



RPUG The RT3 CFME Journey

September 17th, 2013

RT3™ CONTINUOUS FRICTION MEASUREMENT EQUIPMENT



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IRT3TM

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IRT3

4

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MEGA-TEXTURE !!



Designed and
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SOME OF THE ELEMENTS FRICTION IS DEPENDENT ON

- The tire
 - temperature of the compound – MAKES A BIG DIFFERENCE!!
 - Pressure affecting contact patch size and driver feel of support
 - Degradation of compound
- Track surface
 - Concrete, asphalt and surface transition
 - Aggregate surface area in contact with tire (macro texture)
 - Surface friction changing with addition of rubber and contaminant
 - Track elevation change



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SOME OF THE ELEMENTS FRICTION IS DEPENDENT ON

- Car Setup
 - Car weight distribution and Center of Mass height
 - Un-sprung weight, fuel load
 - Aerodynamic load and change with car ride height
 - Brake bias and brake condition
 - Tire static toe and camber, camber change with car movement
 - Suspension geometry and car deformation under load
 - Primary & secondary springing
 - Dampening, type & force values



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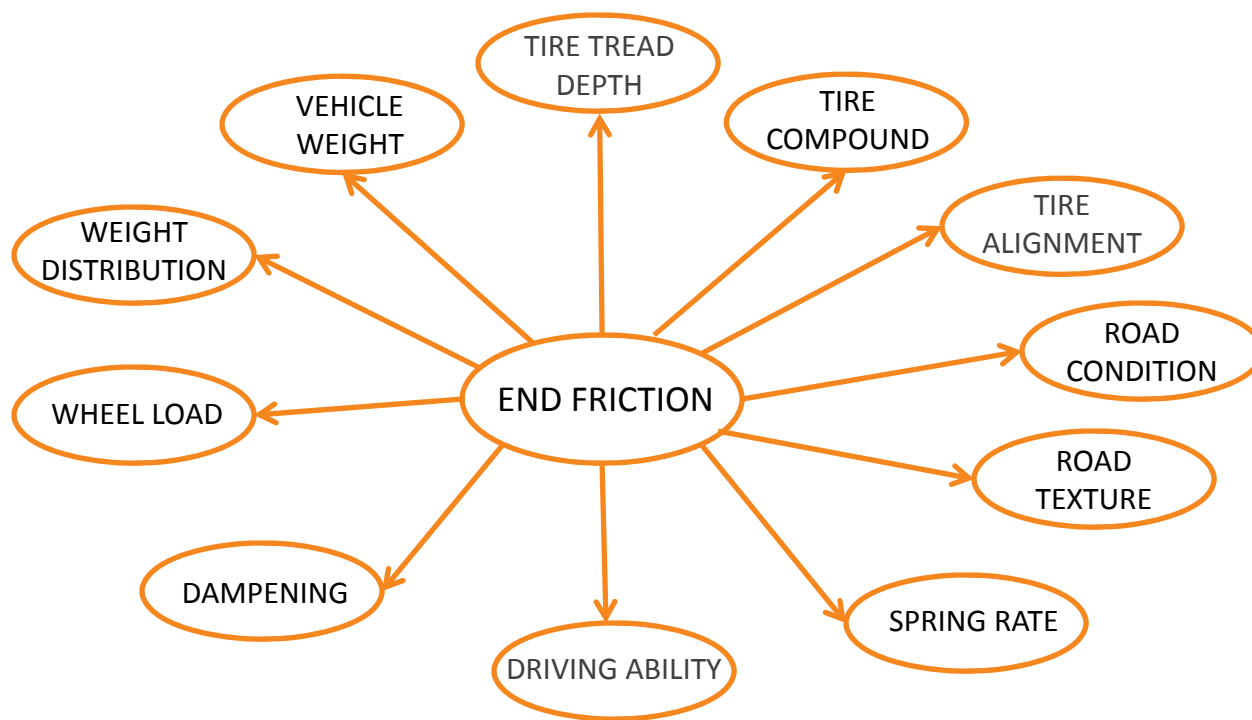
SOME OF THE SENSOR MEASUREMENTS TAKEN

