NRRA
National Road Research Alliance

2018 Pavement Workshop
May 23-24, 2018

+ 46 Associate Members

Future Technologies

Bryan Downing
Caterpillar Paving Products
Global Sales Consultant

Develop → Collaborate → Research → Implement → Sustain.

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TECHNOLOGY TRENDS FOR CONSTRUCTION

- Current Technology – The Age of Smart Iron
- Asphalt Paving
  - 3D or 2D Grade Control
  - Asphalt Temperature Measurement / Mapping
  - Material delivery coordination/synchronization
- Intelligent Compaction
  - Asphalt and base materials
  - Smart compaction systems
- Future technologies
  - The Road to Autonomy
- Workplace Tools to plan - work more efficiently

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LINK

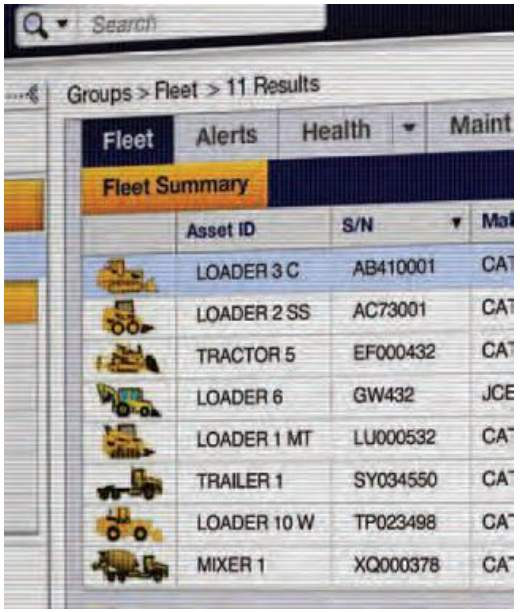
CAT LINK

LINK GRADE COMPACT PAYLOAD DETECT COMMAND HARVEST

CAT® CONNECT TECHNOLOGY

LINK DELIVERS THE INSIGHT YOU WANT

Cat Product LINK™ *is a comprehensive remote monitoring and asset management solution, with remarkably intuitive web interfaces that transform data from a customer's entire fleet of equipment into the essential information required to boost productivity, reduce costs and manage risks.*



Manage Equipment with Real-Time Data

- Equipment Data including machine hours, performance information and more.
- LINK technologies enabling you to monitor the health and status of your machines.

Operators Work More Efficiently

- Operators immediate feedback about machine performance and job progress.
- Operators can monitor payloads, load counts, progress to grade and compaction.

Track Job Progress, Production and Costs – without Guesswork

- VisionLink gives you timely, actionable information.
- Detailed information about each job, such as production totals, time, and job costs.

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CAT PAYLOAD

LINK GRADE COMPACT PAYLOAD DETECT COMMAND HARVEST

CAT® CONNECT TECHNOLOGY

PAYLOAD HELPS DELIVER VALUE

Cat Production Measurement *brings on-the-go weighing to the cab to help operators hit precise load targets and load trucks to optimum payload capacity - increasing the productivity of your entire fleet.*

Work Productively

- Integrated into machine display; operator can easily view payload information and make final load adjustments before loading the truck.
- Tip Off allows operator to make final-pass estimated payload adjustments and quickly view adjusted weights in real time.

Work Efficiently

- Fill trucks to capacity without overloading; increase payload potential; use fewer trucks to move more material.
- Live Weigh provides a quick, real time estimate of payload without swinging.

Improve Operator Performance

- Operators at all experience levels work with confidence and perform at a higher level, producing consistent, accurate loading of materials.

Manage Your Business

- Analyze load times, number of passes and daily payload to determine: operator productivity; jobsite changes to optimize efficiency; incentives to meet fuel burn and production targets.

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CAT GRADE

LINK GRADE COMPACT PAYLOAD DETECT COMMAND HARVEST

CAT® CONNECT TECHNOLOGY

GRADE FOR EARTH MOVING

Cat GRADE Technologies *combine digital design data, in-cab guidance, and automatic controls to enhance* ***grading accuracy*** *brings cut and fill information into the cab to help operators hit elevation and location -* ***increasing the productivity*** *of your entire fleet.*

Work Productively

- Integrated into machine; operator can easily view grade information on the display, grade control buttons built into joysticks, works with current machine integrated systems

Improved Safety

- Removes grade checkers from the job site, out of harms way, improved visibility, theft prevention improved, reduces need to remove components at night

Improve Operator Performance

- Operators at all experience levels work with confidence and perform at a higher level, producing consistent, more accurate grades

Increase Profitability

- Move more material in fewer trips correctly once, save time, fuel and labor costs; reduce machine wear, minimize sites costs

Improved Reliability

- Move components to protected locations, fewer parts, standard design/installation reduces downtime.

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GRADE FOR PAVEMENT

Cat GRADE Technologies *combine easy to use controls with precision to enhance milling accuracy enabling the ultimate* ***smoothness and uniformity*** *to the asphalt paving process.*

High Accuracy

- Easily performs the work to specifications consistently.

Application Flexibility

- Modular grade inputs based on application
  - Sonic sensors, 3D, contact sensors, beams, inboard contact ski's
  - Coming soon Thermal Mapping on asphalt pavers

Improve Operator Performance

- Ease of operation with clear feedback on actual grade performance

Advanced features

- Cold planer ramp in/out and jump hold features for added application efficiency/productivity
- Asphalt Paver auto material loading

Optimize Your Business

- Increased efficiency, Improved smoothness, 3D as-built designs

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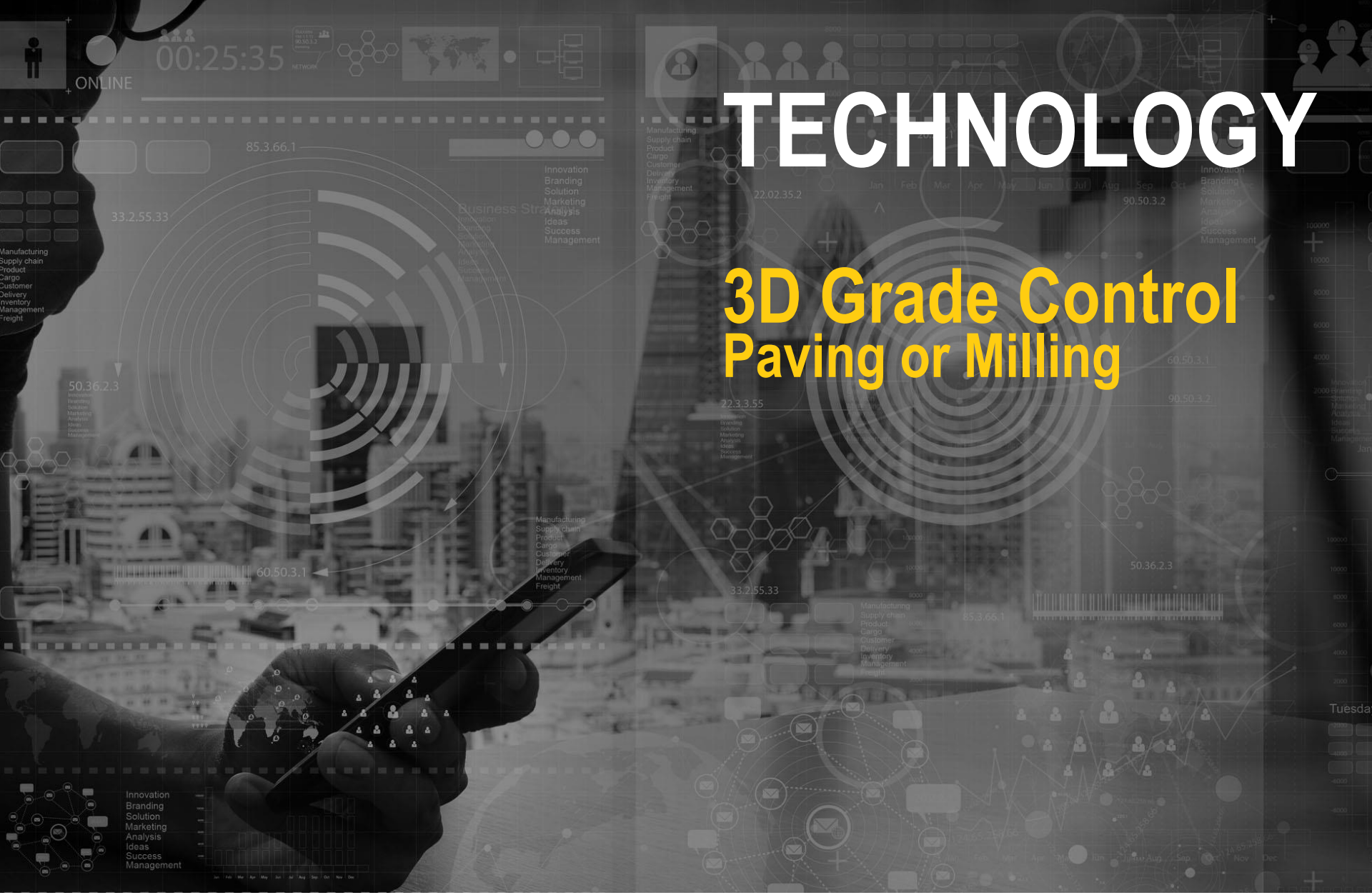

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WHAT ARE THE STAKEHOLDER GOALS?

