

The Future of Procedural Street Design

Presented by : David Wasserman
2015 ESRI User Conference



Defining Procedural Street Design

- **Procedural Street Design:** an umbrella term for a number of techniques that can be used to create 3D models of street environments based on rules for their design.

Infraworks

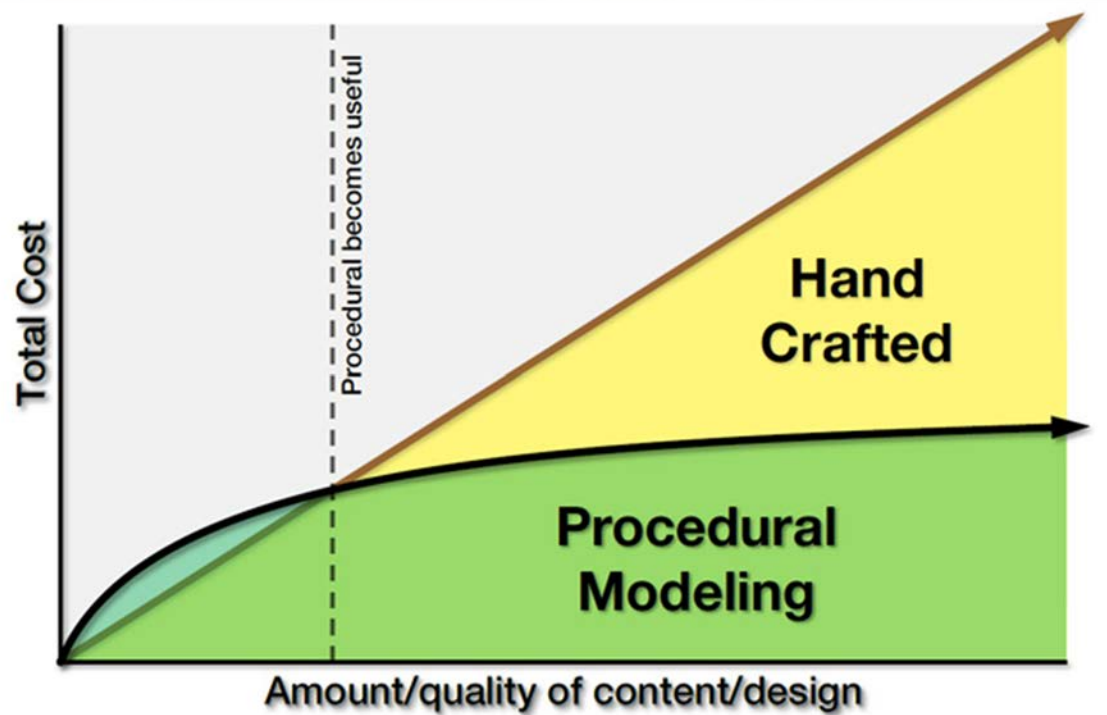


CityEngine



What is ESRI CityEngine?

- Founded in 2008 by Procedural, Inc.
 - Bought by ESRI in 2011.
- Initial Shapes + Code= “Smart models”

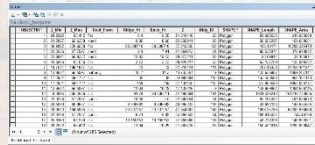
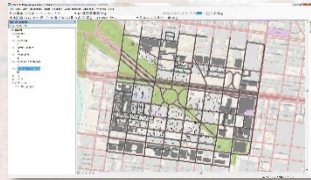


Graphic: ESRI CityEngine



What is the work flow?

1. Base Geometry



2. Procedural Rules

3D Models



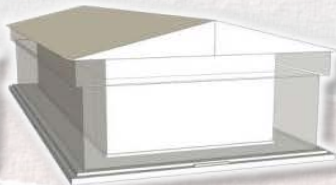
Textures



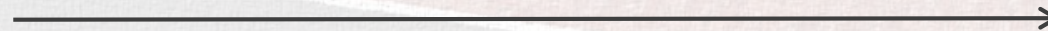
CGA



3. Generated 3D Model



Base geometry



Final 3D model

Iterative refinement

What is the Complete Street Rule?

