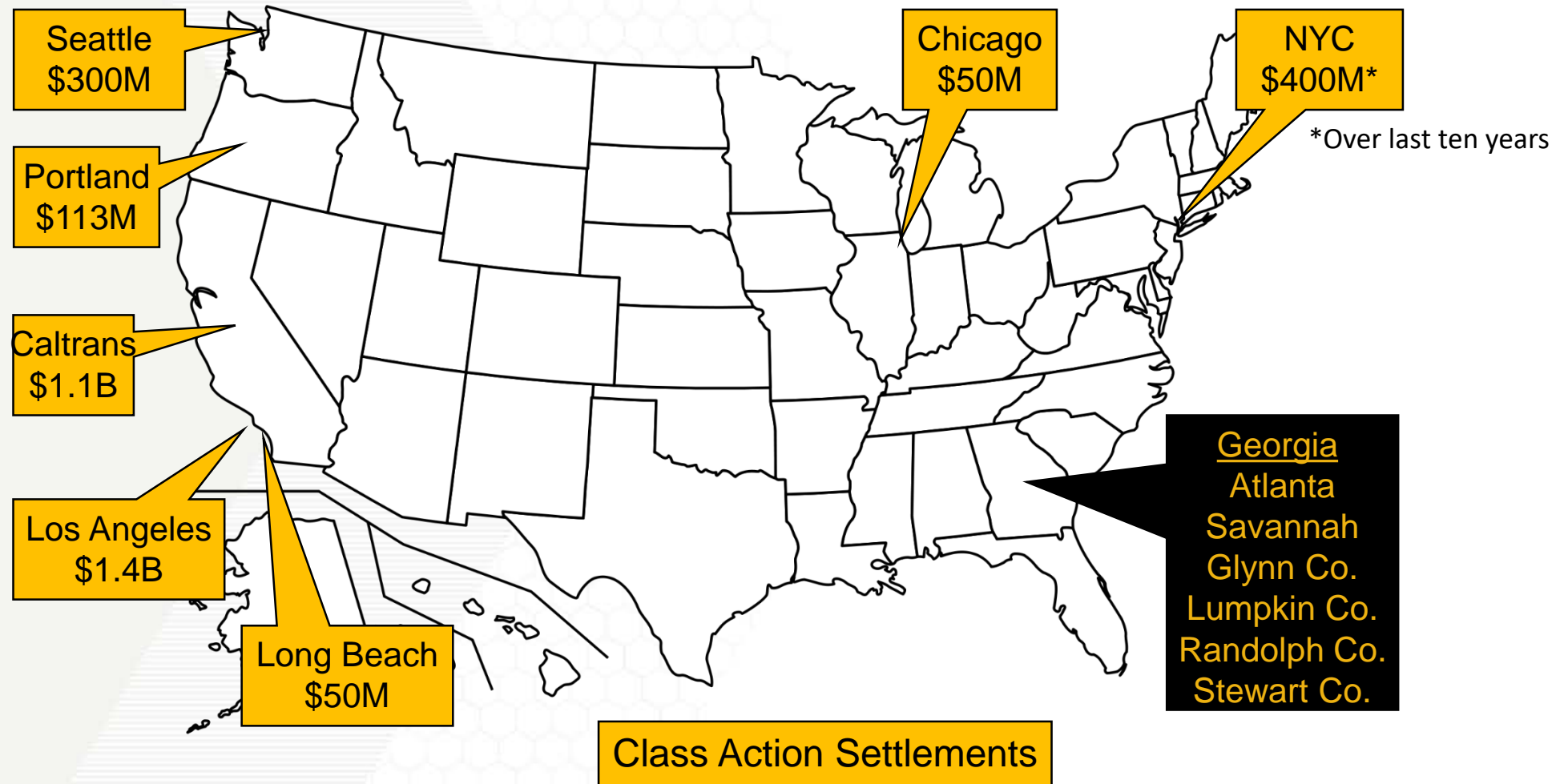
The pedestrian environment must adhere to specific design standards under the Americans with Disabilities Act to ensure access for all persons.

SIDEWALKS LEGAL IMPLICATIONS

Cities face legal issues and financial obligations as a result of poorly maintained pedestrian infrastructure.

Seattle
$300M

Portland
$113M

Caltrans
$1.1B

Los Angeles
$1.4B

Long Beach
$50M

Chicago
$50M

NYC
$400M*

*Over last ten years

Georgia
Atlanta
Savannah
Glynn Co.
Lumpkin Co.
Randolph Co.
Stewart Co.

Class Action Settlements

NPR

2:34

NATIONAL

Legal Battle Over Crumbling Sidewalks Unfolds In Atlanta

August 14, 2018 · 4:39 PM ET
Heard on All Things Considered

STEPHANNIE STOKES

+ QUEUE
DOWNLOAD
EMBED
TRANSCRIPT

Atlanta is one of the biggest cities in the country... crumbling sidewalks. Now, a group of disabled... pavement violates federal law.