- Tire pressure & temperature
- 3 axes of acceleration
- Individual wheel loads
- Car dynamic ride height with lasers
- Damper velocity and displacement
- Steering angle and torque
- Individual wheel speed
- Pitot pressure air speed
- A myriad of engine and gearbox sensors..... etc etc



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FRICTION IS EXTREMELY COMPLEX & MULTI DIMENSIONAL



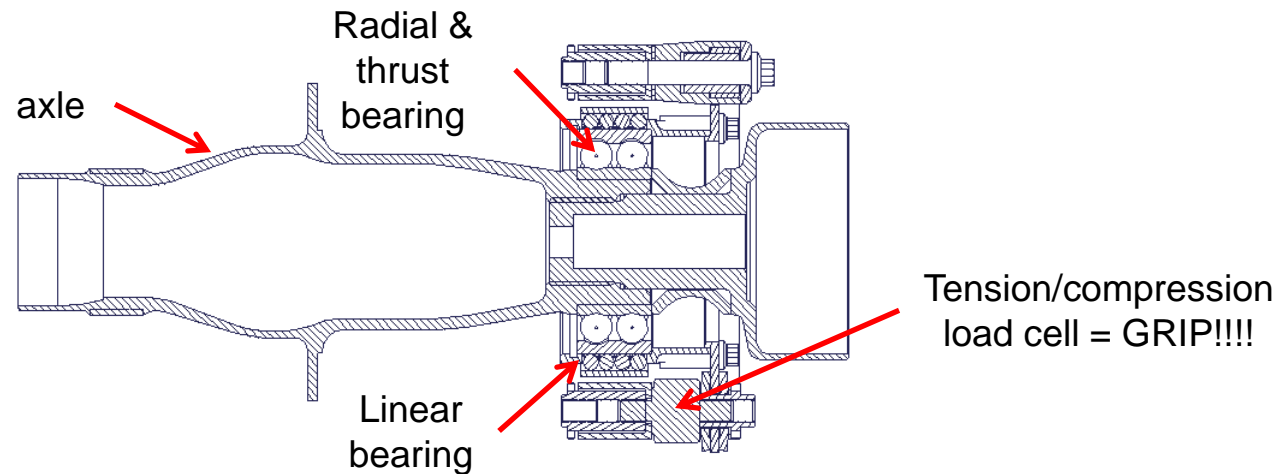
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HALLIDAY TECHNOLOGIES INC // RT3 IS BORN

OBJECTIVE – TO MEASURE FRICTION (GRIP) ACCURATELY

- Invent a sensor system that measures the result of most of these variables and second and third level sensor values.
- This is the principle technology of the RT3 product line.



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CUSTOMER REQUIREMENTS

- Friction result to be representative of a real car situation
- To measure friction without water
- Not operator performance dependent
- Run with minimal maintenance
- Reliable & repeatable result
- Friction result easily interpreted
- Operate in severe conditions
- Have a system that attaches to the vehicle and can be removed easily



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SOLUTIONS

- Use a common treaded tire – measures friction independent of speed
- Develop a tread depth algorithm
- Use a small static slip angle (approx 2 deg = 25 deg steering wheel lock) to maximize tire life & remove compound change
- Develop a system to avoid load cell overload
- Use a constant static load on the friction wheel and use the parent vehicle to dampen the load to the measuring tire
- Design a stand alone hydraulic system to operate the RT3
- Introduce a steering sensor to remove erroneous cornering friction values
- Make major components from stainless steel