- Specifications:

- Diversity of Street Types
- Exact Geometry
- Defendable Assumptions
- Analytics

Images are 100% Procedural



General Architecture of Rule

Start Shape: Sidewalk Left

Start Shape: Street

Start Shape: Sidewalk Right



- SW Walkway-Insert people, texture
- Planter_Split-Stops-Trees-etc
- Microsplit- Lights, Meters, Etc
- Left_Split_Space- Bikes-Buffers-Parking
- Left Transit Split- HOV-BUS
- Left Main Lanes-Default- Grows with Width of ROW
- Center Split- Centerline- Median- Boulevard-Barrier-Barrier with Shoulder**
- Main Width Attributes:**
 - Center_Width- Master Width Control
 - Boulevard Width- Controls Inner Boulevard Width (lane count)
 - Walk Way Width- controls width of sidewalks for the current orientation
- Right Main Lanes- Default- Grows with Width of ROW
- Right Transit Split- HOV-BUS
- Right_Split_Space- Bikes-Buffers-Parking
- Microsplit- Lights, Meters, Etc
- SW Planter_Split-Stops-Trees-Etc
- Walkway-Insert people, texture

DISPLAY OPTIONS	
Display_Textures	<input checked="" type="checkbox"/> true
Display_Thematics	<input checked="" type="checkbox"/> Thematics Off
Solid_Color	<input checked="" type="checkbox"/> #FFFFFF
Flag_Empty_Space	<input checked="" type="checkbox"/> false
LOD_Setting	<input checked="" type="checkbox"/> High
ROAD LAYOUT	
Basic Components	
Lane_Distribution	<input checked="" type="checkbox"/> 0.5
Lane_Width	<input checked="" type="checkbox"/> 3.3
Centerline_Color	<input checked="" type="checkbox"/> yellow
Traffic_Direction	<input checked="" type="checkbox"/> right-hand
Speed_Limit_in_MPH	<input checked="" type="checkbox"/> 30
Stop Markings	
Stop_Begin	<input checked="" type="checkbox"/> with stop marking
Stop_End	<input checked="" type="checkbox"/> with stop marking
Crosswalk Markings	
Crosswalk_Begin	<input checked="" type="checkbox"/> continental
Crosswalk_End	<input checked="" type="checkbox"/> continental
Begin_Crosswalk_To_St...	<input checked="" type="checkbox"/> 0.5
End_Crosswalk_To_Sto...	<input checked="" type="checkbox"/> 0.5
Crosswalk_Color	<input checked="" type="checkbox"/> white
Custom_Crosswalk_Tex...	<input checked="" type="checkbox"/> Complete_Streets/Sidewalk...
Crosswalk_Width	<input checked="" type="checkbox"/> 4.55
On-Street Parking	
Right_Parking_Type	<input checked="" type="checkbox"/> Parallel
Right_Parking_Width	<input checked="" type="checkbox"/> 2.44
Right_Parking_Length	<input checked="" type="checkbox"/> 6.1
Left_Parking_Type	<input checked="" type="checkbox"/> Parallel
Left_Parking_Width	<input checked="" type="checkbox"/> 2.44
Left_Parking_Length	<input checked="" type="checkbox"/> 6.1
Parklet_Percentage	<input checked="" type="checkbox"/> 0

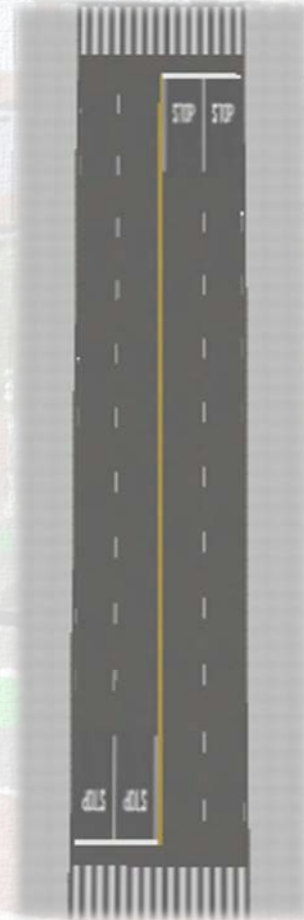
Efficient Cross Section Creation

- ▶ Design Fort Ord
- ▶ Charrette in Monterey, CA.