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Atlanta Researchers Help Cities Track Their Sidewalk Problems

STEPHANNIE STOKES · JUL 20, 2018

Georgia Tech professor Randall Guensler, right, and graduate student Daniel Walls stand with the tool they've developed to assess sidewalk quality.
CREDIT STEPHANNIE STOKES / WABE

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Cities face "known unknowns" and "unknown unknowns" – issues arise because of confusing ownership models and lack of sidewalk asset management planning.

1. What do we own?	2. Who is responsible?	3. How do we manage it?
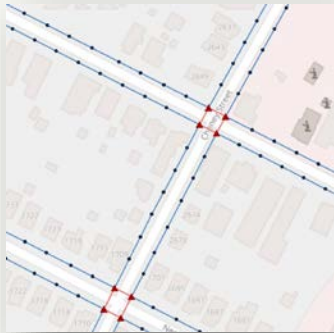
- Mileage and elements
- Element design features
- Element conditions: age, materials, and physical characteristics

- Adjacent property owner: Atlanta, NYC, etc.
- Collective government: Los Angeles, Austin, etc.
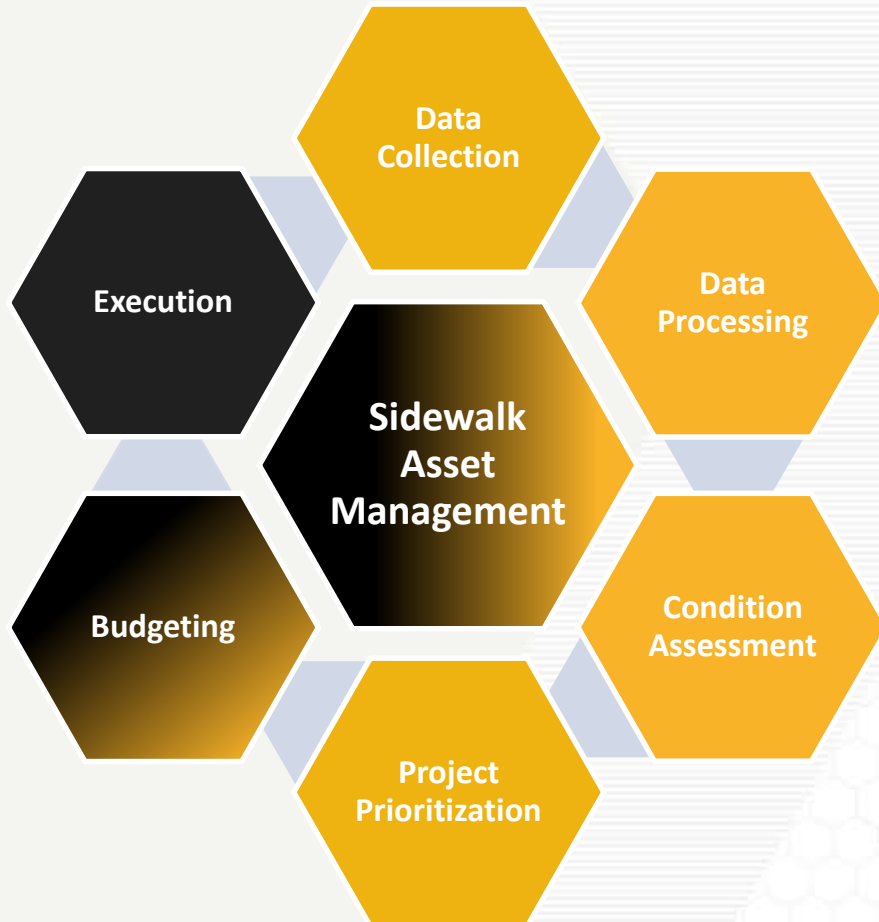- Shared responsibility: San Diego, Phoenix, etc.

- Construction design guides (Federal, State, and Local)
- Asset management system
- Lifecycle planning

GEORGIA TECH SIDEWALK RESEARCH LAB

Our mission is to help communities transition from neglected sidewalks to valued assets.

## Georgia Tech Sidewalk Asset Management System

- Physical data collection

- Semi-automated processing

- Rules-based assessment

- Multiple criteria decision model: Sidewalk prioritization index (SPI)

- Scoping of construction costs

Hexagon diagram labels:
- Data Collection
- Data Processing
- Execution
- Sidewalk Asset Management
- Condition Assessment
- Budgeting
- Project Prioritization

The Georgia Tech Research Lab developed mobile applications for physical measurements, location data, photos, and video. Data is uploaded to a Georgia Tech server for automated processing.

