



# LET'S TALK ABOUT RUTTING

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# BEFORE WE START...



- I DON'T LIKE SPEAKING IN FRONT OF GROUPS
- I LOVE RPUG (BEST WEEK OF THE YEAR FOR ME AND MY FELLOW DATA NERDS)
- BIGGEST SOAPBOX: VENDORS SHOULD BE THE LAST PEOPLE TO PRESENT AT EVENTS LIKE THIS...AND WE SHOULD CHALLENGE OURSELVES TO ADD TO THE TECHNICAL DISCUSSION AND NOT GIVE A SALES PITCH NO ONE WANTS TO HEAR
- VENDORS OFTEN HAVE A UNIQUE PERSPECTIVE BECAUSE THEY WORK ON SO MANY DIFFERENT PROJECTS--AND ALSO SERVE CRITICAL ROLES IN DEVELOPING TECHNOLOGY & EDUCATING US ALL ON BOTH THE POTENTIAL & PRACTICAL LIMITATIONS OF EQUIPMENT AND METHODOLOGIES.
- DATA PRESENTATIONS CAN BE "SEXY"

# RPUG 2017 - DENVER

~~Understanding Design and Data in an Automated World~~ Wings & Napkin old slide!

## Panel Topics:

- The importance of lane markings—what can we do if they don't exist?
- Curvature and Geometrics—Why can't we all agree? <sup>Can we do it they don't what</sup> <sub>we all agree?</sub>
- How to Improve Data Comparisons + Life cycle Analysis
- Friction Data Collection is Antiquated Lock wheel? <sub>Anti-lock is prevalent</sub>
- How can we save \$ on Data Storage?
- Cracking! How about a national standard we all want to use?
- 3D and IMU - Terrain Mapping Is the future  
→ Super Elevation + Curves
- 3D Faulting - We can localize the measurement to the joint - average across the whole lane

## Potential Panel Topics:

1. The importance of lane markings—what can we do if they don't exist?
2. Curvature and Geometrics—Why can't we all agree? States may not know they don't agree with each other.
3. How to improve data comparisons and life cycle analysis using GIS (as an industry)
4. How can we save \$ on data storage? Pavement/Assets groups pay DOT very high IT overhead costs
5. Lock Wheel Friction Data Collection is Sooooo Antiquated. Most cars have ABS
6. Cracking! How can we create a national standard DOTs WANT to use?
7. 3D and IMU- Terrain Mapping is the future. Super Elevation/ Curves
8. 3D Faulting-We can localize the measurement to the joint, averaging across the entire lane
9. Using Data Intelligence (Power Pivot, Power BI, Tableau)
10. Defining a "rut" is more difficult (and important) than it sounds

# WHY START A CONVERSATION ABOUT RUTTING?

- IT'S AN IMPORTANT DATA TYPE! IT'S COLLECTED NETWORK-WIDE BY VIRTUALLY EVERYONE IN THIS ROOM. THE STATISTIC IS AN IMPORTANT METRIC IN OUR CONDITION RATINGS, HELPING TO DETERMINE RECOMMENDED TREATMENTS (AND THEREFORE BUDGETS).
- IT'S A COMPLICATED MEASUREMENT! YOU MAY BE SURPRISED TO LEARN THAT NOT EVERYONE MEASURES/ CALCULATES/ REPORTS RUTTING THE SAME WAY! THERE ARE MANY CUSTOMIZED RUTTING ALGORITHMS USED EVERY YEAR TO MEET THE SPECIFIC NEEDS OF VARIOUS PROJECTS. WE'LL NEED TO COVER SOME SPECIFIC REASONS WHY TODAY...
- WHILE SOME PROCEDURES AND STANDARDS ALREADY EXIST TO HELP VALIDATE SOME MODERN AUTOMATED EQUIPMENT USED TO COLLECT RUTTING DATA (AND OTHER STATS), THE AVERAGE STATE DOT HAS SOME MORE PRACTICAL REAL-WORLD NEEDS AND CONCERNS:
  1. HOW IS A RUT DEFINED (AND CAN IT BE STANDARDIZED ACROSS TECHNOLOGIES)?
  2. ONCE WE HAVE #1 DEFINED, HOW DO WE SIMPLY AND PRACTICALLY VALIDATE THAT OUR EQUIPMENT IS MEASURING IT?