Owner	• Road quality (smoothness, road lifetime, minimal thickness of layers) at minimal cost
Main Contractor Paving Contractor	• Minimize material usage • Meet smoothness and minimal thickness specs • Meet completion deadline
Milling Contractor	• Often paid by square meter/yard and then wants productivity • Meet completion deadline

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ADVANTAGE OF 3D MILLING

- Only mill where needed – Increased production
  - Higher productivity is less Milling cost
- Increased Smoothness – custom mill pattern
  - Remove longitudinal road waves and longitudinal high and low spots
    - No stakes required!
- Variable depth and slope milling enables milling of:
  - Transitions
  - Super-elevated curves
  - Variable drainage slopes
  - Removal of longitudinal waves in the road

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PAVING 3D TERMINOLOGY

- 2D Paving – guidance to grade (elevation-thickness) and/or slope
  - 2D is Ground-up
  - 2D Systems typically place a constant thickness over the base
- 3D Paving – guidance to grade and slope at a known position using a design/model
  - 3D is Design-down and does not use the existing surface for guidance

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ADVANTAGE OF 3D PAVING

- Achieve the highest accuracy and smoothness levels
  - Better material management/yields
- Eliminate the string lines:
  - Reduce staking labor, downtime and errors
  - Reduce costly rework
  - Finish the project faster
- Pave complex designs

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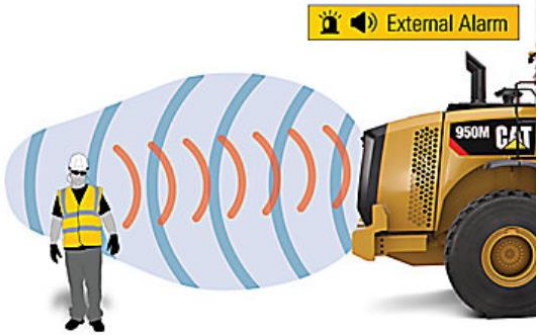
CAT DETECT

DETECT HELPS DELIVER VALUE

Cat DETECT technologies *combine safety and monitoring systems to enhance operator awareness. By expanding your view of the working environment around your equipment, you can keep your people and assets safe.*



Work Safely

- Vest or Hard hat RFID alerts driver to presence.
- Integrated machine job site cameras output to an operator's display make job sites safer.

Work Efficiently

- Live camera views increase efficiency while keeping all personnel safe.

Improve Operator Performance

- Operators at all experience levels work with confidence and perform at a higher level, producing consistent, safely loaded trucks.

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PAVING TECHNOLOGY
ASPHALT PAVERS

Asphalt Thermal Mapping

Machine Telematics

Integrated 2D Grade Control
3D ready

Eco Mode

Integrated Electric Generator
w/Diagnostic Capability

Auto-fill Feeder System

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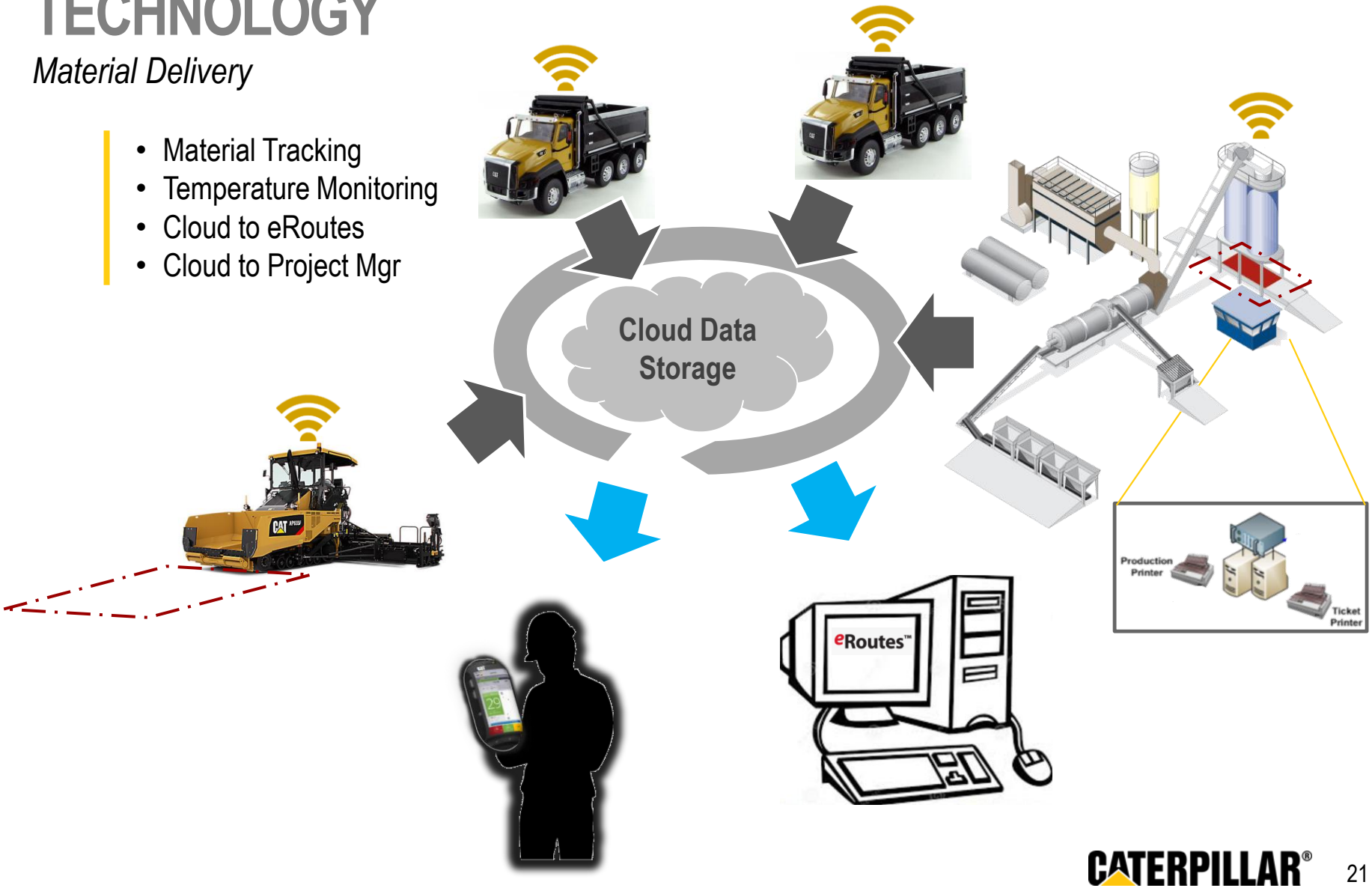
PLANT TO PAVER TECHNOLOGY

Material Delivery

- Material Tracking
- Temperature Monitoring
- Cloud to eRoutes
- Cloud to Project Mgr