Sidewalk Sentry™
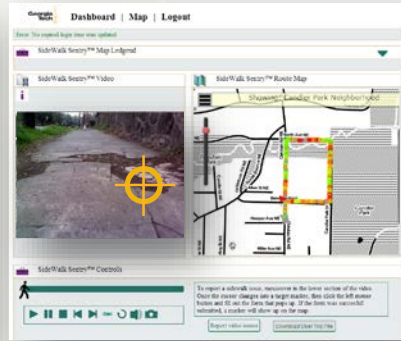
Sidewalk Sentry™ Android tablet app captures rolling video, geo-location, and vibration data from a wheelchair mount (videos review to identify sidewalk features and defects).

Sidewalk Scout™
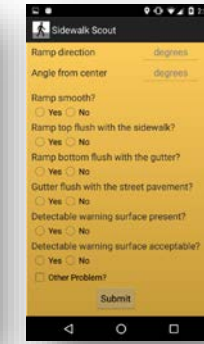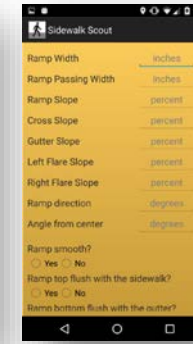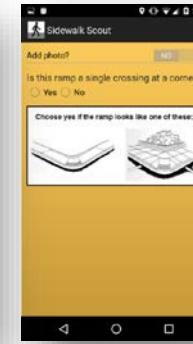
Sidewalk Scout™ Android phone app is used to input design measurements of sidewalks, ramps, curb cuts, bus stops, and crosswalks (with photos and GPS).

Android is a trademark of Google LLC

Using a semi-automated process, field data are tied to approximately 50' sidewalk links.

Sidewalk Network GIS File

- The sidewalk network file forms the basis for condition analysis data visualization

- Raw data containing elements from Sidewalk Sentry™ and Sidewalk Scout™ come together via GIS tools

- Data are aggregated to 50' sidewalk lengths for condition analysis and prioritization

- Position data smoothing helps reduce GPS wander

Raw Data File

Sidewalk Network File

CONDITION ASSESSMENT
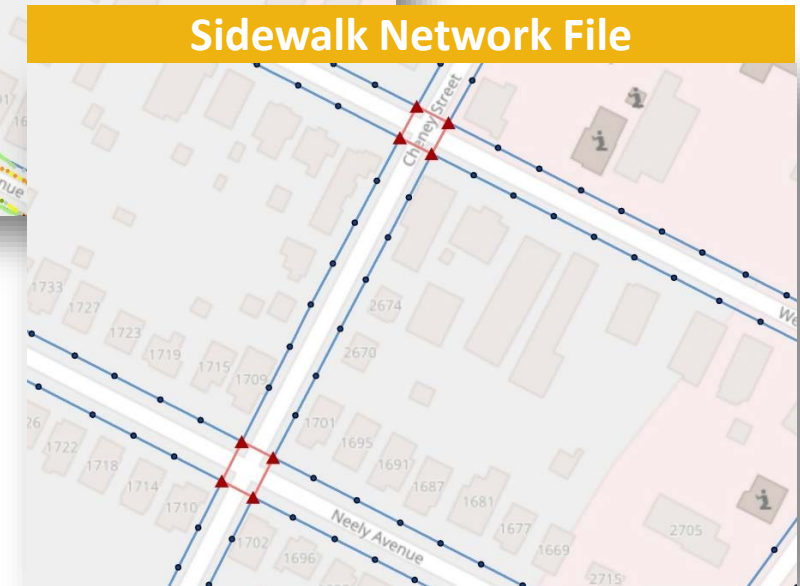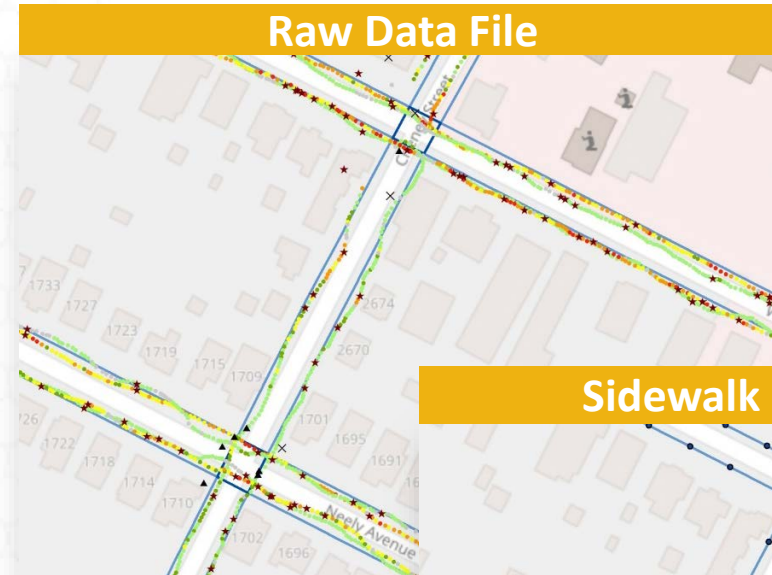
Raw data are analyzed based on physical asset type to determine compliant or non-compliant.

