Chapter 4 Presentation Script

Welcome to the Manual on Uniform Traffic Studies, also called MUTS, computer based training!
This training module will cover Chapter 4 - Turning Movement Counts.

This training contains audio, so please adjust your speakers accordingly.
An alternate version is available on the Resources page.
To begin select the start button or press Shift + N on your keyboard.

During this training module, we will refer to two forms in excel format stored on the MUTS online library through the FDOT's Traffic Engineering and Operations Office website.
Before continuing the training, consider scanning the QR code using your phone camera which directs you to the online library shown in this slide.

When conducting these studies, make sure to download the latest excel form available through the website.
The link to the form is also provided in the resources page to this training.
Please open Form numbers 750-020-02 and -03 as we will refer to these later in the module.

Intersection Turning Movement Counts, or TMCs, are the bread-and-butter of traffic engineering.
Most traffic studies, from corridor plans to signal retiming, require TMCs to understand current demand at study intersections.
More recently, TMCs are being used as an input to intersection control evaluations to help practitioners select the right intersection type at a given location.
This training will share guidance on how to collect, process, and present TMCs.

To get started, we will share a little more detail on the purpose of TMCs and the type of studies that these can inform.

At their core, TMCs are a summary of vehicle movements through an intersection.
In addition to vehicle movements, TMCs should also record non-motorist volumes like pedestrians and bicyclists.
While this training focuses on vehicular TMCs,

MUTS Chapter 9 discusses in depth how to conduct non-motorist volume studies.
If you are interested in learning more on the nuances for non-motorist counts, we encourage you to watch the computer-based training module for MUTS Chapter 9- Non-Motorized Volume Studies after completing this training.

As previously mentioned, TMCs can be used to make decisions for a wide range of studies, from planning to operations.
Some study types that typically need TMCs are listed on the right side of-this slide.
(listed on the slide: Geometric design, Capacity analysis, Intersection control type, Sign and signal installation, Signal timing, Pavement markings, Traffic circulation, Parking and loading and Vehicle classification)

Now that we know how TMCs are generally used, let's look at the most common types of counts out there.

There are three major types of TMCs: vehicle counts, path-based counts applicable to most alternative intersection designs, and counts at other alternative intersection counts.
We will start with "vehicle counts," where each individual vehicle is counted.

When counting vehicles at signalized intersections,
it is recommended that at least five signal cycles be captured within each interval;
intervals are typically 15-minutes long.
Pay extra attention when the intersection has permissive turning movements
or when right-on-red counting is necessary.
When additional information like this is needed,
additional resources may be required to complete the data collection.
Resources can include observers in the field or time during post processing of recordings.

Vehicle counts may be done manually or via automated means;
either method is often paired with the assistance of video cameras or drones.
Manual counts at signalized intersections typically require more than one observer,
as they are commonly done in the peak hour when the volume of traffic is highest.
When using video cameras to manually post-process the footage recordings,
the number of cameras and their placement will depend on the size
and configuration of the intersection.

Automated counts can include video image processing,
in-road tube or loop counters, and emerging technology such as cell phone location data.

In oversaturated conditions, the number of vehicles turning at an intersection
may not reflect the true demand. Let’s look at the analogy of the funnel to visualize this concept.
Water is being poured at a high rate from the pitcher into the funnel.
The funnel’s neck is too narrow to process all that water,
and so water builds up inside of the funnel.

If we were to count the three drops coming out of the funnel ,
we would undercount the amount of water that needs to make it through.
In essence, the water being held up inside the funnel is “unmet demand.”
In certain types of studies, such as signal warrant studies,
quantifying the overall intersection demand is critical to the analysis.

Note that MUTS Chapter 3 provides detailed information on the data collection requirements
to conduct a signal warrant study.
Let’s look into a solution to obtain the overall demand on the following slide.

The solution in these situations is to count the arrival and departure volumes
in addition to the turning movements.
Arrivals are counted as vehicles approach the intersection and join the queue.
Departures are counted as the vehicles cross the stop bar.
A detailed example of this type of counting is provided in the Institute of Transportation Engineers
or ITE Manual of Transportation Engineering Studies 2nd Edition referenced on this slide.

Now, let’s take look at the second major type of TMCs: "path-based counts.”

Some intersection configurations combine multiple movements into shared lanes,
such that the TMCs are dependent on the origin and destination of vehicles,
also known as the vehicle path.

Alternative intersection designs, such as roundabouts, jug-handles,
quadrant roadways or median U-turns, require this type of counting.

As an example, let’s take a look at how drivers complete their turning movements at two different alternative intersection types: Restricted Crossing U-Turn or R-CUT and Median U-Turns or MUT.