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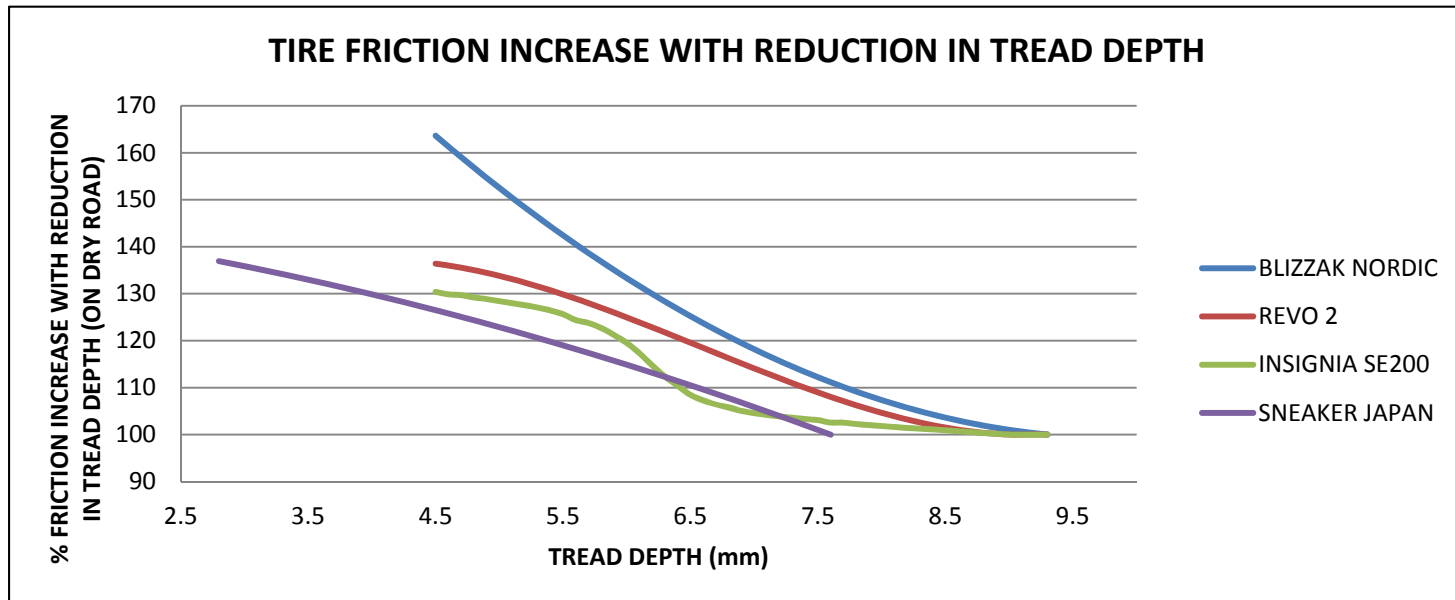


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DISCOVERY: DRY TIRE FRICTION - CHANGE WITH TREAD DEPTH

- Several different winter tires have significantly different friction behavior as tread depth decreases