Real-Time Creation and Evaluation:

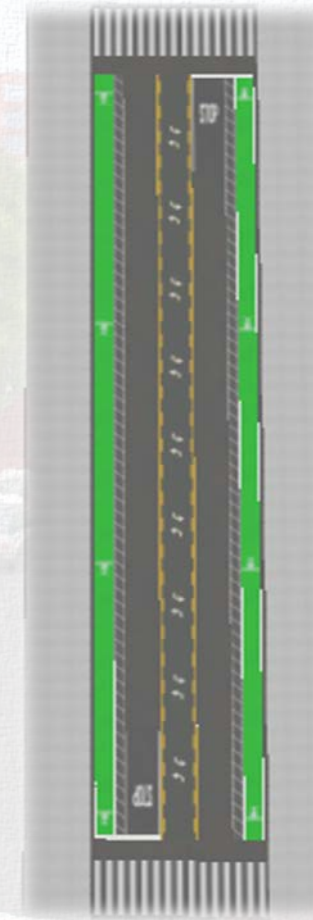
- Custom metrics can be developed



LTS 3: Mixed Traffic

LTS (0 to 1 scale):Auto St...	1	0.00	0.60
LTS (0 to 1 scale):Bicycle ...	1	0.00	0.33
LTS (0 to 1 scale):Pedestr...	1	0.00	0.60
LTS (0 to 1 scale):Transit ...	1	0.00	0.20

Both Segments are 30
MPH streets



LTS 1: Buffer and Bike Lane >6 ft.

LTS (0 to 1 scale):Auto Stress	1	0.00	0.60
LTS (0 to 1 scale):Bicycle Stress	1	0.00	1.00
LTS (0 to 1 scale):Pedestrian Stress	1	0.00	0.60
LTS (0 to 1 scale):Transit Stress	1	0.00	0.20

Generate Interactive Shareable Outputs

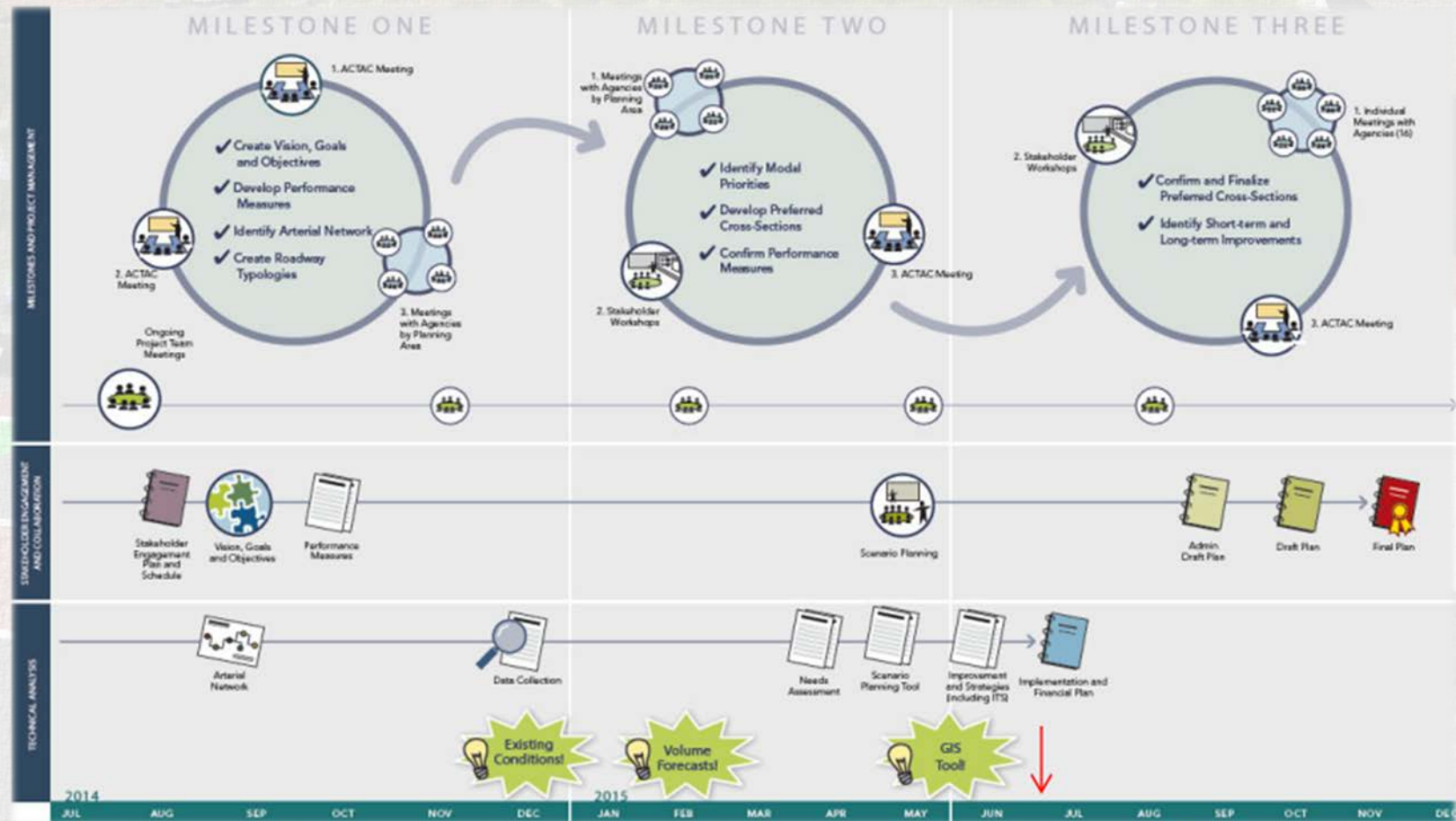
- Anyone with an Internet connection can see a proposal
- Support variety of scales:
 - Large scale web map of proposals
 - Neighborhood cross sections in context
 - Singular cross section