If we were to count only the primary intersections, the associated turning demand would not be reflected in the count. In our first example , you will notice that a motorist making a northbound through movement at this R-CUT intersection needs to make a northbound right first, complete a U-turn, and then make a westbound right.

Our second example shows a northbound left movement at a MUT, which shows up as a northbound right at the primary intersection, followed by a U-turn and the vehicle continues westbound through at the primary intersection. Because of movements like these, it is necessary to conduct path-based counts at intersections with these configurations.

There are three methods of obtaining path-based counts: though manual observation, video tracking, and sampling. The manual method works best for small roundabouts where the observer can keep track of vehicle movements.

In heavier traffic or intersections with larger footprints, video cameras or drone footage can be used to improve accuracy and vision. Video tracking involves using machine vision to track and count vehicles as they navigate the intersection.

Note that the sampling method involves gathering origin-destination for only a subset of all the vehicles turning at the intersection. Based on complementary counts of *all* vehicles using either manual or automated means, the sampling method can then be extrapolated to a TMC estimate.

Finally, let’s take a look at other alternative intersection counts.

Other alternative intersection designs, including Single Point Urban Interchange
and Displaced Left Turns or DLT generally do not require path-based counts
as all movements can be observed in isolation at a single location.
If not already, the observers should become familiar with the flow patterns
at these intersection types before conducting the study.

Now that we have covered the broad types of TMCs,
we will dive into the different methods for collecting the data.

As previously discussed, the primary distinction is between manual and automated methods.
In the MUTS, we define manual collection methods as those where a human observer
must manually tally the counts.

Automated counts reduce observer workload by using technology
to perform the tallying without human input,
although a person must still perform quality checks, review, and report.

Let's dive a little deeper into the differences between manual and automated data collection.
Manual data collection is still the industry standard for TMCs,
as it requires little setup and is flexible enough to work in a wide range of conditions,
including poor lighting and weather.

It also has the added benefit of being able to capture other elements of the location at the same time, such as lane configuration, signal timing, queuing and more.

On the other hand, automated counts may be more cost efficient as the number of locations or the number of hours to capture goes up. It can also be the preferred alternative when counts are needed for a past date, as some automated methods can rely on archived data.

There are several tools that can aid during manual data collection and input.
The most basic of tools is simple paper and pencil,
using predetermined forms such as the ones included in this chapter.
We will describe these in more detail in later slides.

Another solution is electronic count boards, which can keep track of time while aiding in data entry.
As mentioned earlier, cameras may also be used to enable post-processing of counts
away from the count site.

Finally, mobile devices such as laptops, tablets,
and phones may be loaded with software that can help keep track of time,
aid in data entry, and summarize the data for delivery.

As to personnel needs, the number of observers will depend on the type of count,
the duration of the counting period, traffic levels, and number of lanes being observed.
Whether the counts are being done on the field or later based on video footage
will also affect personnel needs.

Breaks of 10 to 15 minutes are recommended at least every 2 hours,
or 30 to 45 minutes every 4 hours for data collection periods longer than 8 hours.

The first step when doing data collection fieldwork is to obtain and review a preparation checklist,
such as the one published by ITE in its Manual of Transportation Engineering Studies 2nd Edition.
It is important to identify good locations with unobstructed views of the intersection
ahead of time and arriving at least 15 minutes before the start of the data collection period to set up.
Safety vests and other personal protective equipment should be worn at all times.

If drones are being used for the data collection,
it is critical to prepare ahead of time as the Federal Aviation Administration
regulates the operation of drones.

Regulations include altitude restrictions or complete bans on flying drones.
All data collection should be researched in advance to comply with these regulations.

Drone video collection requires special personnel,
including having Federal Aviation Administration-one or more licensed drone pilots.
For short counts, a single drone or pilot may be sufficient.
Longer counts could benefit from more drones and pilots to ensure continuous filming
while batteries are being recharged.

A tethered drone plugged into a power source is recommended for extended periods.

Now that we have covered the different tools for manual data collection,
let's dive into the forms available with this chapter.
We will start with Form number 750-020-02: Summary of TMCs.

The heading of this form should be filled in completely.
Identify the location of the observer by marking the appropriate checkbox in the intersection diagram.
If more than one observer is used, name and number each and identify their location by number.
Briefly describe the weather if relevant and include any road conditions
which may influence the results of the data being collected under *Remarks*.
For example, a stalled vehicle that may temporarily restrict a vehicle movement
during a time period should be noted.

Enter the Street Name of each roadway and orient the intersection
by indicating north by directional arrow.
Enter the letters NB, EB, SB, or WB indicating the direction of approach
in the appropriate box of the intersection diagram.
In the box behind the movement indications, enter the number of lanes for each movement.
Note right turns can occur even if no exclusive right turn lanes are present.

