1. Are you using crash data in your site selection process?

   No, I have not, but that is a criteria mentioned by others such as the Traffic Monitoring Guide who copied (with attribution) it from the National Bicycle and Pedestrian Documentation Program which recommend locations "where either bicyclist and/or pedestrian collision numbers are high." I agree with that.

   Words of caution: As a bicyclist safety researcher, I think we need to be cautious of how we do our safety studies. Either count all sites in a given category (regardless of crash history) in a systematic way or possibly focus efforts on in depth analysis of high crash sites. I'm not sure that casual inclusion of locations with one or more bicycle-motorist or pedestrian-motorist collision will benefit either the safety study or the count program. Only studying locations with one or more crashes may lead to bias in safety studies, because locations with zero crashes would not be included in a systematic way.

2. What's the difference between the site selection criteria and the grouping criteria? Why wouldn't you want groups based on some of the other site selection criteria identified (i.e. facility type, land use, etc.?)

   Site selection criteria are a combination of the criteria you think will be important in grouping stations and the technical and political considerations. The grouping stations criteria are the ones that actually are found to be related to different patterns, so yes, they are related.

   Traffic Patterns. In the Colorado analysis we found that the traffic pattern didn't seem to be determined by the facility type. We saw commute patterns both on-path and on-street. I had expected paths to be more recreational, but that's not what I found. And we see on-street locations with non-commute patterns as well as paths. For this reason, I don't recommend grouping counters by facility type necessarily. However, I still recommend that permanent counters be located on both paths and roads because this finding might not be true everywhere, and it's just good to get a variety of count locations, if possible.

   Land Use. About land use, I think that could be a good criteria for both. Our work in Colorado found that patterns differed in central city vs the outskirts of town and outside of city limits. Others have found land use to be an important factor in biking and walking behavior, so that's a great thing to look at and I hope we see more research to tell us if and how land use might be a good way to select station locations and group stations. On the state level, however, urban vs. rural seems to be close enough to accounting for land use until we have larger data sets to work with.

3. How do you calculate the error in short duration counts?

   Great question! One can only really compute the error for the permanent count locations because those are the only locations where you have the true Annual Average Daily Bicyclists or Pedestrians (AADBP). Many are staring to do these calculations and we're listing their work on our webpage (http://www.pdx.edu/ibpi/compute-factors). In our 2013 TRB paper (which I showed in the presentation), we show the error for different counting time periods ranging from 15% to 60%. After creating factors, similar analyses could be done to estimate error.

4. In your example, what resources does boulder have to implement their counting program?

The city of Boulder started counting by hiring grad students from the University of Colorado. They decided that it might be cheaper for them and they'd get better data in the long run if they used the money to buy some counting equipment and have their signal staff install it. They started doing this in 1998. With very little maintenance, many of the count sites are still in operation. It has been a very low budget operation for them and has resulted in some of the oldest continuous counts available in North America. Lately they've been spending a little more to update the equipment. (They have about 25 sets of loops distributed at about 12 locations in the old program). That was a while back (late 90's) and they did most of the installation themselves.

5. We're starting a counting program from scratch, and have a very limited budget; we may only have enough for 3-4 counters statewide. Would you suggest concentrating efforts on choosing permanent locations or conducting a series of short-term counts?

Two options:

1) If you already know some locations with relatively high bike/ped volumes, I'd just do all permanent counters at those high volume locations distributed in different geographic/climate areas around the state.

2) If you don't know where more than one high volume location is, install one permanent counter in the known high volume location and spend the rest on temporary counters so you can find the higher volume locations for the next round of permanent counters. I hope you have at least one known high volume location.

6. Did I miss video and image recognition software to count? Could count number, female/male, age, helmet, speed, even type of bicycle.

I didn't have enough time in the webinar to talk about all the technology options, so you're right, I chose to just focus on the common and tried and true technologies and didn't cover video image recognition. (Of course I did mention that can video tape and watch in office later, but I'm guessing that's not what you mean.) I have hope that video image recognition will be a great way to conduct bike/ped counts. I know it has worked in some locations. I'm still looking for a good validation study that shows that this technology is sufficiently accurate and sufficiently low cost to be applied more generally. If you have one, please send it! Even in cases where it has been used to count with decent accuracy, I'm dubious that it could correctly identify gender, helmet, age, or type of bicycle. That's hard enough when you're there in person and even harder watching a video in the office. But it could do a great job with speed.

7. We have an annual traffic count program for our MPO (screenline tube counts) and would like to incorporate bike counts, but our contractor has told us that the tubes are not senstive enough for bikes, and adding a 2nd tube for bikes could create issues on higher-volume roads (they can pull out of the road more easily since they are lighter weight). Any suggestions for how to incorporate bike counts into our program?