Project Case Study: Alameda Multimodal Arterial Plan

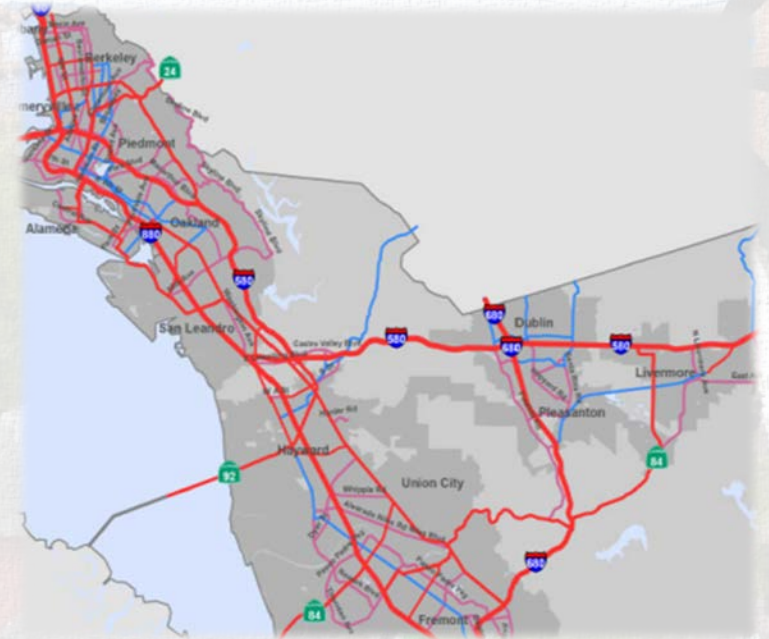
• Project Design

- Stakeholder Engagement Plan
- Identify Arterial Network
- Data Collection Plan
- Travel Demand Forecasting White Paper
- Roadway Typologies
- **GIS Cross-sectional Tool**
 - Proof of Concept



