Traffic Evaluation Methodology
Overview

One of the required technical evaluations for a roadway project is determining whether the existing roadway accommodates existing traffic volumes and identifying alternatives that will address the future traffic needs. It is necessary to quantify how well a roadway is currently operating and how well it is projected to operate in the future for all alternatives considered. This determination is based on traffic data and the use of approved analytical procedures.

EXISTING TRAFFIC

Evaluating the existing roadway traffic operation occurs in a three-step process: 1) Data Collection, 2) Data Processing, and 3) Data Analysis. The following is a summary of those steps:

Data Collection

The first step in evaluating the roadway traffic operation is to collect existing traffic volumes in the study area. These counts are obtained manually by people counting each car, truck, pedestrian, and bicycle at each intersection. At a minimum, the two to three highest morning and evening traffic hours of the day are counted to assure the highest hour is counted. Typically, the following time periods are counted:

1) 12-hour movement counts are taken at all signalized intersections.
2) 2-hour movement counts are taken in the morning and 3-hour counts are taken in the evening at all non-signalized intersections with public streets.

Specific procedures are followed for these manual traffic counts. These include:

1) All vehicle movements at the intersection are counted (left turns, throughs and right turns).
2) All pedestrians and bicyclists that cross the main road and side street are counted.
3) Trucks are counted in addition to cars.
4) Counts are only taken on Tuesday, Wednesday or Thursday to avoid fluctuations in traffic occurring near the weekend.
5) Counts are not taken on days immediately before or after a holiday.
6) Counts are not taken during inclement weather (rain or snow).
7) Local conditions are considered since that may influence the count (i.e. school not in session).
8) Closely spaced intersections are counted on same day when possible.

Other field measurements may be collected in order to provide a more accurate analysis of the traffic operations. These could include measurement of saturation flow rates (maximum number of vehicles going past a point per hour) and lane utilization (percentage of cars in each lane going in the same direction), in addition to conducting travel time studies along the route (time to go from one end of the route to the other).

Data Processing

Some processing of the data collected is necessary. Since all of the intersections in the study area are not counted on the same day, there will be slight variations in volumes between each day. It is necessary to assure a balance in traffic volumes between intersections. In other words, assure that the volume of traffic leaving one intersection is closely equal to the volume arriving at the next intersection. In order to do this, the following steps are completed for both the morning and evening periods:

1) Determine the common peak hour
    - Identify the peak hour for each intersection. This is the 1-hour period in the morning and evening that has the most traffic passing through the intersection.
    - Identify which peak hour in the morning and in the evening occurs most often at all intersections.
2) Using the common peak hour, compare arriving and leaving volumes at intersections to evaluate the variations in traffic between the intersections. Choose one or two intersections where the variations are smallest and use these as the starting point to balance the volumes through the adjacent intersections.

3) During the balancing, consideration is given to mid-block driveways and cross streets which may generate traffic and create an imbalance in volumes between two adjacent intersections.

Annual Average Daily Traffic (AADT) volumes are also developed for the study area. These volumes represent a typical 24-hour volume which is a total of traffic traveling in both directions. Two methods can be used to develop AADT volumes when a full 24-hour count is not available. The first method uses 12-hour counts and the second uses peak hour counts if 12-hour counts are not available.

In the first method, two factors are used to convert the 12-hour counts to AADT:

1) Seasonal Adjustment Factor (SAF)
    - Traffic volumes vary throughout the year based on month of year, type of roadway and character of adjacent land use (residential, recreational).
    - The SAF is based on historical data and is applied to traffic counts to adjust to an "average" day
2) Expansion Factor (EF)
    - Traffic volumes can vary throughout the day, but have a consistent percentage of the AADT occurring during a 12-hour period. As with the SAF, this can vary based on type of roadway.
    - The EF is based on historical data and is applied to 12-hour traffic count totals to expand the count to a 24-hour volume.

The second method recognizes that the peak hour volume is generally about 8-10% of the total 24-hour volume on urban arterial roadways. The AADT can be estimated by dividing the 2-way peak hour volume on an approach to an intersection by this factor.

Once AADT's are developed, they are submitted to the Chicago Metropolitan Agency for Planning (CMAP) to obtain concurrence that they are consistent with the regional model. CMAP is the official regional planning organization for the northeastern Illinois counties of Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will and is responsible for developing the comprehensive regional plan for the Chicago area.

Data Analysis

Utilizing the peak hour and AADT information developed for the study area, an analysis is completed to quantify the capacity and operation of the existing intersections and corridor.