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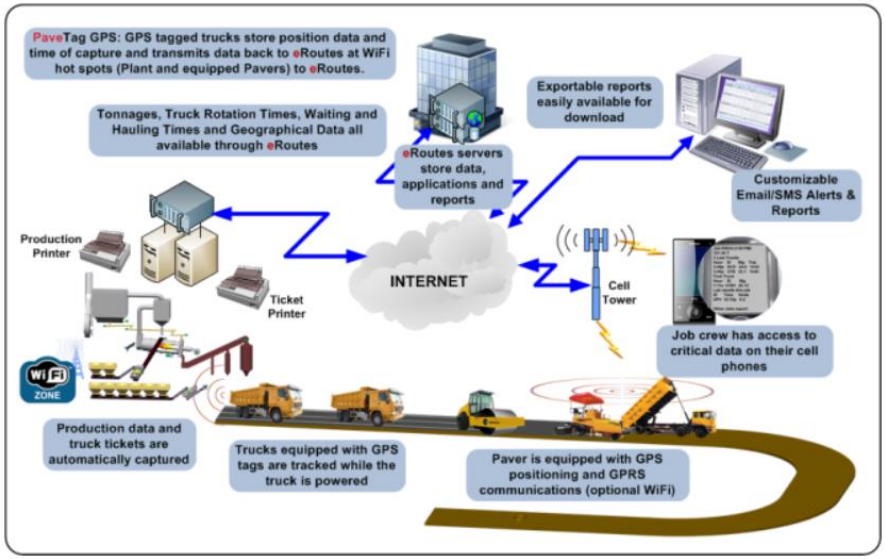
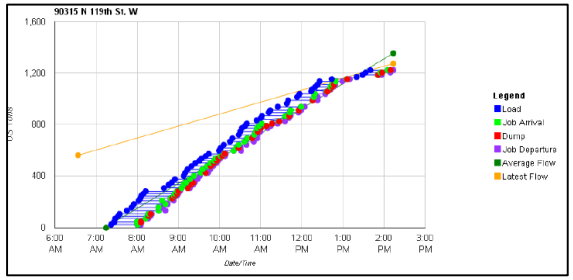
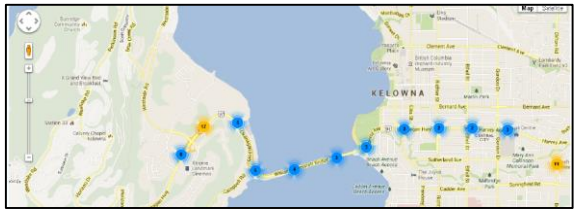
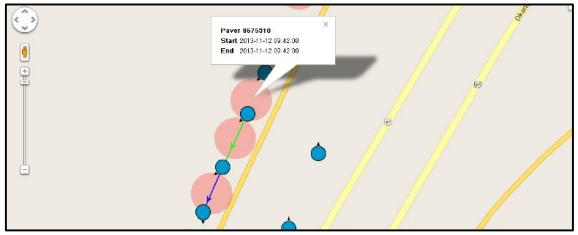
INFORMATION
OUTPUT

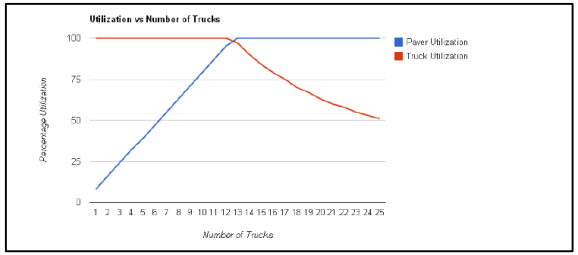
Software Part











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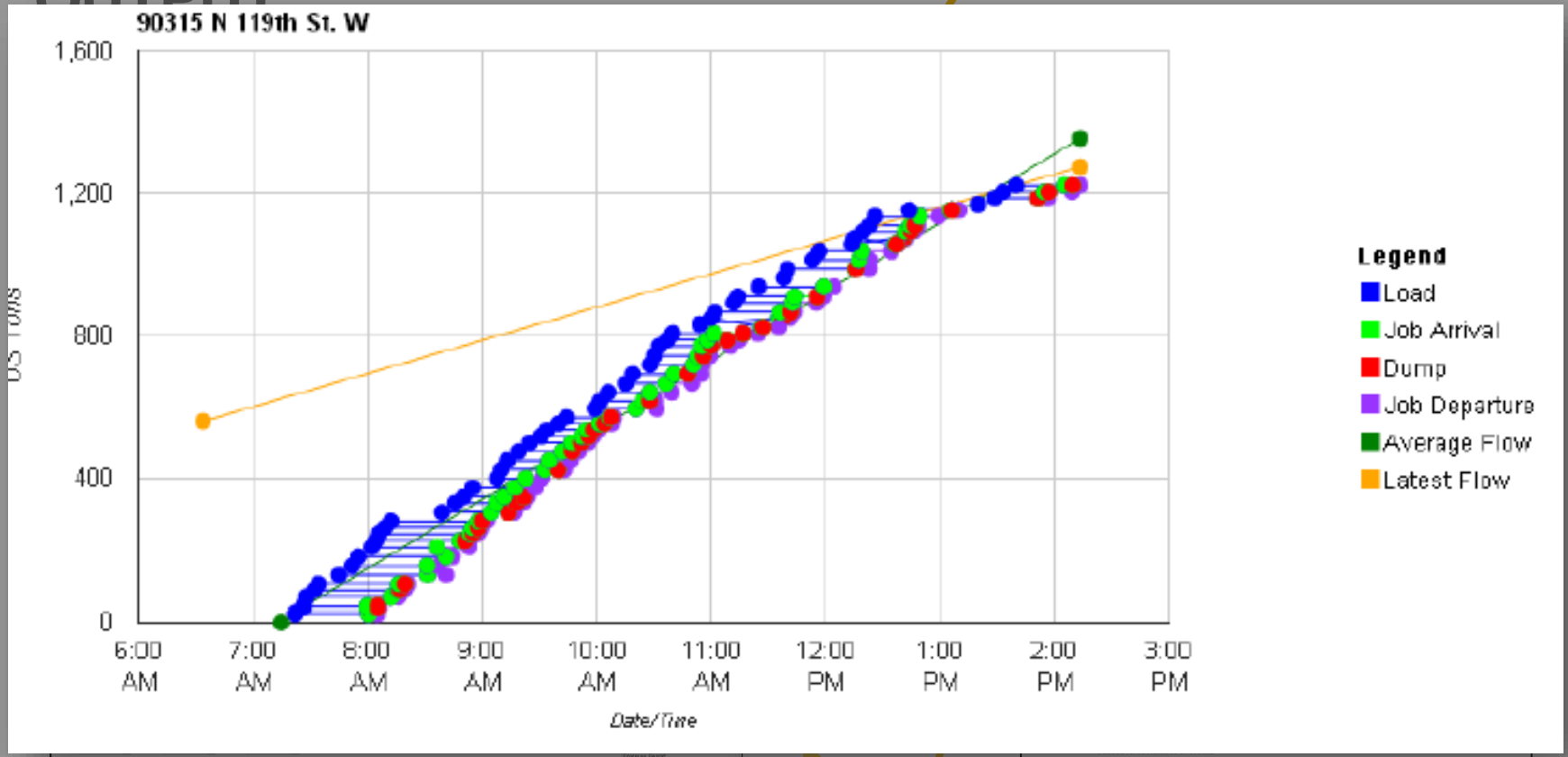

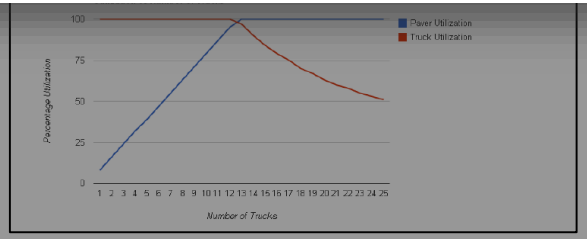

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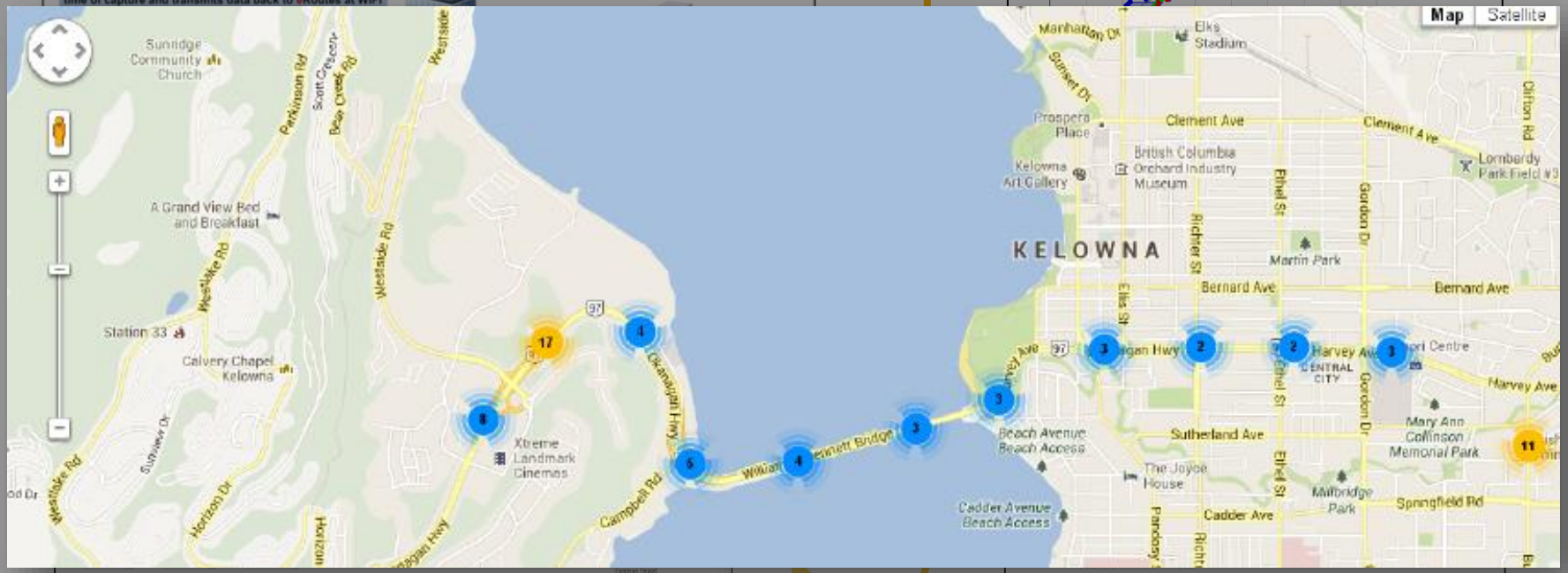
INFORMATION
OUTPUT