Arterial Network and Typology Identification

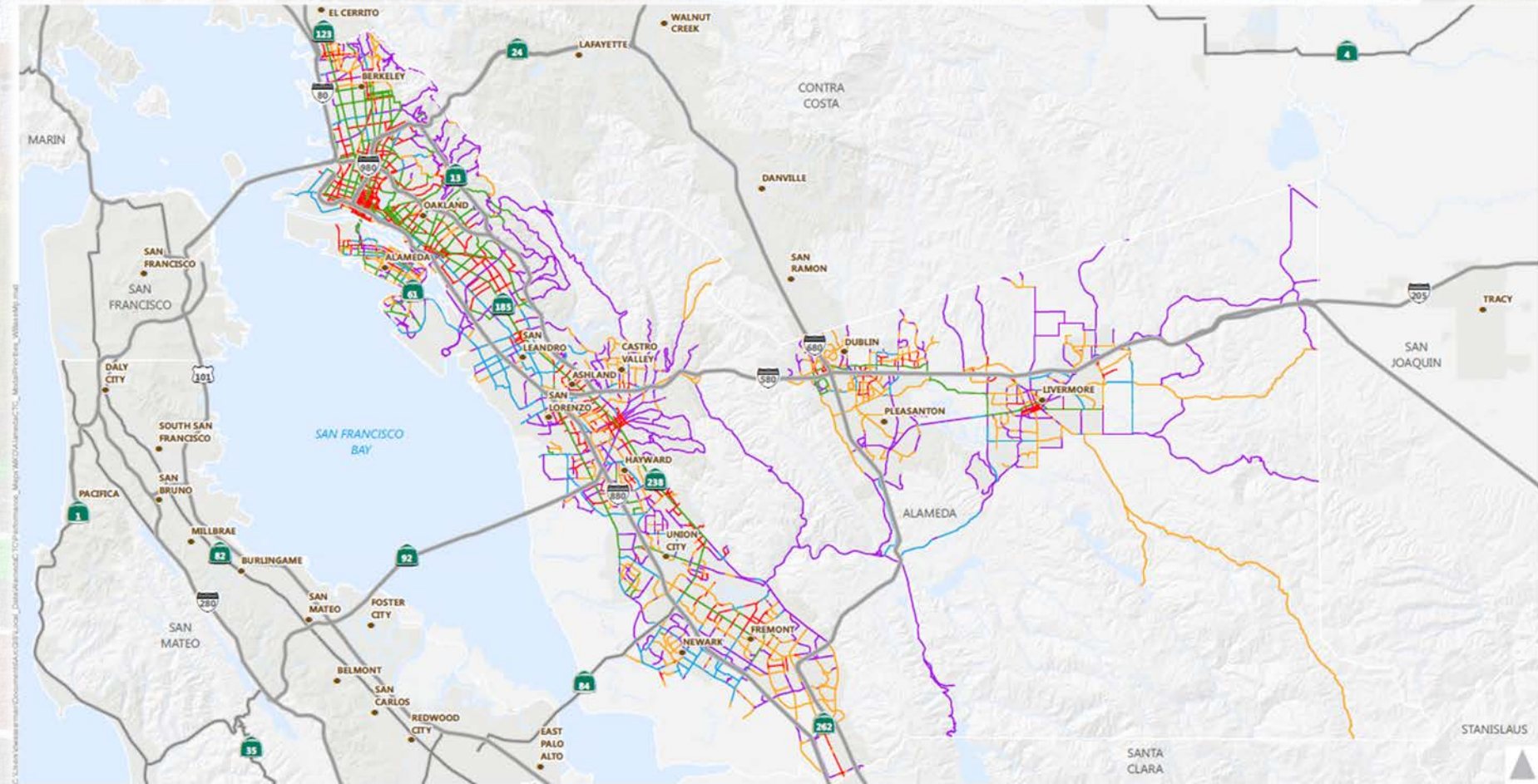
- Identify Arterials
 - Goal is to develop cross-sectional improvements for entire arterial network
- Identify Street Typologies
 - Informed by context, scale of travel, and function
- Typologies developed will identify parallel facilities to help build a more complete street network



Identify Modal Priorities

Modes Considered:

- Auto
- Trucks
- Transit
- Bicycle
- Pedestrian



Modal Priority 1

- Auto
- Trucks
- Transit
- Bicycle
- Pedestrian

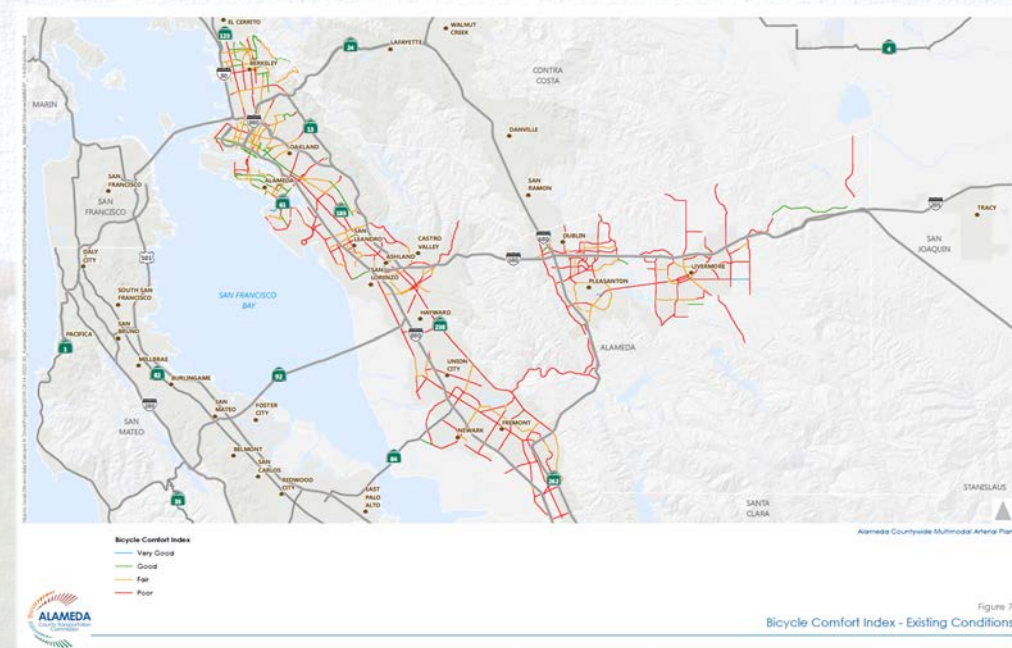
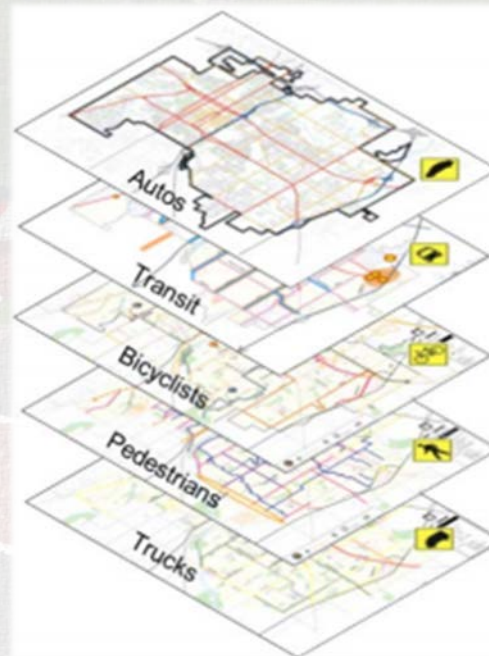


Alameda Countywide Multimodal Arterial Plan

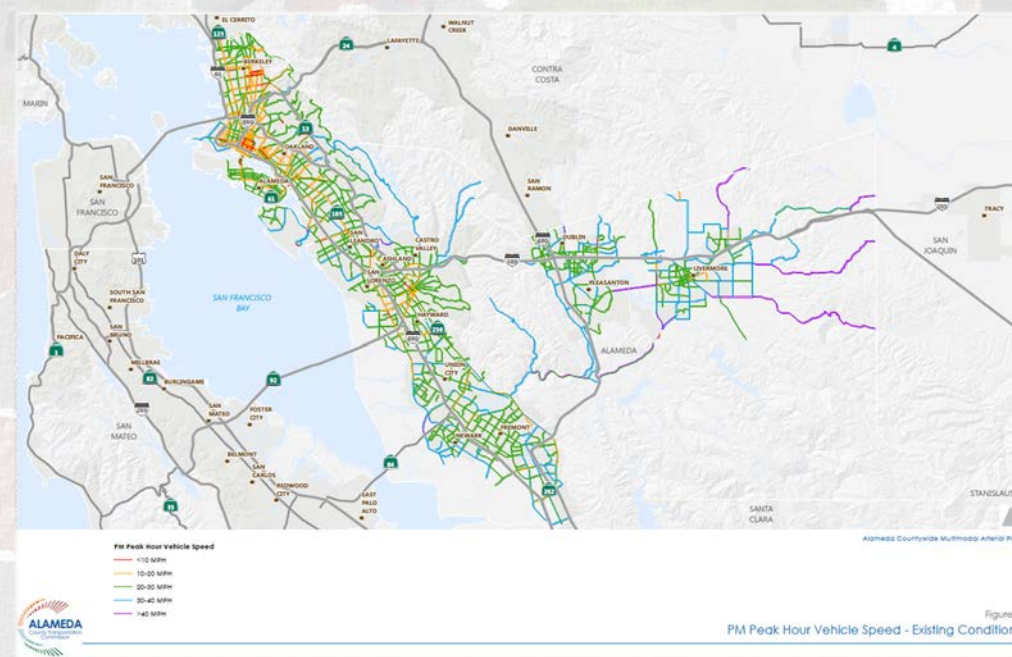
Modal Priorities for Arterials

Performance Evaluation

- Multimodal performance measures for entire network:
 - 60+ New Fields
 - Bicycle Stress
 - Pedestrian Comfort
 - Congested Speeds
 - Volume to Capacity Ratios
 - Truck Accommodation Index