Each of the signalized intersections is first analyzed to calculate the intersection capacity. This is done using a nationally accepted methodology based on the Highway Capacity Manual (HCM) which is a publication of the Transportation Research Board (Special Report 209, 2000). The Highway Capacity Software (HCS) was developed by the University of Florida for the FHWA following the methodology in the HCM and is used for the analyses.

The HCM methodology calculates the capacity of signalized intersections based on an isolated method (i.e. the intersection is not influenced by adjacent intersections). The primary input into the HCS software includes traffic volumes including traffic mix (cars, trucks, pedestrians), number of lanes (through and turning), lane widths, traffic control (stop sign or signalized), and general terrain (shallow or steep grades).

When signalized intersections are fairly closely spaced (typically ½ mile or less between adjacent signals), a system analysis is also normally completed. This type of analysis takes into account the traffic flows and influence from adjacent intersections. Synchro/SimTraffic software can be used for the system analysis. The two parts of the software provide different types of analyses and serve different functions as follows:

1) Synchro
    - This is a macroscopic analysis and optimization program.
    - The software calculates the Level of Service utilizing the Intersection Capacity Utilization method (different method than HCS).
    - Synchro looks at queuing between intersections and the additional delay caused by the queues.

- Synchro can either use existing signal timings to evaluate existing operation or can optimize the signal operation and coordination between the signals to improve traffic flow.

2) SimTraffic
   - SimTraffic performs microsimulation and animation of vehicle traffic.
   - Individual vehicles are modeled and displayed traversing a street network.

Capacity of an intersection or roadway segment is described by its Level of Service (LOS). For an intersection, this is based on average vehicle delay at an intersection. For a roadway segment, it is based on density or average travel speed. Table 1 provides a general description and the average seconds of delay for signalized intersection level of service while Table 2 provides a general description and average travel speed for segments. The information in Table 2 is based on a typical free flow speed of 35 m.p.h.

Table 1 – Signalized Intersection Level of Service

Level of Service	General Description	Average Delay (seconds per vehicle)
A	Free flow traffic; many vehicles do not stop at all	<10
B	Generally good traffic flow; more vehicles stop than with LOS A	>10-20
C	Fair traffic flow; the number of vehicles stopping is greater than LOS B although many still pass through without stopping	>20-35
D	Longer delays; many vehicles stop and the number passing through without stopping decreases	>35-55
E	Poor flow and progression; the number of vehicles stopping is very high	>55-80
F	Very high delays with long queues of vehicles	>80

Table 2 – Segment Level of Service

Level of Service	General Description	Average travel speed
A	Traffic moves freely at or above the posted speed limit; all drivers have complete mobility to change lanes	>30 m.p.h.
B	Slightly more congested than LOS A; lane changes may be limited as motorists must occasionally drive side by side	>24-30 m.p.h.
C	More congestion than LOS B; the ability to pass or change lanes is not always assured	>18-24 m.p.h.
D	Speeds are somewhat reduced, motorists are hemmed in by other cars	>14-18 m.p.h.
E	Flow becomes irregular; road is approaching its design capacity	>10-14 m.p.h.
F	Flow is forced; every vehicle moves in lockstep with the vehicle in front of it	<10 m.p.h.

20-YEAR FUTURE TRAFFIC (2030 No-Build and 2030 Build)

Roadway improvement alternatives are evaluated based on 20-year future traffic (2030). These 2030 volumes are developed by CMAP using their regional model for each of the alternatives as follows:

Data Collection

The 2030 No-Build is one of the alternatives to be considered and compared to the Purpose and Need of the project. The 2030 No-Build traffic is developed assuming no changes are made to the roadway in the CMAP model. The model is then used to obtain traffic volume projections for the year 2030 based on employment and population trends and other updates provided by regional planners. The model accounts for all programmed regional roadway improvements.

Each Build alternative being considered must also be compared to the Purpose and Need of the project and must have 2030 traffic volumes developed for it. For the Build alternatives, changes are made to the roadway in the CMAP model based on the configuration of the proposed alternative. Again, CMAP's model is used to obtain traffic volume projections based on employment and population trends and other updates.

Data Analysis

The method of analysis to be used for future traffic volumes is basically the same as the methods used for the existing traffic data.

Using the 2030 projections developed by CMAP for the No-Build and Build alternatives, 2030 Design Hourly Volumes (DHV) are developed based on projected traffic growth from existing volumes to 2030 volumes. The same analyses will be run which were completed for existing conditions, including the HCS analyses for each intersection and the Synchro system analysis. These will be used to determine the capacity (Level of Service) of the intersections and roadway for the No-Build and each Build alternative.