The sidewalk asset management system compares sidewalk element field measurements to applicable U.S. Access Board's ADA Accessibility Guidelines (ADAAG) based on the type of element to determine compliance status.

Ramp Type	Standard	Diagonal	Combination Diagonal Parallel	Combination Perpendicular Parallel	Perpendicular	Built-up	Parallel	Other
Minimum Width	36"	36"	N/A	N/A	36"	36"	"NA"	36"
Maximum Running Slope	8.33%	8.33%	N/A	N/A	8.33%	8.33%	"NA"	8.33%
Maximum Cross Slope	2%	2%	2%	2%	2%	2%	2%	2%
Maximum Gutter Slope	5%	5%						
Maximum Left Flare Slope	10%	10%						
Maximum Right Flare Slope	10%	10%						
Minimum Passing Width	36"	36"						
Smooth Surface?	Smooth	Smooth						
Ramp Flush at Top?	Flush	Flush						
Ramp Flush at Bottom?	Flush	Flush						
Ramp Flush at Gutter?	Flush	Flush						
Detectible Warning Surface Present?	Present	Present						
Detectible Warning Surface Condition	Compliant	Compliant						
Another Problem	No	No						
Maximum Left Transition Slope	N/A	N/A						
Maximum Right Transition Slope	N/A	N/A						
Minimum Landing Slope	N/A	N/A						
Minimum Landing Width	N/A	N/A						

Ramp Type	Standard	Historic	Sidewalk Diversion Curb Cut	Sidewalk Depression Curb Cut
Maximum Cross Slope	2%	2%	2%	N/A
Minimum Passing Width	36"	N/A	N/A	N/A
Maximum Left Flare Slope	N/A	8.33%	N/A	N/A
Maximum Right Flare Slope	N/A	8.33%	N/A	N/A
Maximum Passing Cross Slope	2%	N/A	N/A	N/A
Maximum Left Sidewalk Ramp Slope	N/A	N/A	N/A	8.33%
Maximum Left Sidewalk Ramp Cross Slope	N/A	N/A	N/A	8.33%
Maximum Right Sidewalk Ramp Slope	8.33%	8.33%	N/A	8.33%
Maximum Right Sidewalk Ramp Cross Slope	2%	2%	2%	8.33%
Minimum Depression Sidewalk Width	10%	10%	N/A	36"

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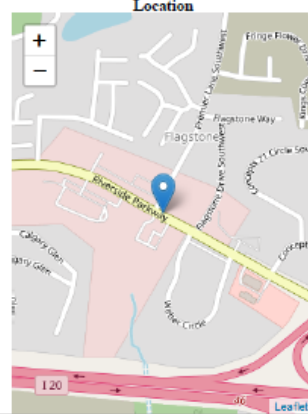College of Engineering

Individual pedestrian elements are identified as compliant or non-compliant.

Reports are complied for each pedestrian feature:

- Ramps
- Curb cuts
- Crosswalks
- Intersections
- Bus stops
- Sidewalk Problems

SIDEWALK PROBLEM REPORT

Object ID:	900022999
Sidewalk Issue:	Uneven Surface
Latitude:	33.777326941252902
Longitude:	-84.565566691140106
Neighborhood:	Cobb County
Date Reviewed:	6/14/2018 5:07:00 PM
Comment:	
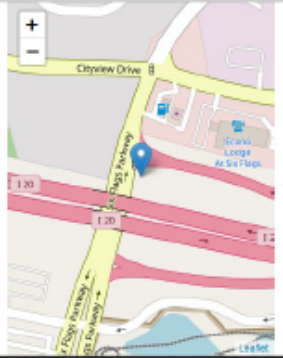
Location

Problem Image

PEDESTRIAN RAMP REPORT

Ramp ID:	6864
Inspection Date:	6/17/2018 4:03:00 PM
Ramp Type:	Other
Compliance Status:	NONCOMPLIANT
Sum of Issues:	5
Latitude:	33.773184190000002
Longitude:	-84.551357209999999
Closest Address:	

Issue Name	Measurement	Compliant?
Ramp Width	98	Yes
Running Slope	3.60	Yes
Cross Slope	3.00	No
Gutter Slope	2.40	Yes
Left Flare		Yes
Right Flare	7.30	Yes
Passing Width		No
Surface	Smooth	Yes
Flush Top	Flush	Yes
Flush Bottom	Not Flush	No
Flush Gutter	Not Flush	No
Detectible Warning Surface Present	Absent	No
Detectible Warning Surface Condition		NA
Other Problem		Yes
Transition Slope Left		NA
Transition Slope Right		NA
Landing Slope		NA
Landing Width		NA

PROJECT PRIORITIZATION

Georgia Tech's Sidewalk Prioritization Index (SPI) helps incorporate engineering judgement and public input into a standard rating tool

Challenges

Communities need to know where to start:

- With a limited budget, a community will not be able to pay for all requirements at once

- With an massive repair backlog, prioritizing repairs can be overwhelming and contentious

- Competing interests may make communities overly conscious of any perceived partiality

Asset Management Benefits

The Sidewalk Prioritization Index (SPI) can help:

- Use agreed upon metrics to evaluate the relative importance of sidewalk links

- Incorporate public feedback to meet pedestrian infrastructure expectations for certain land uses

- Remove partiality from prioritization by adhering to a multiple criteria decision matrix

The SPI is a performance evaluation tool that prioritizes sidewalk links using condition data weighted across safety, mobility, and accessibility concerns.