For each time period to be counted, enter the Begin and End time.
Twenty rows are provided so that a total of 4 hours can be counted in 15-minute periods
and allow the user to enter hourly totals.
The intervals can be adjusted by the observer and these should be recorded accordingly in the form.
Enter the actual counts of vehicle movements in the appropriate time period and L, T, R column.

Finally, add up the counts and record in the "TOTAL" row below and "TOTAL ALL" column
to the right of the input cells.
Note that the spreadsheet will automatically add the counts into the total columns
if data is entered electronically, so practitioners do not need to compute totals manually
if the field data is recorded electronically into the spreadsheet directly.

This slide shows an example of how to fill out Form number 750-020-03:
Vehicle TMCs, which can be used for most intersections.
As with the previous form, the heading of the form should be filled out completely.

This form can be used to record the total number of passenger vehicles
and other vehicle classifications such as heavy vehicles for each movement within a peak hour
or analysis period.

Now that we have covered manual counts and the tools available,
let's take a look at the types of automated counts available.
There are three categories described in the MUTS chapter:
in-road counters, typically pneumatic tubes, or loop detectors;
video processing technologies; and the more recent and emerging,
probe data sources - these are typically from cell phone or connected vehicle datasets.

While in-road counters may not be useful for TMCs,
they could be used in conjunction with other methods described above
(such as the sampling method) to estimate TMCs.

When deploying in-road counters in the field,
start with obtaining and reviewing a preparation checklist.
Research ahead of time for a suitable location that will accomplish your study's goals.
In-road counters should be installed at right angles to the flow of vehicular traffic
as shown in this picture.
Areas to avoid include parking lanes, locations with frequent queuing, expansion joints,
sharp edges, and curves. Make sure to note in a sketch diagram
where the counter is ultimately placed.

Once the counter is in place, test it with a test vehicle to ensure it is working as intended.
Secure the sensor to the pavement and to a fixed object on the ground
such as a sign or tree to prevent vandalism.

Roll up any loose cables and tie down as short and compact as possible.
Finally, set the count interval to reset on the hour for ease of analysis and write down the start time.
Consider checking back periodically to ensure the sensor is still capturing data as intended.

Another type of automated counting relies on video image processing,
where a computer runs an algorithm to analyze an image and identify vehicles and their movement.
Video image processing can also be used to read license plates for use in the sampling method.

As with most automated technologies, there are some limitations.
If the footage has poor lighting or visibility,
the computer may not be able to pick up every vehicle in the frame.
It can also miss vehicles that are behind large objects, including trucks or buses.
As always, a human reviewer is needed to quality check the data and ensure its accuracy.

As noted earlier, the two forms available through this chapter,
Form number 750-020-02 and -03, have fields for various roadway elements.
This section summarizes these elements and the databases that can be used to obtain them.

The forms in this chapter ask for lane geometry, site layout, signal timing, and more
(listed on slide: location geometry, site layout, signal timing, equipment inventory, photographs of the site and equipment).

This information is often available from databases by FDOT or local agencies.
Three of the most common databases include the FDOT Roadway Characteristics Inventory or RCI database, the Florida Transportation Information or FTI,
and the Florida Traffic Online Web Application.

Let's look at key takeaways from this chapter and the forms.

TMCs are useful in a wide range of planning and operations studies.
They can be collected manually or through automated means,
with or without the assistance of video cameras.
If manual data collection is to be performed,
consider using some of the tools described in this training,
ranging from paper and pencil to drones and mobile devices.
If automated technology for data collection is to be employed instead,
the practitioner may need to plan for additional setup and review time,
as well as investigating potential limitations.

The two forms described earlier in this training can be accessed
by clicking the link on this slide or by scanning the QR code with a cellphone camera.

This concludes the Manual on Uniform Traffic Studies computer based training,
Chapter 4 - Turning Movement Counts.

[Web]

You will now be directed to a 10-question quiz to test your knowledge and understanding on the material presented in this computer-based training.
A passing grade of 70% is required to obtain the Certificate of Completion for the training.
If a grade below 70% is obtained, the trainees are required to re-take the full training until a passing grade of 70% or higher is obtained.
If you do not pass the quiz, please return to the Index page by selecting the Index button below and re-take this training.
To continue to the next chapter of this training please select the “NEXT” button below this CBT.
On the next slide, please enter your first and last name before continuing to the quiz.
Thank you for your time and attention.

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If you do not pass the quiz, please return to the Course Content tab, and re-take this training.
To continue to the next chapter of this training please go to the next chapter on the MUTS course content tab.
Please, continue to the quiz and thank you for your time and attention.