Software Part



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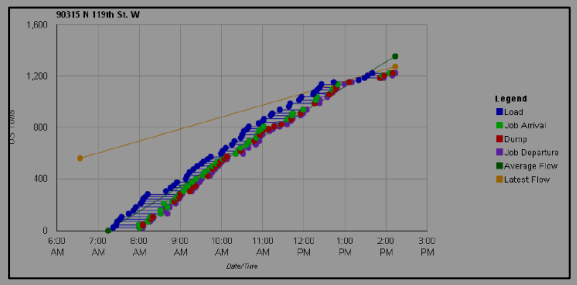
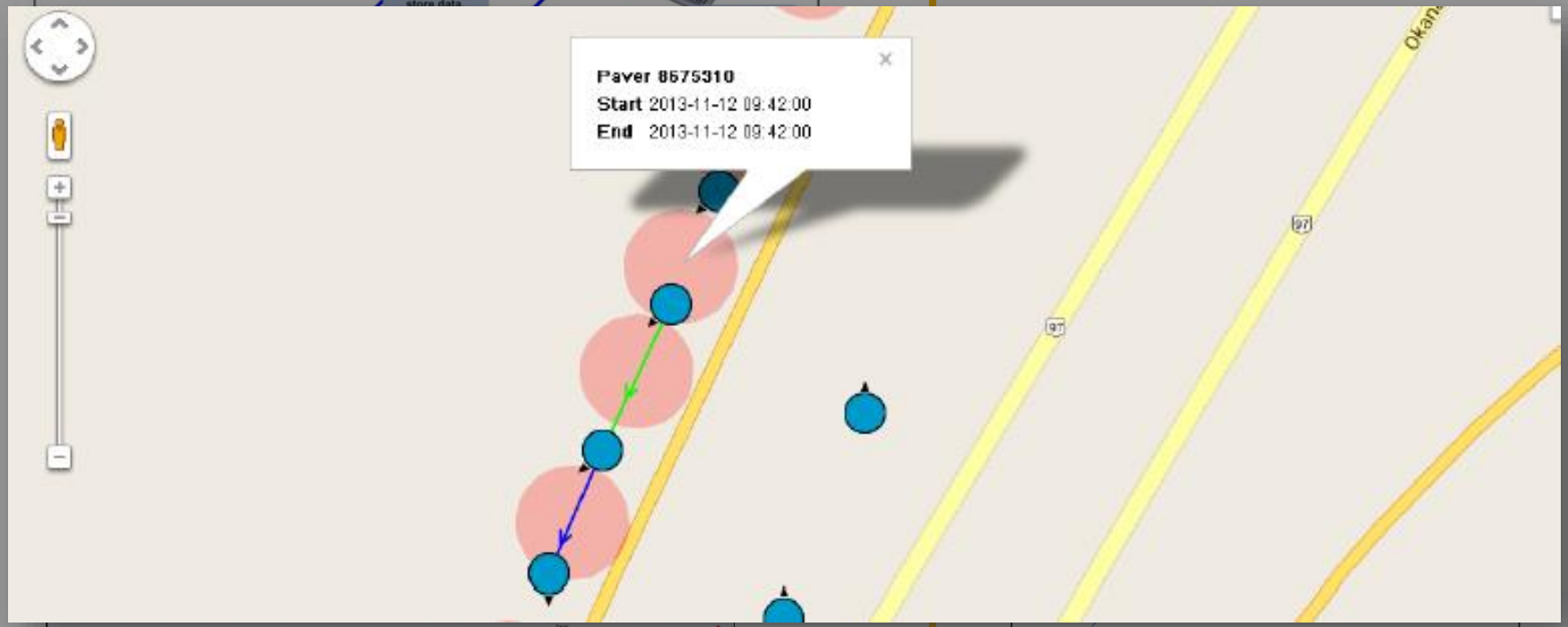
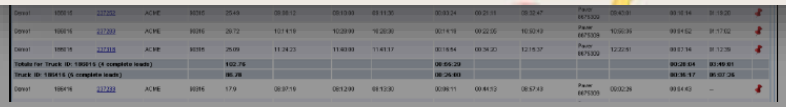
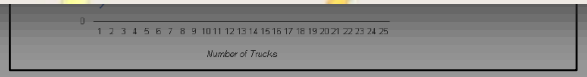
INFORMATION OUTPUT

Software Part









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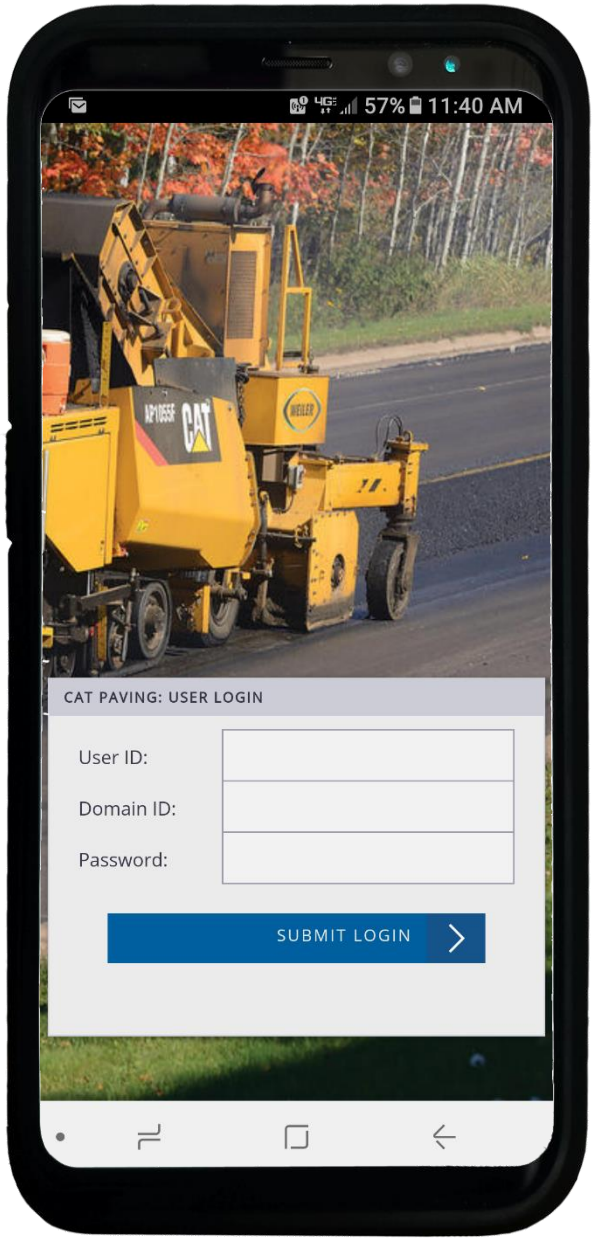

eROUTES MOBILE APP

Login

Developed for ….