Boulder County has integrated bicycle counting into their motor vehicle count program using MetroCount pneumatic tube counters. They use smaller diameter tubes and a different classification scheme than that provided by the manufacturer. A recent paper in ITE Journal documents their work, and we're also providing the resources including the classification scheme itself and instructions on our website at http://www.pdx.edu/ibpi/short-duration-count-program . Sometimes they have to use two sets of tubes for wider roads, but for two lane county roads with little shoulder they can use just the regular motorvehicle tubes and they

apply an adjustment factor to account for the inaccuracies, especially for bikes on the far side of the road from the detector.

8. How well/poorly do short duration counters work on roadways/on-road bike lanes? Can pneumatic tubes differentiate well between cyclists and vehicles?

    Most pneumatic tube counters for motor vehicles don't work at all, but Eco Counter makes one specific for counting bicycles which can differentiate between cyclists and vehicles. (Documented in recent paper in ITE Journal – Hyde-Wright et al 2014) See also the question above for Boulder County's experience.

9. If doing manual counts, How many hours per day and then how many days to get accurate average?

    Of course this depends on what you mean by accurate and what is humanly possible. The TMG says, "The preferred length for short-duration counts is 12 hours, which permits calculation of time-of-day use profiles" and also cautions, "Manual observers' counting accuracy declines after 2 hours, so observers should be given short breaks or replaced with other observers." Of course recording 12 hours of video and watching it later in the office can meet this requirement if you have either the volunteers or the staff to do it.

    The National Bicycle and Pedestrian Documentation project gives this advice: "We suggest that between 1 and 3 counts be conducted at every location on sequential days and weeks, based on the approximate levels of activity. Areas with high volumes (over 100 people per hour during mid-day periods) can usually be counted once on a weekday and weekend day, unless there is some unusual activity that day or land use nearby."

    If you really can only count for only a few hours, it's critical to choose that time period carefully. The **5 to 7pm time on a weekday (Tuesday, Wednesday or Thursday) in mid-September** as recommended by the National Bicycle and Pedestrian Documentation Project does seem to be one of the best times to count. I found that if relatively robust seasonal adjustment factors are available and just one hour of count data is available for a Tuesday, Wednesday, or Thursday from 5pm to 6pm in mid-September, I computed an average absolute error of 27%. If counts from 5pm to 6pm on 3 days (Tuesday, Wednesday, and Thursday) in a week in mid-September were collected, the absolute error averaged over 8 locations was just 12%. This is stunning given only 3 hours of data were used to make the estimate!

    In conclusion, here are the conditions under which one can minimize error when using manual counts:

    -   Count in mid-September
    -   Know your patterns. At least once, record the counts over a whole day so you'll know if this is a commute pattern site, non-commute or some mix of the two. The best factors in the world won't do you any good if you choose the wrong factor group.
    -   Know your factors. Strive to get at least 7 permanent counters per factor group.
    -   If you have a commute pattern, count 5 to 7pm (or 4 to 6pm – depending on the site), Tuesday, Wednesday, and Thursday. I'd rather see just one hour of counts (5 to 6pm) on all three days than three hours of counts on one day, assuming you know the pattern at that location.
    -   Accuracy will be higher for higher volume locations, generally, because higher volume locations have lower variability.

Of course there are some advantages to manual counts, such as the ability to determine gender and helmet use and to involve the community. It's not the best for accurate volume estimates, but that doesn't mean it's not useful or beneficial in the big picture.

10. Would you like to do a webinar about capacity of bicycle facilities?

    Oh, I'd love to! I've ridden many paths and lanes that felt over capacity (not LOS A!). I'm sure we can find some other folks to speak on the topic as well.

11. Can anyone share objectives, activities and performance measures that meet MAP21 needs to support development and implementation of a bike count project, especially that would fit into a Traffic Records Coordinating Committee strategic plan, or a Strategic Highway Safety Plan?

    As I mentioned at the end of the webinar, the National Institute of Transportation and Community (housed at OTREC) is embarking on a project to create a national bicycle and pedestrian count data archive which would feed into the FHWA's Travel Monitoring Analysis System (TMAS). TMAS is the database which houses FHWA's motor vehicle traffic, so integrating non-motorized travel into this database is a way to more readily provide data to any nation-wide plan. That FHWA is now accepting non-motorized traffic data is a huge step forward!

    For other visionary efforts to integrate non-motorized traffic data with safety and other datasets, check out the Transportation Research Board's Bicycle and Pedestrian Data Subcommittee's mockup of what a clearing house for all bike/ped related data might look like (including safety data): https://sites.google.com/site/bikepedclearinghouse/home

12. If doing manual counts, How many hours per day and then how many days to get accurate average?

    See 9