Categorical Evaluation

- Each sidewalk link is scored across three categories:
  - Safety – potential for pedestrian injury
  - Accessibility – likelihood of moving many people
  - Mobility – support for persons with mobility limitations

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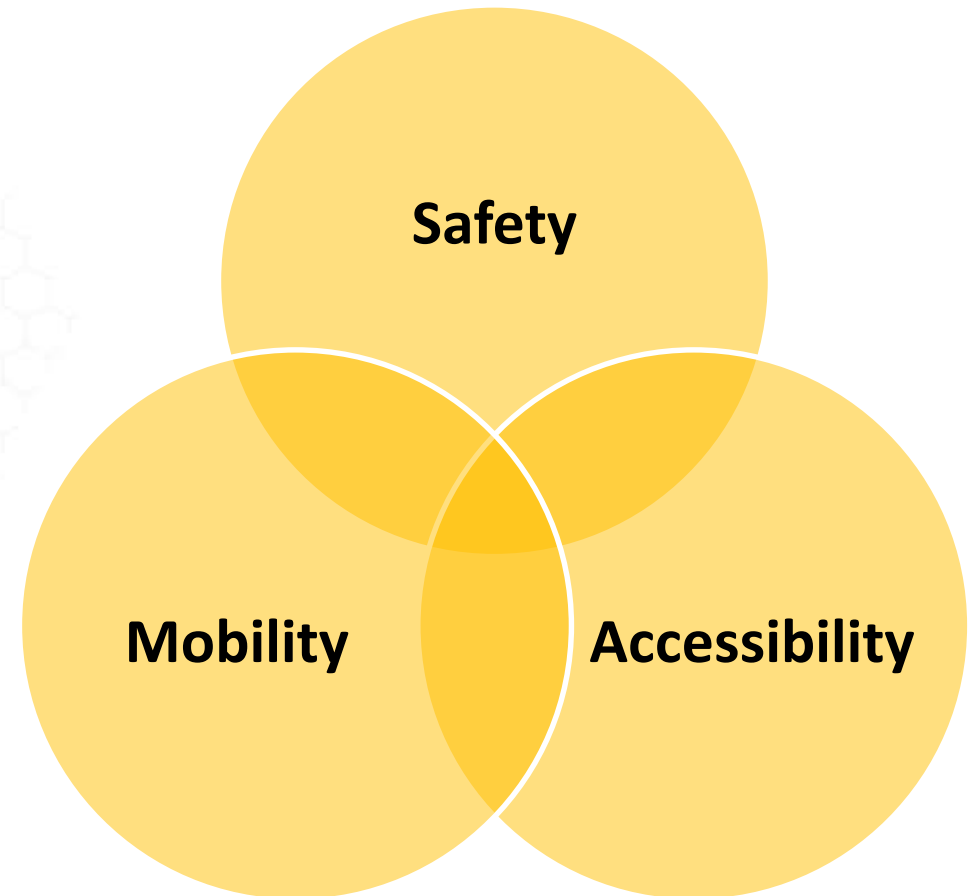
Distinct categories are broken into mutually exclusive factors tied to a combination of demographic data and field measurements for link scoring.