- Superintendents
- Job Foremen
- Paving Foremen
- Paving Crews

Real-time information in the hands of those who need it most

Remotely monitor the jobs of the day

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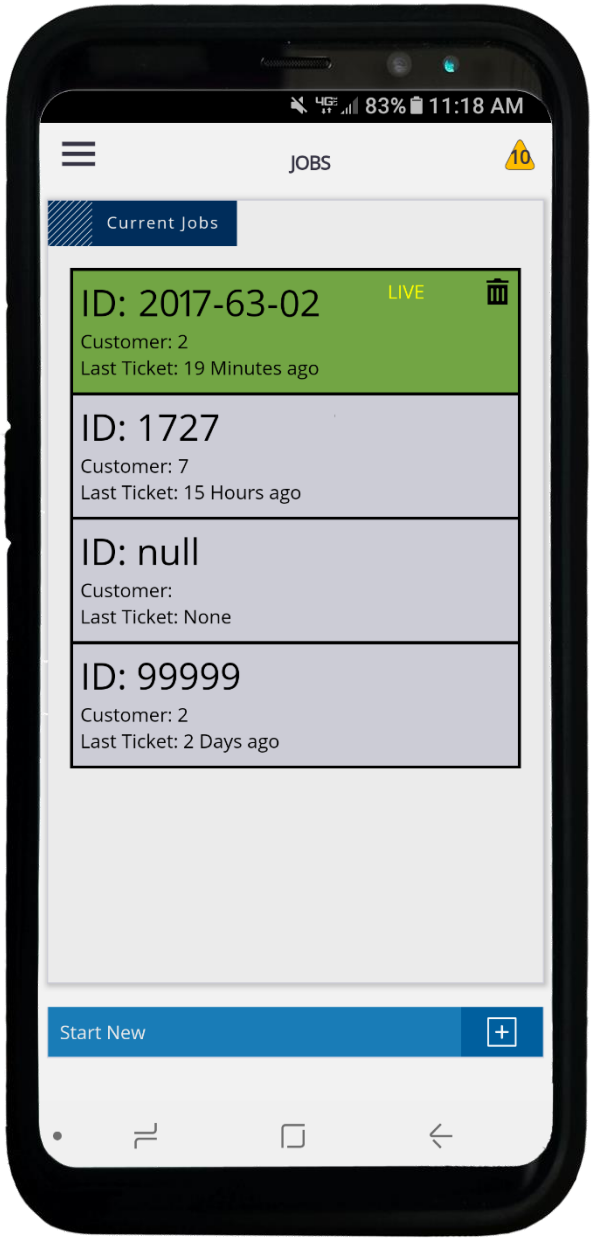

eROUTES MOBILE APP

Jobs

Developed for ….

- Superintendents
- Job Foremen
- Paving Foremen
- Paving Crews

Real-time information in the hands of those who need it most

Remotely monitor the jobs of the day

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eROUTES MOBILE APP

Dashboard

Main navigation screen summarizing critical information about the job

Based on user input

- Tons/day
- Time
- Distance
- Number/Capacity of trucks

Information includes:

- LIVE truck arrival times at paver
- Trucks at plant, paver, and in transit
- Tons paved, loaded, and in transit
- Ticketed loads

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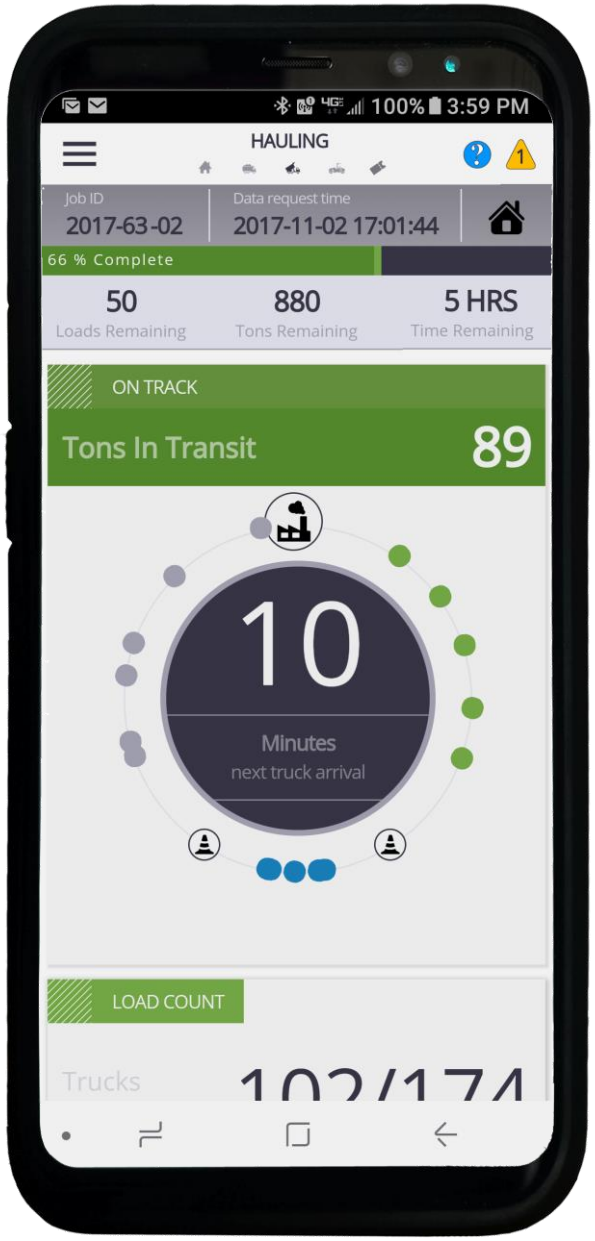

eROUTES MOBILE APP

Hauling

Detailed information of trucking cycle

- Tons in transit
- Next truck arrival time

Broad view of all trucks

- Green – Ticketed and in transit
- Blue – On the jobsite
- Gray – Returning to plant

Selecting a truck indicates Truck ID with the ability to scroll through the trucks

Swiping down shows number of loads versus a target

Last, average, and estimated cycle times

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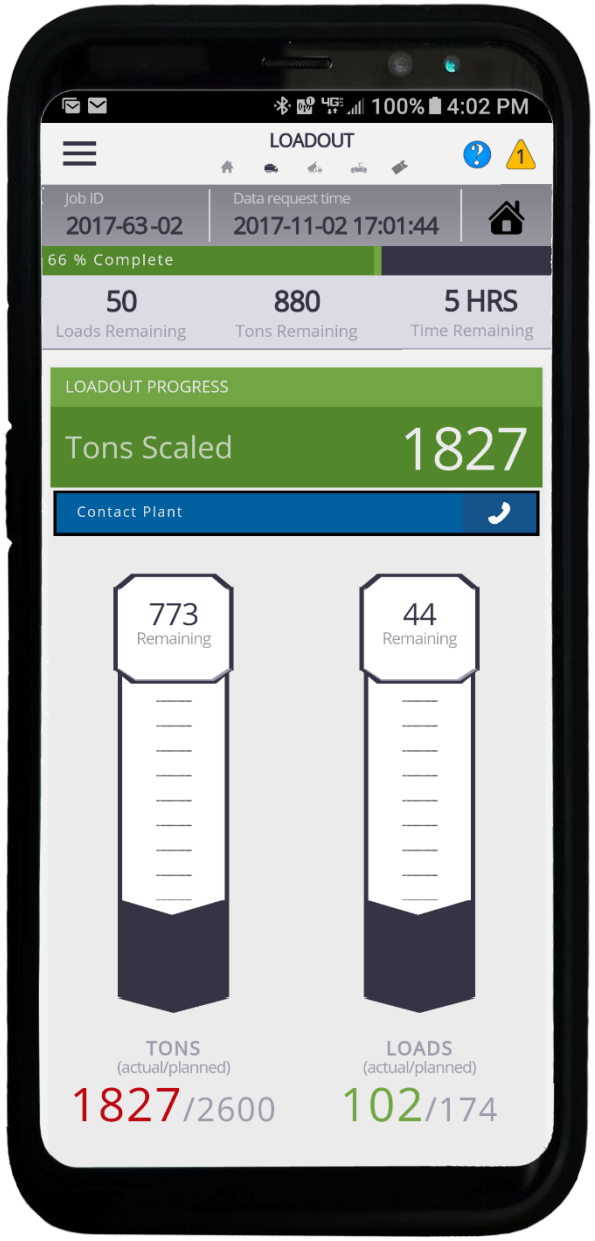