# AN OFF-THE-RECORD, VENDOR-AGNOSTIC SURVEY



- TO SOLICIT FEEDBACK FROM INDUSTRY, I SENT OUT REQUESTS TO ALL VENDORS I COULD THINK OF, MENTIONING A DESIRE TO START AN OPEN CONVERSATION IN THE PUBLIC SETTING OF RPUG ON THIS TOPIC— PROMISING IT WOULD BE COMPLETELY AGNOSTIC OF COMPANY/BRAND NAMES. THE HOPE IS TO FACILITATE A COMMON EFFORT TOWARD DEFINING A PRACTICAL STANDARD THAT CAN CLEARLY DEFINE INDUSTRY NEEDS AND ENSURE WE ALL ATTEMPT TO MEASURE THE SAME THING ACROSS ALL TECHNOLOGIES / CLIENT REQUESTS /VENDOR CUSTOMIZATIONS.

- FEEDBACK RECEIVED WAS INCREDIBLE! THANKS TO ALL THAT RESPONDED. EVERYTHING SHARED TODAY WILL BE FREE OF VENDOR OR PERSONALLY IDENTIFYING INFORMATION. WHAT FOLLOWS IS IMPORTANT QUOTES AND ANECDOTES SHARED, ALONG WITH THE 11 KEY VARIABLES IDENTIFIED THAT HAVE THE BIGGEST IMPACT ON AUTOMATED RUT MEASUREMENT, CALCULATION & REPORTING

# VENDOR RUTTING QUOTE #1



*"FOR THE MOST PART, WE RELY ON OUR CUSTOMERS TO TELL US WHAT THEY WANT, BUT I THINK THE IDEA OF DEFINING HOW RUTS SHOULD BE MEASURED AND REPORTED IS LONG OVERDUE."*

# VENDOR RUTTING QUOTE #2



*“One thing that stood out in our internal discussion is the distinction between **measurement accuracy versus definition**. It seems like current efforts such as TPP testing are primarily focused on validating how well systems replicate a “ground truth” profile, rather than addressing how rutting itself is defined or calculated. Those are related, but ultimately separate challenges, and both likely need to be addressed to move toward true standardization.”*

# VENDOR RUTTING QUOTE #3



*“It would be great to see a basic and easy-to-run validation process developed focused on rutting, as this is the metric DOTs need to measure and report. The TPP tests and provisional AASHTO standards describing them have a much larger scope, as you also pointed out. Many of these tests are not related to rutting at all, but to crossfall, geometrics, GPS positioning accuracy, 3D point cloud registration accuracy, and so on. They are useful for overall system validation, but they overcomplicate and obscure the rutting data validation process”*

# VENDOR RUTTING QUOTE #4



*“We also discussed the importance of keeping any future standards grounded in real-world application. There is a risk that requirements become too tightly aligned to controlled testing environments, which may not translate well to typical network level data collection. Variability in live roadway conditions, safety considerations, and operational constraints all introduce challenges that are difficult to replicate on a test track.”*

# VENDOR RUTTING QUOTE #5



*"WE BUILD TRANSVERSE PROFILE SYSTEMS WE KNOW WILL MEET THE NEEDS OF DOTs TO ACCURATELY MEASURE RUTS, MANY OF OUR UNITS DON'T HAVE AN IMU. MAYBE THERE COULD BE ADDITIONAL RESEARCH INTO "RUTTING ONLY" SYSTEMS?"*

# UNSOLICITED DOT RUTTING QUOTE



*"WE AS A STATE JUST WANT TO KNOW THAT OUR EQUIPMENT IS WORKING PROPERLY AND THE AUTOMATED CALCULATION MATCHES THE RUT VALUES WHEN WE MEASURE IT MANUALLY--BUT I'D FEEL A LOT BETTER IF OTHER STATES WERE MEASURING THE SAME THING IN THE SAME WAY WE ARE. I KNOW IT'S COMPLICATED, BUT WE'VE BEEN ABLE TO STANDARDIZE IRI PRETTY WELL, SO HOPEFULLY WE CAN DO THE SAME FOR RUTTING."*

# VENDOR RUTTING ANECDOTE #1



"IN TERMS OF CRAZIEST THINGS WE'VE SEEN ON A NETWORK LEVEL IN RECENT YEARS, WE HAVE ONE CLIENT WHERE WE ARE FORCED TO MATCH THEIR HISTORICAL METHODOLOGIES, WHICH INCLUDES TAKING OUR PROFILE OF THOUSANDS OF POINTS AND USING ONLY 13 OF THOSE DATA POINTS IN SPECIFIC LOCATIONS EVERY FOOT TO CALCULATE THE MAXIMUM RUT VALUE FOR EACH WHEEL PATH--- YOU CAN IMAGINE JUST HOW DIFFERENT THAT WOULD LOOK IF WE USED ALL THE POINTS OR DID THE **AVERAGE** VALUE"