Factor Evaluation

Categories are broken into mutually exclusive factors

- Factors may be tied to field measurements, environmental factors, or both

- Factors are weighed through public input and/or professional judgements

- Factors are then weighted intra-categories

Safety

Mobility

Accessibility
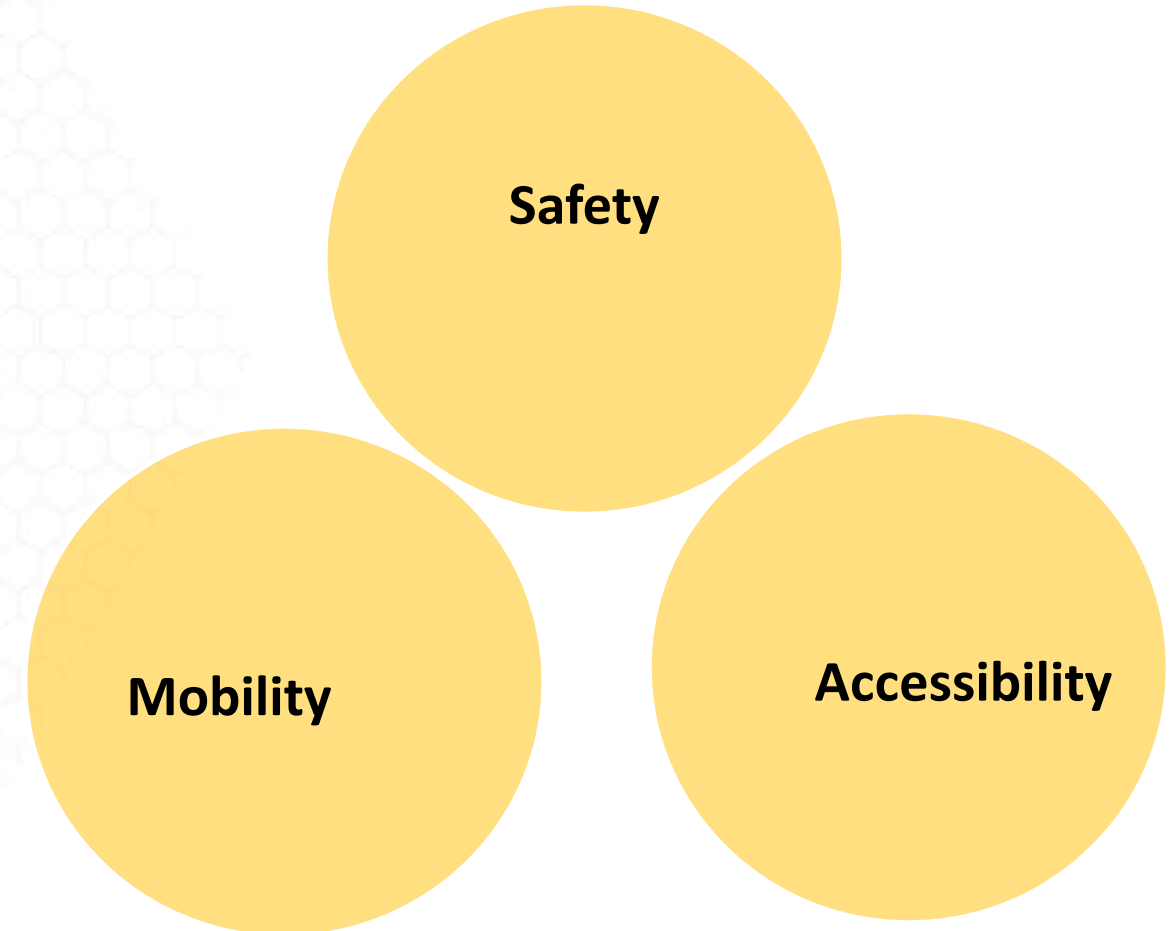
SIDEWALK SURVEY WEIGHTING

The Community Sidewalk Preferences Survey gathers public input on the relative importance of sidewalk factors. Results can be used to scale local responses to national ones.

- Survey of more than 1000 individuals in the Southeast in eight cities of various sizes

- Asked respondents to rate the relative importance of sidewalk factors

- Respondents provided numerical ranks and allocated funds
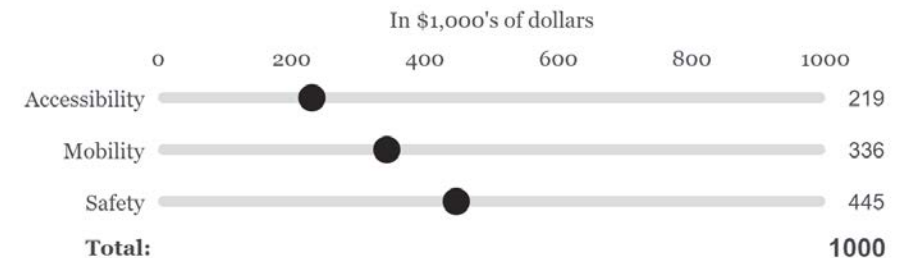
COMPOSITE SCORE CONTRIBUTION BY FACTOR

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Categories are evaluated by appropriate factors.

| Safety Factors	Score
Locations where pedestrians were injured in the last three years	3.84
Roadways 2 lanes or less	2.94
3 lane roadways	3.01
4 lane roadways	2.94
5 lane roadways	2.62
6+ lane roadways	2.44
Roadways with average speeds below 25 MPH	2.48
Roadways with average speeds of 25-34 MPH	3.14
Roadways with speeds of 35-44 MPH	2.95
Roadways with average speeds at or above 45 MPH	3.01
Maximum Composite	10.00

Accessibility Factors	Score
Shopping/commercial district	2.15
Services district	2.13
Employment district (single-story office buildings)	1.77
Employment district (two-story office buildings)	1.93
Employment district (multi-story office buildings)	1.92
Employment district (high-rise office buildings)	1.98
Residential District (Single Family Homes)	2.00
Residential District (Single and Multi-Family Homes)	2.20
Residential District (Multi-Family Homes)	2.27
Mixed residential and commercial	2.20
Industrial district	1.40
Schools or daycares are nearby	2.66
MARTA Accessible	2.53
GRTA Accessible	2.53
Maximum Composite	10.00