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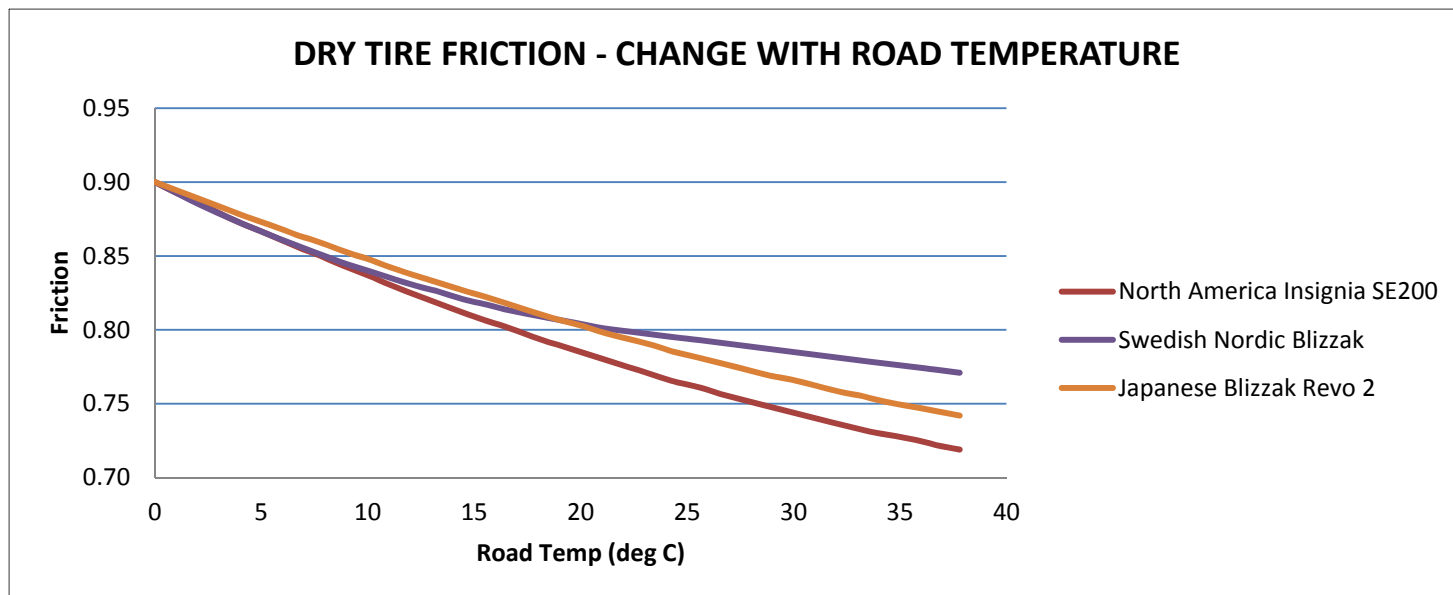


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DISCOVERY: DRY TIRE FRICTION - CHANGE WITH ROAD TEMPERATURE

- Some winter tires can change their friction value by over 25% when run on clean tarmac at 0 deg C versus 40 deg C



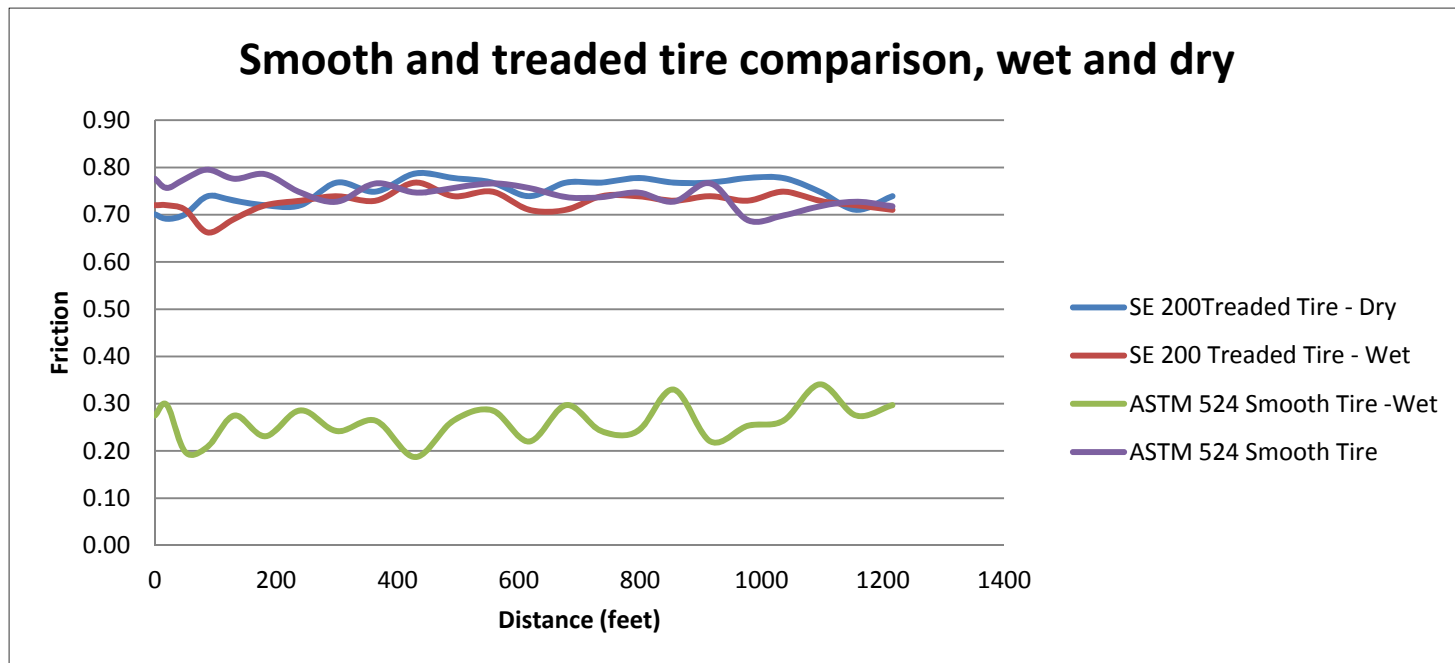
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DISCOVERY: WET AND DRY SURFACE TESTING SMOOTH ROAD