eROUTES MOBILE APP

Loadout

Detailed information of loading process

- Tons scaled
- Tons/Loads remaining versus the target

Ability to quickly call the plant

Swiping down shows tons loaded in the last hour

Next truck arrival time to plant

Average wait time at the plant

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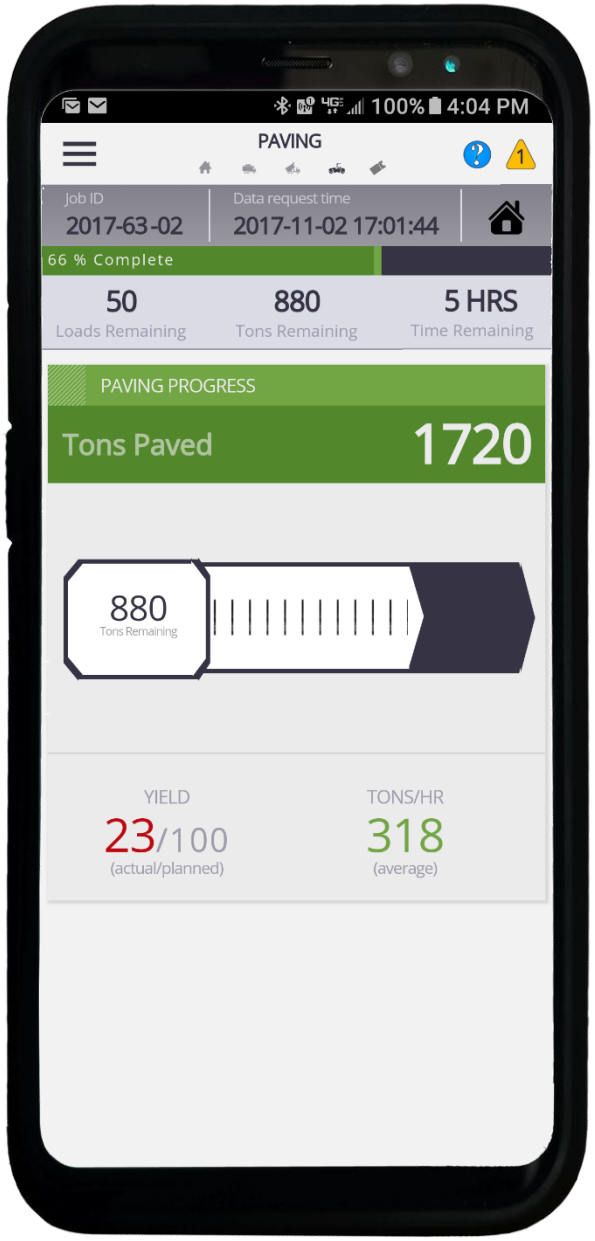

eROUTES MOBILE APP

Paving

Detailed information of paving process

- Tons paved
- Tons remaining versus the target

Estimated yield

Average tons/hr paved

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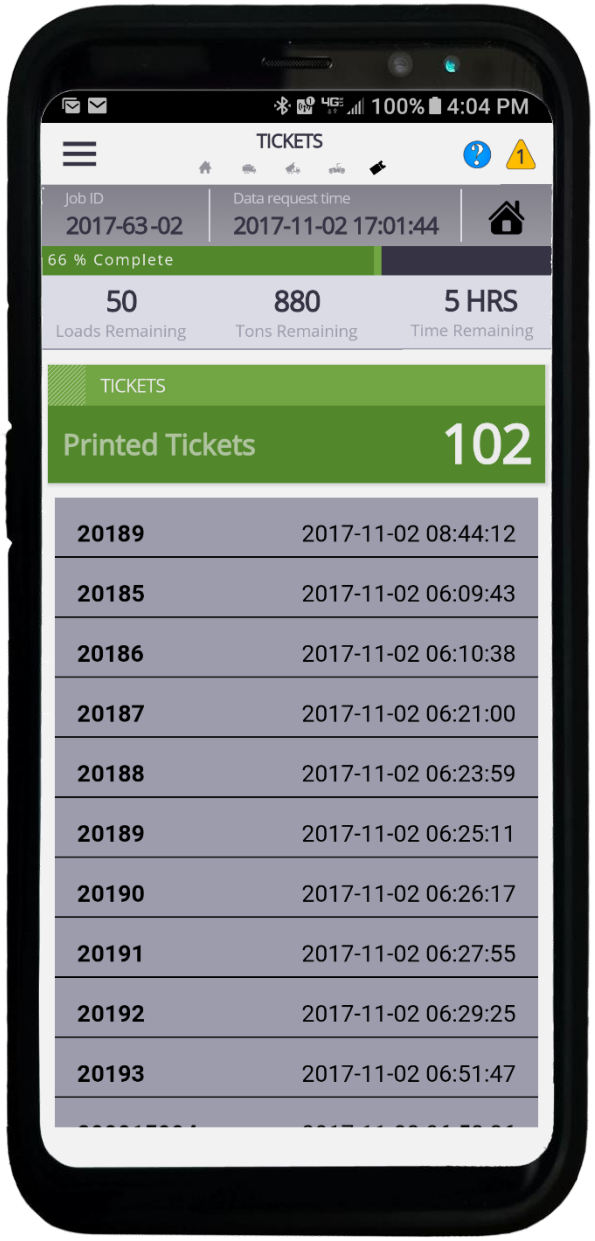

eROUTES MOBILE APP

Tickets

List of printed tickets with time/date of printing

Select from list to view the ticket

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Why eROUTES?

Customer Value

Quickly see the whole process

- Merge paver/truck/ticket data into real-time information
  - Cycle times/waiting times per job/truck/plant
  - Tons loaded, in-transit, and paved

Driver performance comparison

- Hire trucks/Company trucks? (Performance you expect?)
- “Where are my trucks!” (mystery solved!!)

Help eliminate paver stops

- Your bonus depends on it!
- Balance laydown and delivery

Balance plant production for multiple crews

- The right mix produced at the right time
- Reduce plant wait times

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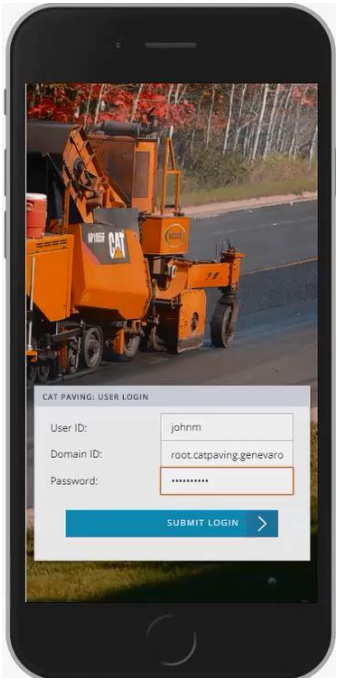
ASPHALT PAVING
CONNECTED SYSTEMS



Increasing **Customer value** by offering **solutions** that **optimize** processes to generate **profits** via data communication and **productivity** technologies that provide **real time** job site management.

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CAT COMPACT

LINK GRADE COMPACT PAYLOAD DETECT COMMAND HARVEST

CAT® CONNECT TECHNOLOGY

COMPACT HELPS DELIVER VALUE

Cat® COMPACT technologies *combine advanced compaction measurement, in-cab guidance and reporting capabilities to help you consistently meet compaction targets faster, more uniformly, and in fewer passes—saving on fuel and reducing rework and material costs in both soil and asphalt applications.*

Uniformity + Confidence = Quality

- Empowers operators with documentation of the work completed.

Measure

- Measurement for base compaction; CMV and/or MDP
- Measurement for asphalt compaction; CMV and/or Temperature

Document – GNSS Mapping

- Measurement plus Pass Count mapping

Analyze

- Meet target pass count
- Asphalt Paver auto material loading

Make every pass count

- Increased efficiency and Improved layer smoothness
- Documentation of compaction process ensures uniformity

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PAVING TECHNOLOGY
ASPHALT COMPACTION

Machine Telematics

Compactor to Compactor Data Communication

Cat Compaction Control
GPS Temperature, Pass Count and Compaction Mapping

Object Detection

Automatic Compaction Control

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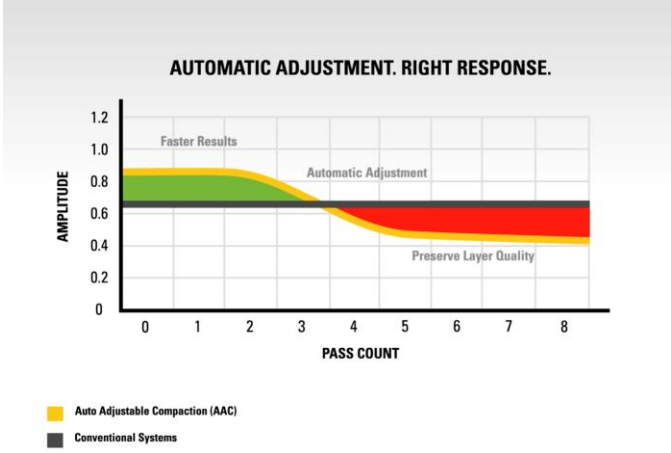
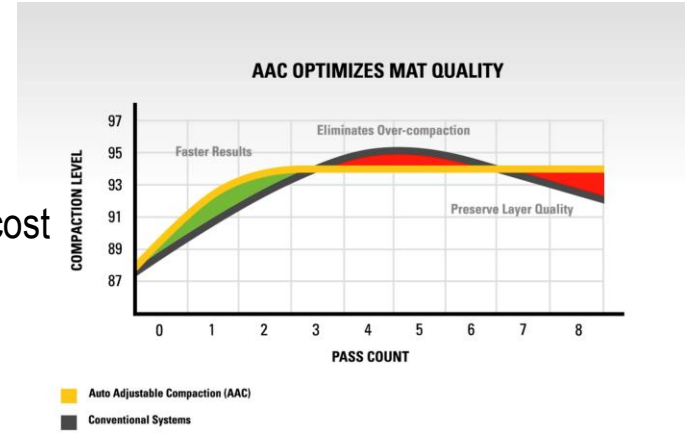
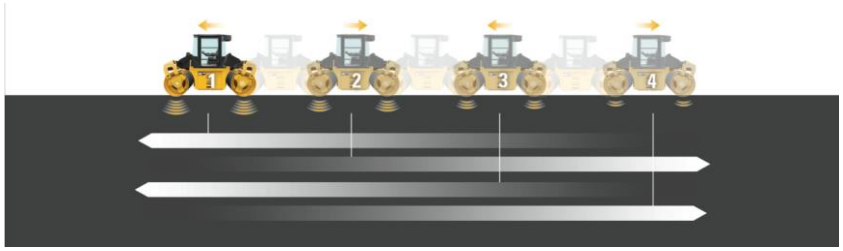
COMPACTION TECHNOLOGY
AUTOMATIC COMPACTION CONTROL