Bicycle Comfort Maps

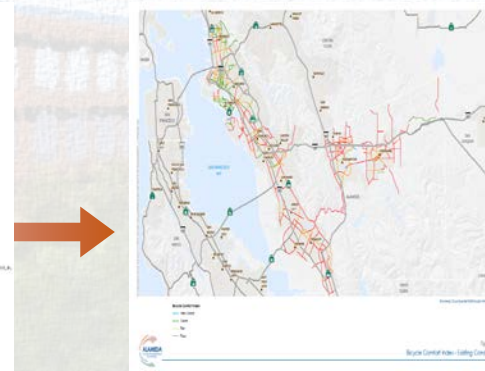
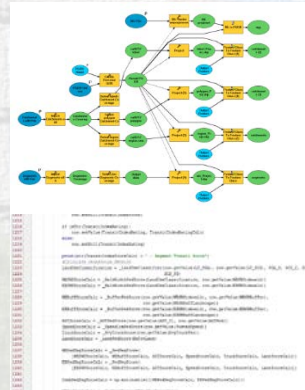


PM PH Volume to Capacity Ratios

Paradigm Shift: Alameda County Cross- Sectional Tool

GIS Analysis

Output: Attribution



- Data Informed Design:

1. Performance Evaluation + Modal Priority Identification
2. GIS Tool Attributes Line Segments
3. Attribution from GIS Tool translates into 3D models of cross sections.

3D Models



Textures

+



Data Driven
Decisions



- GIS Data → Analysis → Shared Visions

Theoretical Outputs

Theoretical Example: Portland Map App as Template

2035 Comprehensive Plan
Proposed Draft Map App

Map App Explorer

Land Use

1 of 3

Sandy Blvd Corridor Improvements, Phase 2

Project Number: 40068
Project Status: TSP List
Lead Agency: PBOT
Project Timeline: Years 1 - 10
Estimated Cost: \$6,481,860

Retrofit existing street with multi-modal street improvements including bicycle facilities, redesign of selected intersections to improve pedestrian crossings, streetscape, and safety improvements. Project design will consider freight movement needs, consistent with policies, street classification(s) and uses.

Transportation

Infrastructure

Layers

- Complete Street
- Existing Conditions
- Option A
- Option B
- Option C
- Option D
- Option E

View Comments

MAPS INFO LEGEND FAQs CONTACT

POWERED BY esri

Waves of New Data

- **Real-time data collection**
 - Cameras/Sensors
- **Remote sensing**
 - Drone Imagery/Satellite Video
- **Mobile Trace data**
 - GPS/Phone Signal
- **Street Level Data Collection**
 - Mobile LIDAR/Imagery
- **Contextual Modeling**
 - MXD/Activity Based Modes