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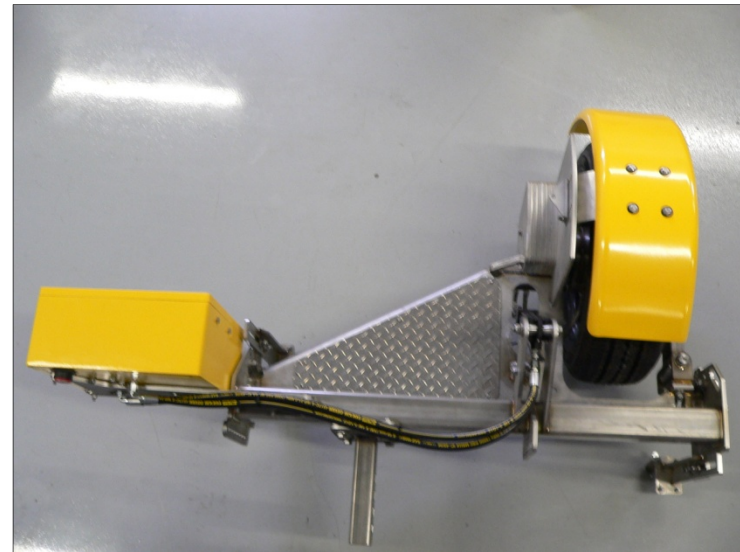
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RT3 FIXED HITCH

- Japanese system is towed with wheel on left side



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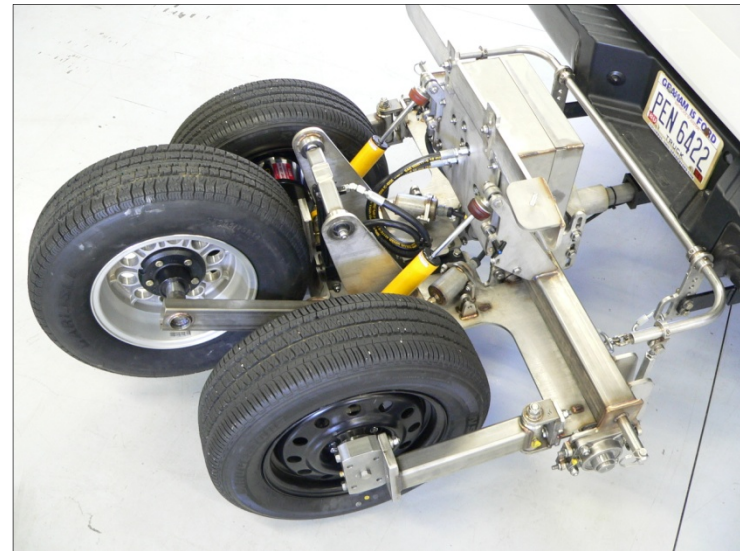