- Operational Simplicity - Automatic control
  - Ensures the amplitude is optimized
  - Easy to use for all operators – Simple operation
  - Operators see the system value immediately
  - Ensures inexperienced operators do not damage the asphalt.
- Increased Productivity - Do More
  - Intelligent compaction next to sensitive structures
  - The system prevents decoupling / damage to asphalt
  - Sensitivity customized for different bitumen stiffness.
- Quality Compaction
  - Homogeneous, uniform compaction creates compaction with less cost
  - Reduced risk of over-compaction







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VALUE OF
ROLLER MAPPING – INTELLIGENT COMPACTION

Rolling Pattern Analysis

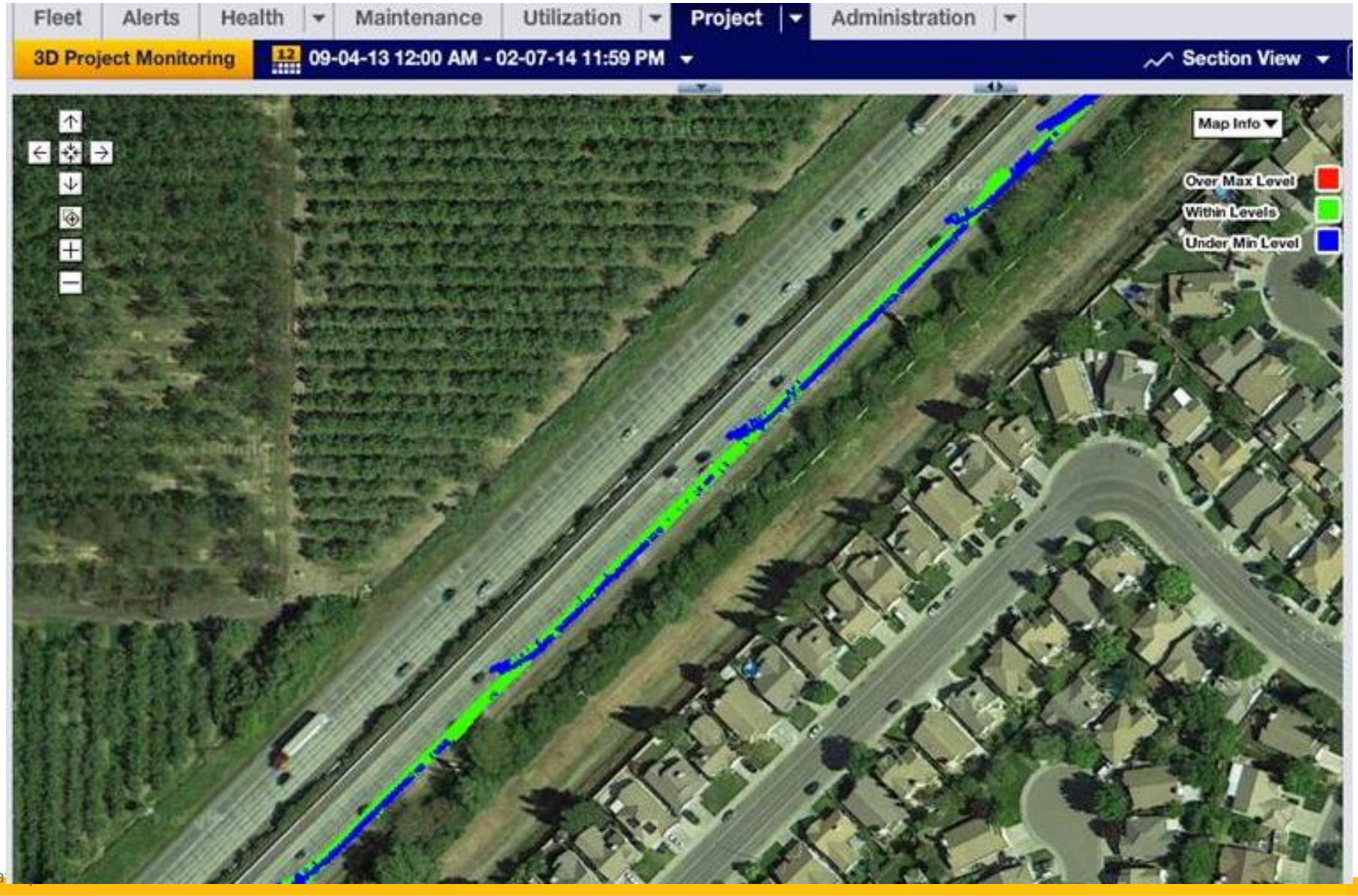
VALUE OF
ROLLER MAPPING – INTELLIGENT COMPACTION

Rolling Pattern Analysis

Cate
Caterpillar

VALUE OF
ROLLER MAPPING – INTELLIGENT COMPACTION

Temperature Variation



VALUE OF
ROLLER MAPPING – INTELLIGENT COMPACTION

CMV Analysis

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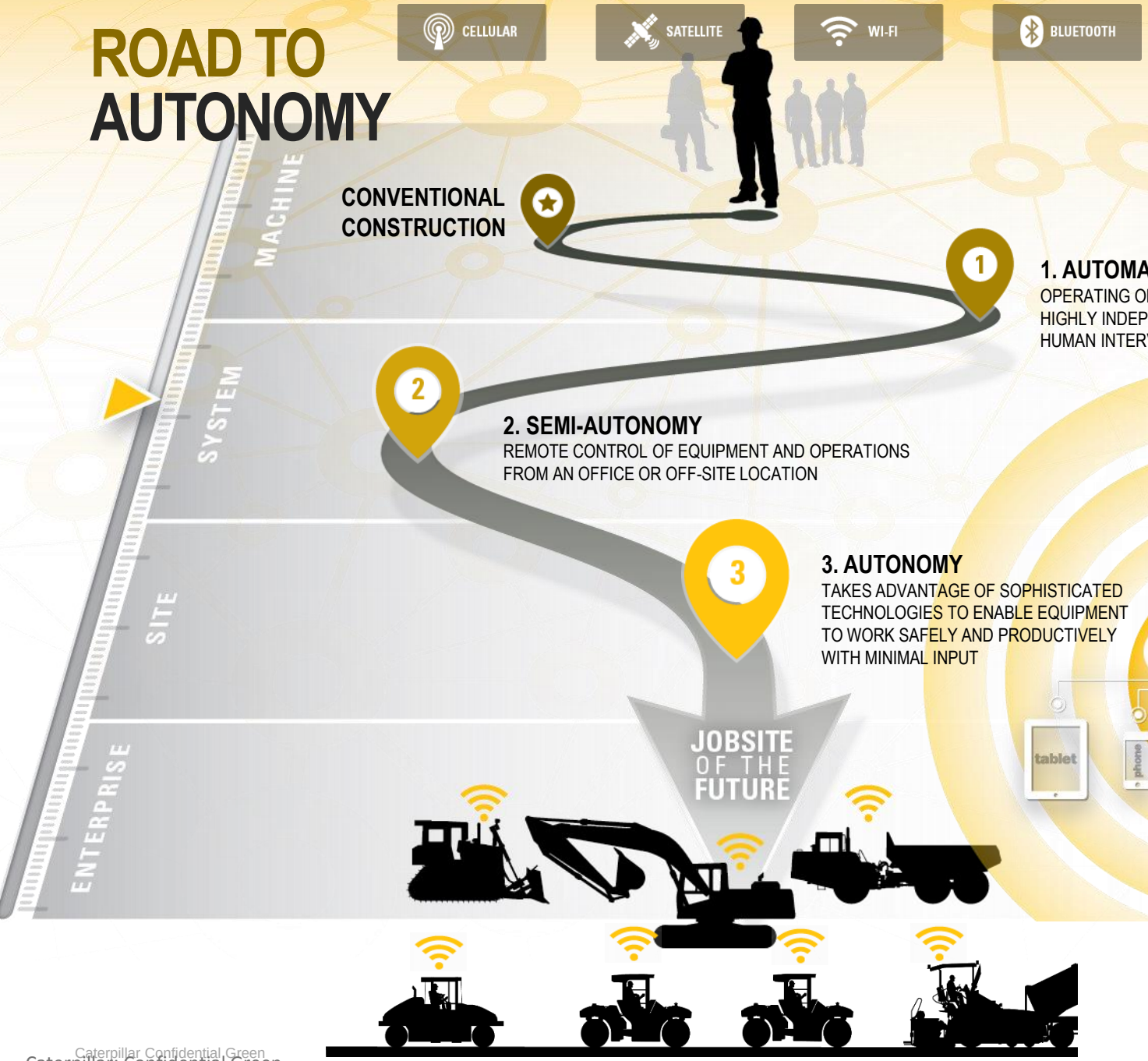
ROAD TO AUTONOMY