Mobility Factors	Score
Locations where the sidewalk is less than 3 feet in width	1.63
Locations where the sidewalk is 3 to 3.9 feet in width	1.30
Locations where the sidewalk is 4 to 4.9 feet in width	0.95
Sidewalk running slope is moderate (from 5%-8.33% slope)	1.05
Sidewalk running slope is steep (over 8.33% slope)	1.34
Sidewalk cross-slope is moderate or steep (over 2% cross slope)	1.49
Presence of horizontal or vertical obstructions in path of travel, but a 3' clear path is not present	1.81
½ inch or more abrupt change in sidewalk level	1.80
Presence of a curb ramp that doesn't meet ADA standards	1.92
Maximum Composite	10.00

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SPI ratings are clustered into severity bins for data visualization to help planners identify problematic areas.

The SPI is tabulated in an excel file extracted from GIS, grouped into severity bins, and imported back into GIS for visualization.
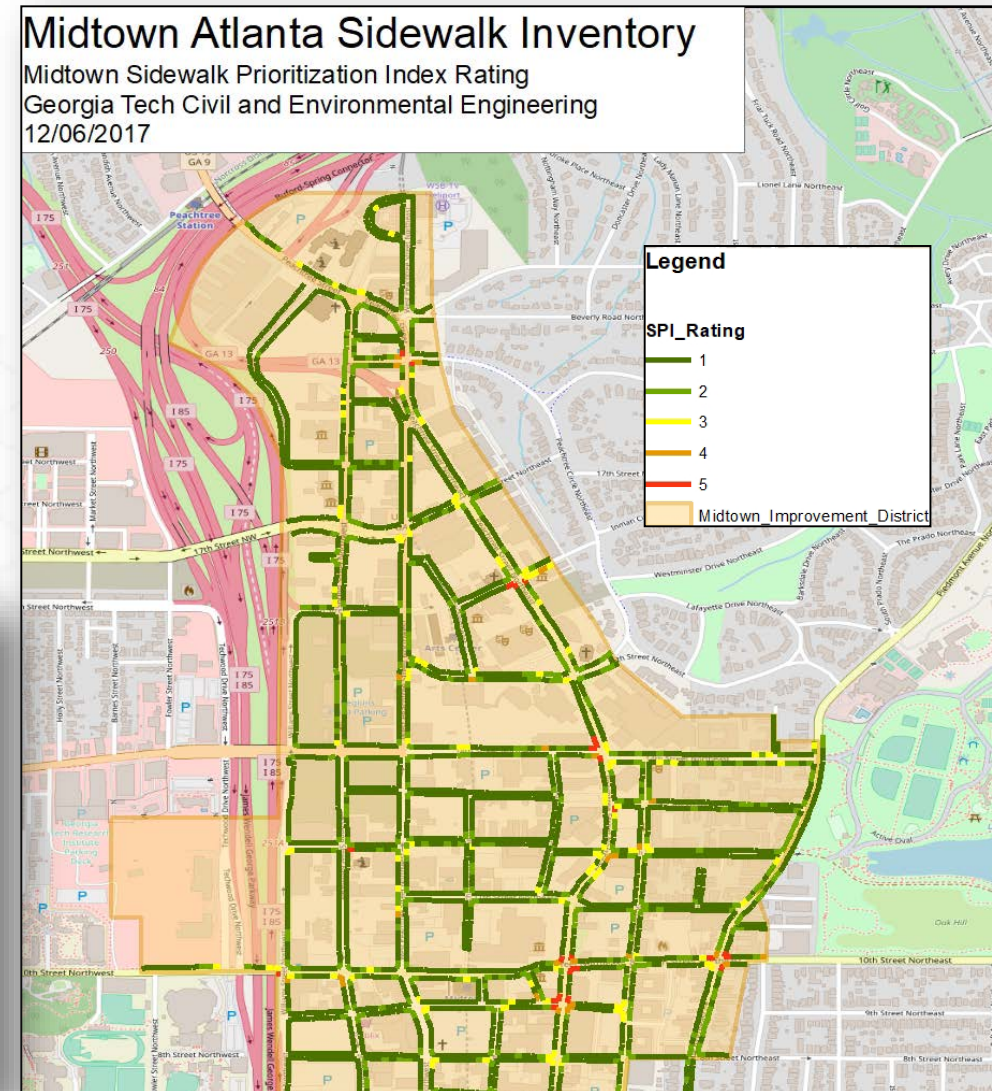
Numerical composite results can be used to compare relative priority across sidewalk links.
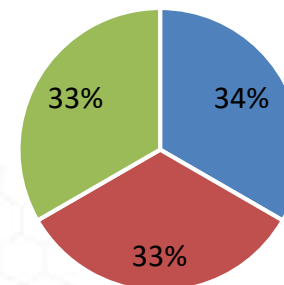
Final category index values are weighted to a maximum composite index score of 10