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RT3 CURVE

- Initially developed for the Swedish Govt. to be capable of measuring friction year round on all types of road including curves



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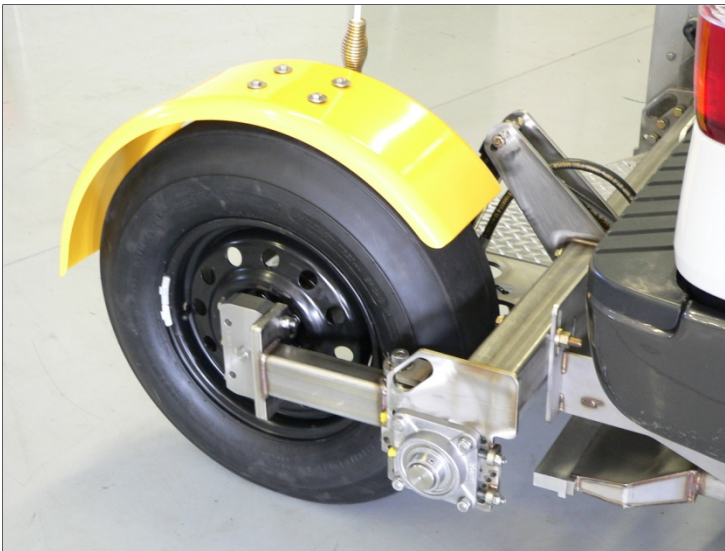


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RT3 FLIGHT

- The towed version and water system have been developed into the FAA approved RT3 Flight



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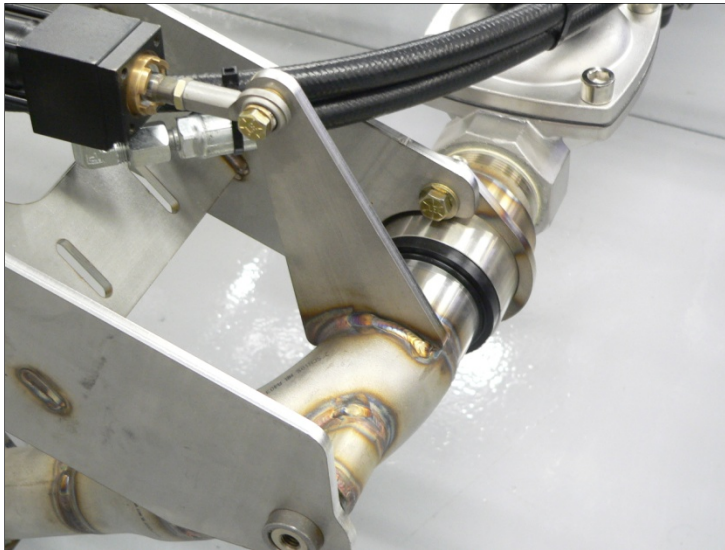


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RT3 WATER SYSTEM

- Originally designed for Swedish Road Administration who wanted to be able to manually vary the flow rate so that they could determine the affects of reflective glass bead concentration in road paint