# VENDOR RUTTING ANECDOTE #2



*"WE ADDED A FEATURE WHERE THE DOT CAN SIMPLY CHOOSE THE LANE WIDTH THEY WANT TO USE—MEANING THEY COULD BE REPORTING RUTTING USING AN ASSUMED LANE WIDTH OF 6 FEET AND WE WOULDN'T KNOW—AT THAT POINT THE ENTIRE "ROAD" IS THE WHEEL PATHS"*

# VENDOR RUTTING ANECDOTE #3



*"WE'VE SEEN DIFFERENCES OF MORE THAN 2" WHEN PROCESSING THE VERY SAME RAW DATA WITH SLIGHTLY CHANGED PARAMETERS FOR FILTERING OR LANE EDGE DETECTION."*

# VENDOR RUTTING ANECDOTE #4



*"ONE CHALLENGE THAT DEPARTMENTS OF TRANSPORTATION NEED TO BE AWARE OF ON A STATE LEVEL IS THAT USING THE FULL RAW PROFILE INTRODUCES NOISE—AND FILTERING THAT PROFILE INTRODUCES BIAS. CRACKS ARE NOT PART OF RUTS AND NEITHER ARE CURBS/EDGE DROP OFF, BUT REMOVING THEM CORRECTLY IN ALL SCENARIOS WILL BE COMPLICATED."*

# VENDOR RUTTING ANECDOTE #5



*"ONE CLIENT CLOSELY MONITORS CHANGES IN RUTTING PER REPORTING SEGMENT—SO RUTTING AVERAGE VALUES THAT CHANGE EVEN BY SMALL AMOUNTS (.01") NEAR SEVERITY LEVEL THRESHOLDS CAN MEAN VERY DIFFERENT RESULTS IN THE PAVEMENT MANAGEMENT SYSTEM. IN SUCH CASES, EVERY TECHNICAL OR ENVIRONMENTAL VARIABLE WE CAN REMOVE WILL MAKE THE DATA MORE HELPFUL AND TRUSTWORTHY"*



# 11 KEY VARIABLES THAT IMPACT RUT CALCULATION

1. How the “high points” of the rut are determined along the transverse profile
2. How the calculation implements the use of a virtual straight edge (We’ve been asked for 4 foot and 6 foot lengths before)
3. How the depth
4. How (and how
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8. What, if any “s
9. What, if any ef profile (block/v
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11. What, if any ef raw data point



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# WHAT'S ALREADY HAPPENING TO HELP



Multiple vendors noted that the 2020 Review of the AASHTO R87 standard mentioned limitations that are being worked on thru TPF-5(299)/(399)-approved funding to improve the definitions. Below are some of the recommendations made by Amy Simpson and others:

- The rut depth should be calculated using a simulated 1.8-m straight edge so that it can be easily compared to reference measurements.
- Transverse profile data should be rectified to a zero slope and filtered using a 2<sup>nd</sup> order Butterworth low pass filter with a cut-off wavelength of 19 mm prior to rut processing.
- The simulated ruler used to measure rut depth should have a width of 19 mm.
- The transverse profile should be truncated to limit the profile to within the travel lane, defined by the inside edge of the paint stripe on either side of the lane. For roads that do not have clearly delineated lane marks, a fixed lane width of 3.2 m should be used centered on the driving path (center of measured transverse profile).
- The measured rut depth should fall within the defined wheel paths defined by the AASHTO road zones to eliminate edge effects.

While the above recommendations need to be vetted (and others likely added), this unpublished report might be a good starting point toward standardization. QES is also working on a relevant NCHRP project.

# CONCLUSIONS



- I HAVE NONE! WAS JUST HOPING TO GET PEOPLE THINKING AND TALKING ABOUT THE TOPIC— PERHAPS AN ACTUAL PANEL DISCUSSION AT SOME POINT TOO?
- AS A NEXT STEP, PERHAPS WE CAN DECIDE IF THIS TOPIC IS IMPORTANT ENOUGH TO PUT ORGANIZED EFFORT INTO WORKING TOWARD STANDARDIZATION—AND THEN PRACTICAL VERIFICATION OF THAT STANDARD
- IF SO, WE CAN TRY TO TAKE ADVANTAGE OF THE BIG BRAINS IN THE ROOM AND THE ALREADY STARTED PROJECTS THAT WE COULD INTEGRATE WITH (PERHAPS THE NCHRP/QES PROJECT-SEE MONA'S SLIDES FROM YESTERDAY'S POOLED FUND MEETING))