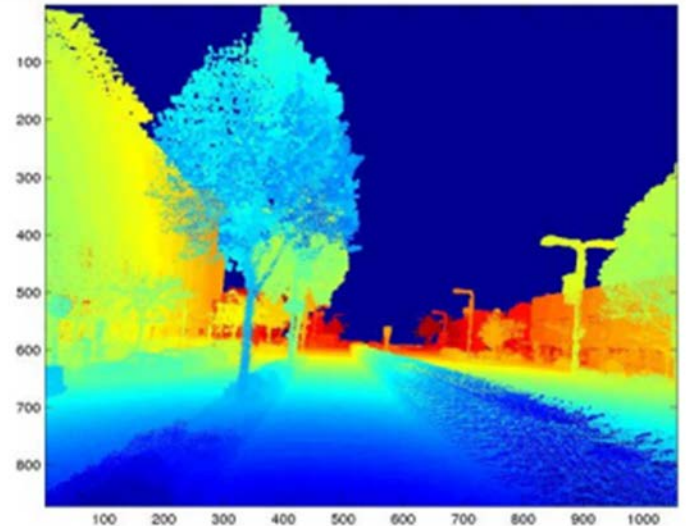
3D Imagery + GIS



LIDAR + CAD



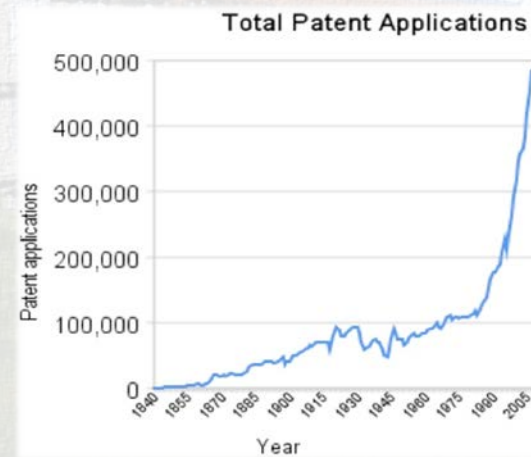
Surveying



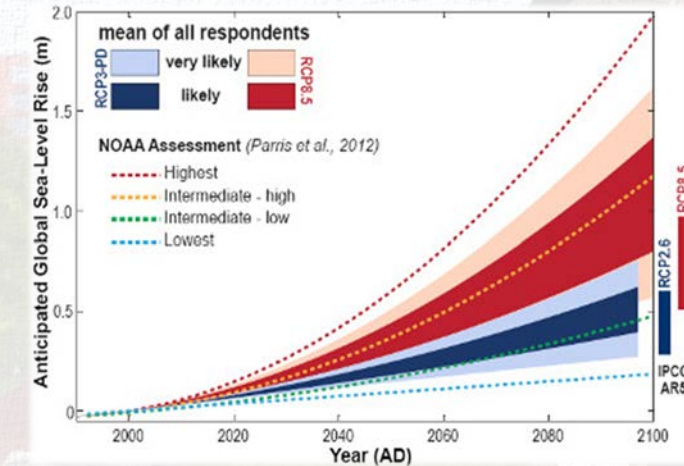
Where are we heading?

- We are moving into a dynamic, interconnected, and uncertain 21st Century.
 - Data-hungry adaptive plans and designs.
 - Cooperation among disciplines, stakeholders crucial
 - Budgets are tight; expectations for fast, informed decisions are high; importance of communication is critical.

Patent Applications



Sea level rise- NOAA



Global Facebook Graph





Questions?

Contact Card:

David Wasserman

Transportation Planner/GIS Programmer

Email: D.Wasserman@fehrandpeers.com

Geonet: <https://geonet.esri.com/people/Holisticbynature>

FEHR & PEERS

Sources

- Miller, Bill. Geodesign: Project Workflow. 2015. <http://www.wrmdesign.com/documents/GDProjectWorkflow-6.pdf>
- City of Goteborg, CityEngine Renderings. <http://www.cgarchitect.com/2014/11/webinar-procedural-modeling-for-beautiful-city-design>
- 2035 Comprehensive Plan Proposed Draft - Map App. Portland Bureau of Planning and Sustainability. <http://www.portlandmaps.com/bps/cpmapp2/>
- Fehr & Peers. MMAP for Alameda County. Presentations, Materials, and Scope of Work.
- Esri. Esri CityEngine Training Presentations. http://proceedings.esri.com/library/userconf/proc14/tech-workshops/tw_464.pdf
- Understanding Street Level Data Capture Technology. Anthony Fassero. Nokia Location and Commerce. http://www.nsgic.org/public_resources/02_Fassero_NSGIC-Nokia-Presentation-Final.pdf
- Why technology accelerates (Why does technology accelerate?) <http://www.s21.com/why-technology-accelerates.htm>
- Smith, David. "Facebook's Social Network Graph." *'Revolutions'*, 2010. Web. 29 June 2015.
- SLR Projections: Benjamin P. Horton, Stefan Rahmstorf, Simon E. Engelhart, Andrew C. Kemp, Expert assessment of sea-level rise by AD 2100 and AD 2300, Quaternary Science Reviews, Volume 84, 15 January 2014, Pages 1-6, ISSN 0277-3791, <http://dx.doi.org/10.1016/j.quascirev.2013.11.002>.