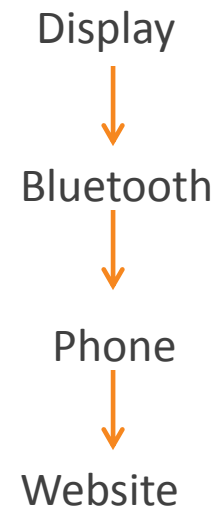
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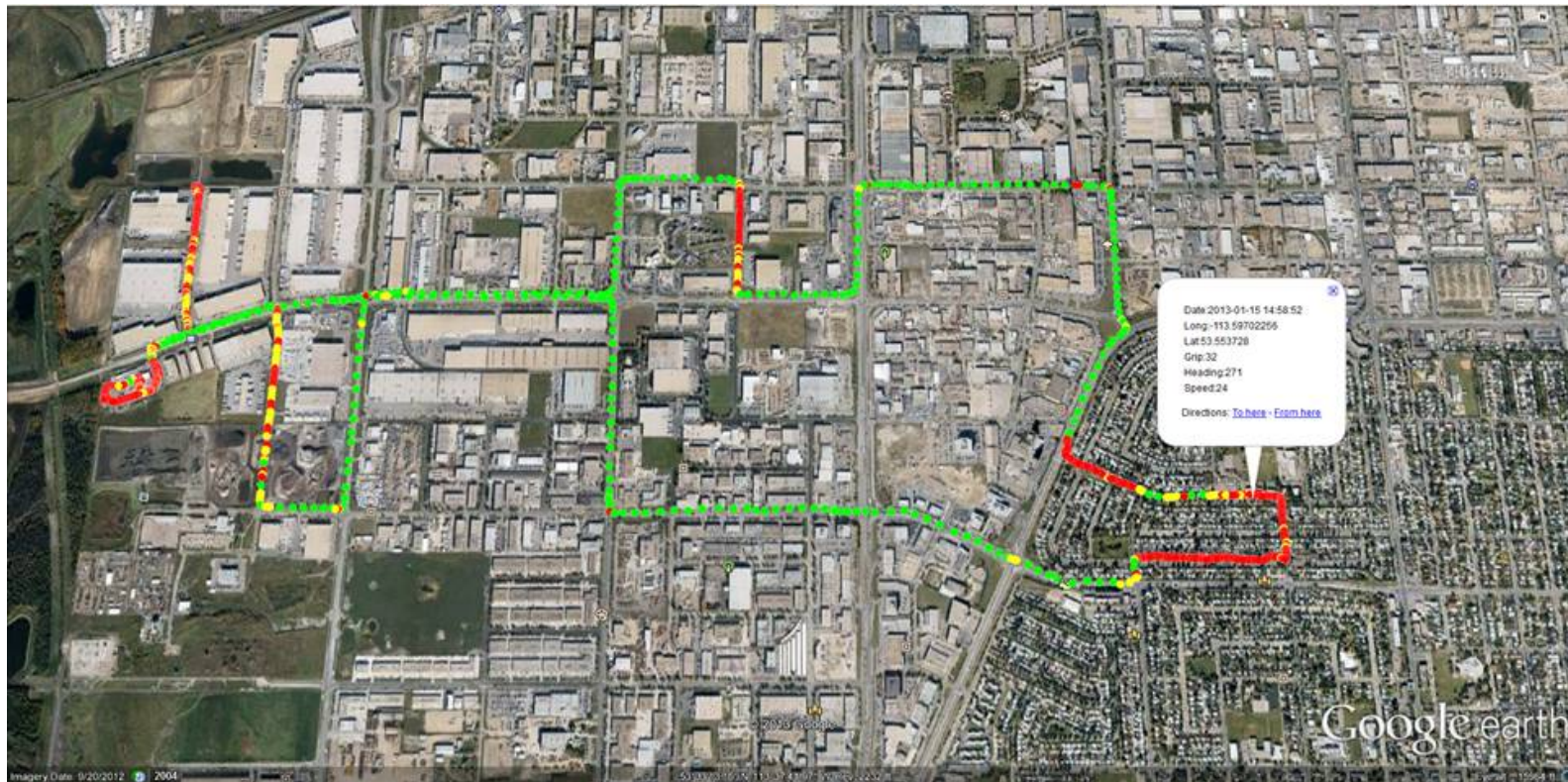
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DEDICATED WEBSITE: REAL TIME ACCESS TO ALL DATA



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INTEGRATE TECHNOLOGY INTO DOT'S

- Identify opportunities to work with DOT's to integrate the technology into their year round operations.
 - HTI's GOAL: Improve road safety in both winter and summer operations.
- Make friction ACCESSIBLE to operators through:
 - Training - initial
 - Coaching - ongoing
- Demonstrate the value of the use of this technology





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