Potential composite scores:

- Maximum (worst case) = 10.00
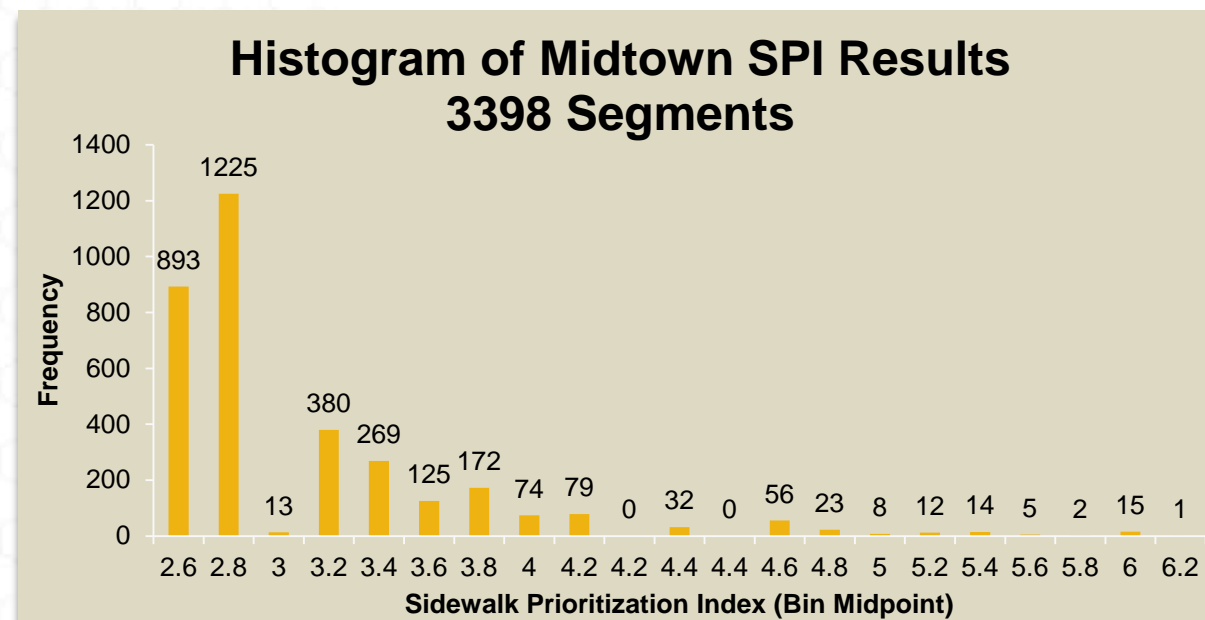
- Minimum (best case) =   2.31

3,458 sidewalk links scored:

- 6.20 maximum observed score

- 2.51 minimum observed score

Category Weights

- ■ Accessibility
- ■ Mobility
- ■ Safety

34% 33% 33%

**Histogram of Midtown SPI Results
3398 Segments**

Frequency values:
893, 1225, 13, 380, 269, 125, 172, 74, 79, 0, 32, 0, 56, 23, 8, 12, 14, 5, 2, 15, 1

Bin midpoints: 2.6, 2.8, 3, 3.2, 3.4, 3.6, 3.8, 4, 4.2, 4.2, 4.4, 4.4, 4.6, 4.8, 5, 5.2, 5.4, 5.6, 5.8, 6, 6.2

X-axis: Sidewalk Prioritization Index (Bin Midpoint)
Y-axis: Frequency

IMPLICATIONS FOR COMMUNITIES

The final steps in the asset management cycle are budgeting and execution. Communities may find that these steps are easier to accomplish with access to better data.

Budget

- Finding sources for funding is difficult – establishing a plan before attempting to raise money can ease constituent tax aversion.

- Cluster analysis can be used to reduce transaction costs for repairs within the same proximity.

- Understanding liability ramifications may encourage cities to take ownership of their pedestrian infrastructure.

Execution

- An assessment of equity can help drive improvement near certain use cases, such as bus stops and schools.

- Having an understanding of the pedestrian asset inventory and current condition helps scope repair costs and prepare RFPs.

- Tracking improvements can establish credibility and plan for in-house public works staffing.

Automation reduces front end labor costs and back end manual processing costs.

Sidewalk Cost Estimator

The Sidewalk Research lab is refining a cost estimation tool that provides estimates for construction based on standard pricing with the potential for economic benefits of scale by addressing problematic areas in proximity.

Automated Sidewalk Data Collection

The Sidewalk Research lab is investigating new approached to data collection to leverage advances in remote data collection, video processing, and deep learning.

CONCLUSIONS

- Sidewalks are transportation assets

- Surveys can reveal community goals and objectives

- SPI can transparently reflect community interests

- Sidewalk asset management systems can improve

  repair efficiency and overall sustainability of sidewalks

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Questions?