Bicycle Safety Feasibility Study

Study Components

- Safety Analysis
- Network Analysis Tool
Safety Analysis

- Crash Reports
  - Fatal: Indiana ’04-'05
  - Injury & PDO: Tippecanoe County ’04-'05
  - Some Reports Incomplete
- Bicycle Volumes Unavailable

Crash Reports

- 23 Fatal Crashes (Indiana ’04 -’05)
  - 14 Fatalities Not at Intersections
  - Common Causes Cited
    - Poor Lighting (10)
    - Erratic/Unsafe Cyclist Behavior (8)
    - Hit and Run Incidents (3)
Crash Reports

- 38 Injury & PDO (Tippecanoe County)
  - Most Crashes at Intersections
  - Common Causes Cited
    - Illegal Cycling on Sidewalks (3)
    - Cyclist Traveling Wrong Way (3)
    - Failure to Yield to Oncoming Bicycle Traffic (4)
    - Cyclists Ignoring Traffic Control Devices (5)

Potential Methods to Improve Safety

- Improve Lighting in High Volume Areas
- Enforce Sidewalk Ordinances
- Change Motorist Perception
  - Shared Use Lane Markings
  - Colored Bike Lanes
Measuring Safety

• Available Measures
  ▪ Bicycle Compatibility Index (BCI)
  ▪ Bicycle Level of Service (BLOS)
• Predicting User Perceptions Using Physical Properties
• No Bicycle Volume Factor

Bicycle Level of Service

(Sprinkle Consulting Engineers, Inc.)

• Prescribed Route Cycled by 150 Riders
• Riders Quantified Segment Comfort
• Linear Regression Fit to Factors
Bicycle Level of Service

\[ \text{BLOS} = a_1 \ln(\text{Vol}_{15}/L) + a_2 \ln(\text{SPD}_p (1+HV\%)) + a_3 \ln(\text{COM}15'NCA) + a_4 (\text{PC}_{15})^2 + a_5 (\text{We})^2 + C \]

- \( BLOS \) = perceived hazard of the shared-roadway environment
- directional traffic volume in 15-min time period,
- number of through lanes
- posted speed limit
- \% heavy vehicles

- frequency per mile of uncontrolled vehicular access (e.g., driveways and on-street parking spaces)
- trip generation intensity of the land use adjoining the road segment
- pavement surface condition
- average effective width of outside through lane

Bicycle Level of Service

- Requires Detailed Information
  - Trip Generation
  - Complicated Access/Parking Variable
  - Pavement Conditions
- Not Practical for Network-Wide Use
Bicycle Compatibility Index

(UNC Highway Safety Research Center)

• 202 Cyclists Viewed Videos of 67 Locations
• Cyclists Gave Perceived Comfort Level
• Linear Regression Fit of Factors

\[ BCI = C - a_1BL - a_2*BLW + a_3CLW + a_4CLV + a_5OLV + a_6SPD + a_7PKG - a_8AREA + AF \]

- LB < BCI < UB
- Bicycle Lane or Paved Shoulder present?
- Width of Bicycle Lane or Paved Shoulder
- Curb Lane Width and Vehicle Volume
- Other Lane Vehicle Volume
- 85th Percentile Speed of Traffic
- Presence of a Parking Lane With More Than 30% Occupancy?
- Presence of Residential Roadside Development
- Adjustment Factors for Truck Volumes, Parking Turnover, Right Turn Volumes
**Bicycle Compatibility Index**

- Requires Simpler Inputs Than BLOS
- More Practical for Network-Wide Use

**Network Analysis Tool**

- Weighted Links
- Aggregate Links Method
- All-to-All Shortest Path Method
Link Weights

• Assumes Cyclist Makes Route Choice Based on Two Factors
  ▪ Link Length
  ▪ Perceived Safety (BCI)
Bicycle Route Choice

BCI = 2.5
Length = 1 mi

BCI = 5.5
Length = 0.6 mi

Add in bike lane

BCI x Length = 1.8
BCI x Length = 3.3

Bicycle Route Choice

BCI = 5.2
Length = 0.3 mi
BCI = 3.8
Length = 0.5 mi
BCI = 2.1
Length = 0.4 mi
BCI = 4.9
Length = 0.7 mi
BCI = 1.9
Length = 0.3 mi
BCI = 4.2
Length = 0.3 mi
BCI x Length = 1.90
BCI x Length = 1.68
BCI x Length = 1.55
BCI x Length = 1.47
BCI x Length = 1.56
BCI x Length = 1.33

Bike Lane
Bicycle Level of Service

\[ \text{BLOS} = a_1 \ln(\text{Vol}_{15}/L) + a_2 \ln[\text{SPD}_p(1+\text{HV}\%)] + a_3 \ln(\text{COM15}\times\text{NCA}) + a_4 (\text{PC}_5)^2 + a_5 (\text{We})^2 + C \]

- **BLOS** = perceived hazard of the shared-roadway environment,
- **Vol** = volume of directional traffic in 15-min time period,
- **L** = total number of through lanes,
- **SPD** = posted speed limit (as defined in the Highway Capacity Manual),
- **HV** = percentage of heavy vehicles (as defined in the Highway Capacity Manual),
- **NCA** = effective frequency per mile of uncontrolled vehicular access (e.g., driveways and on-street parking spaces).

**COM15** = trip generation intensity of the land use adjoining the road segment (stratified to a commercial trip generation of 15, multiplied by the percentage of the segment with adjoining commercial land development).

**PC5** = FHWA’s 5-point pavement surface condition rating, and

\[ \text{We} = \text{Wt} + \text{Wl} - \text{Wr} \]

where **Wt** = total width of outside lane (and shoulder),
**Wl** = width of paving between the outside lane stripe and the edge of pavement, and **Wr** = effective width (reduction) due to encroachments in the outside lane.

Bicycle Compatibility Index

\[ \text{BCI} = C - a_1 \times \text{BL} - a_2 \times \text{BLW} + a_3 \times \text{CLW} + a_4 \times \text{CLV} + a_5 \times \text{OLV} + a_6 \times \text{SPD} + a_7 \times \text{PKG} + a_8 \times \text{AREA} + \text{AF} \]

- **BL** = Presence of a Bicycle Lane or Paved Shoulder
- **BLW** = Bicycle Lane or Paved Shoulder Width
- **CLW** = Curb Lane Width
- **CLV** = Curb Lane Volume
- **OLV** = Other Lane Volume
- **SPD** = 85th Percentile Speed of Traffic
- **PKG** = Presence of a Parking Lane With More Than 30% Occupancy
- **AREA** = Presence of Residential Roadside Development
- **AF** = \( f_t + f_p + f_r \)
  - **f_t** = Adjustment Factor for Truck Volumes
  - **f_p** = Adjustment Factor for Parking Turnover
  - **f_r** = Adjustment Factor for Right Turn Volumes