1. AUTOMATION

OPERATING OR CONTROLLING A PROCESS BY HIGHLY INDEPENDENT MEANS, REDUCING HUMAN INTERVENTION AT THE SITE LEVEL

2. SEMI-AUTONOMY

REMOTE CONTROL OF EQUIPMENT AND OPERATIONS FROM AN OFFICE OR OFF-SITE LOCATION

3. AUTONOMY

TAKES ADVANTAGE OF SOPHISTICATED TECHNOLOGIES TO ENABLE EQUIPMENT TO WORK SAFELY AND PRODUCTIVELY WITH MINIMAL INPUT

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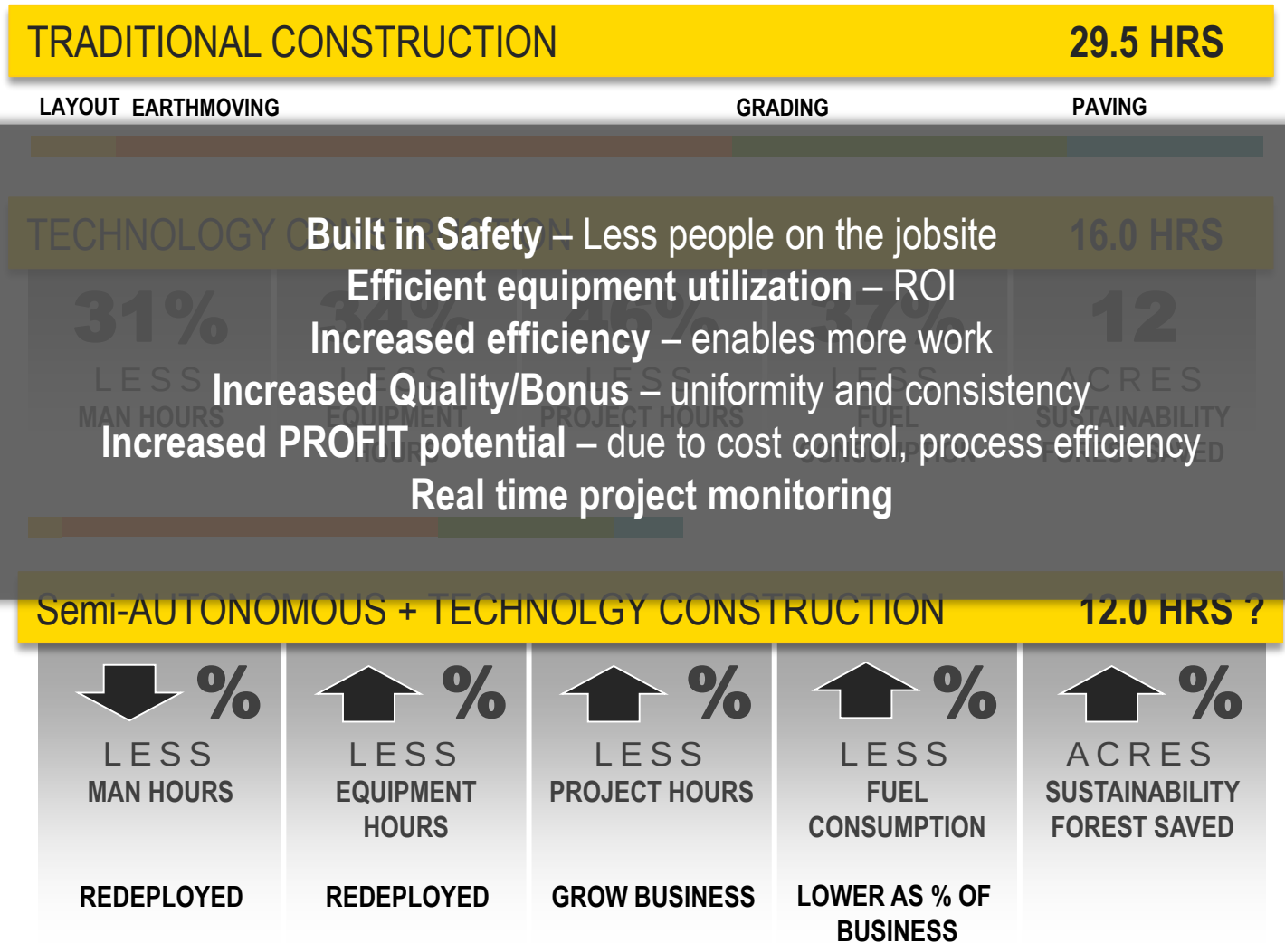
THE NEXT GENERATION
SEMI / FULL AUTONOMY



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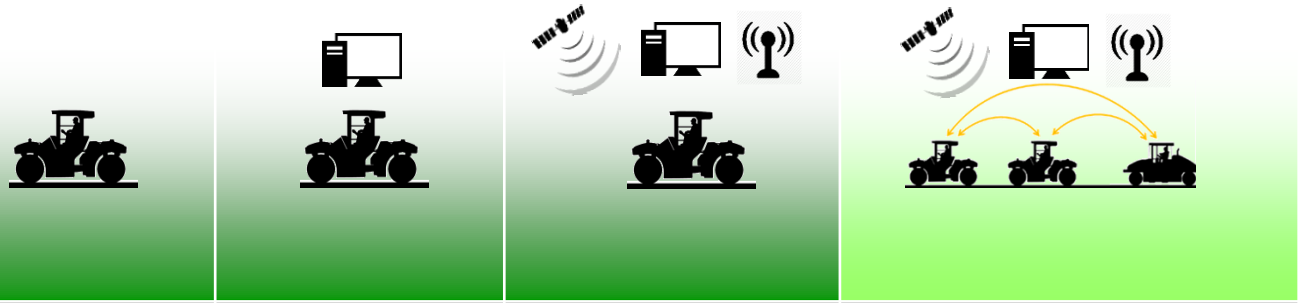
TECHNOLOGY IS…
REDEFINING INDUSTRY STANDARDS

Telematics	Performance	Connectivity	Autonomy
Products Condition External Environment Products Operation Products Usage	Enhance product performance Allow predictive diagnostics	Enhance product performance Through the Value Chain	Full Jobsite Automation of Machines



Product	Smart Product	Smart Connected Product	Smart Connected Products Part of a Product System
Compaction Mapping AAC (Automatic Adjustable Compaction)	Compaction Efficiency & Utilization	Compaction Optimization	Roller to Roller M2M Compaction Map Sharing – full documentation

CATERPILLAR®

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APPLICATIONS
FOR MOBILE DEVICES

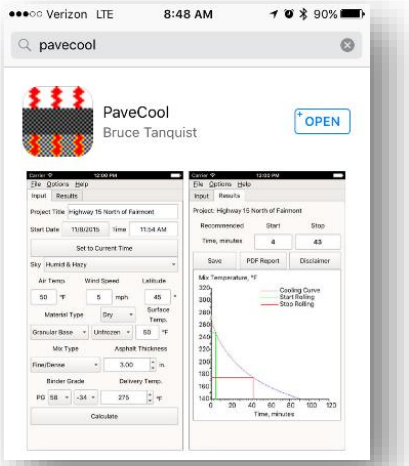
Plan the work – Tools to aid the PLAN

Production Calculator App

- Our popular Production Calculator as a mobile app for iPad/iPhone and Android.
- Allows the customer to enter production numbers and generate a report for calculating trucks, paving speed and compaction specs.
- Download from iTunes and Google Play.
  - Search for “Caterpillar Paving Calc”

Industry Developed PaveCool

- A productivity tool that helps determine the cooling rate for asphalt layers and provides guidance for the compaction time window.
- Download from iTunes and Google Play.
  - Search for “Pavecool”



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