

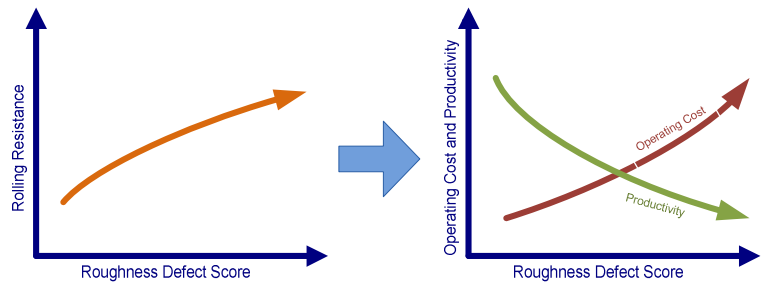
## ECS SMART ROAD – sustainable roads for a sustainable future

### *A GIS-based road maintenance management solution for improving your carbon and energy footprint*

Haulage road condition is critical to the cost-effectiveness of large scale mining, forestry and agricultural operations, because functional roads are an integral part of the production system. Hence best practice needs to be applied in road design, construction and maintenance.

Considering that cost of design and construction of haul roads represents only a small proportion of the total road utilisation and maintenance costs, there is an important requirement for an effective road maintenance management solution.

The implementation of such a solution has the potential to facilitate significant reductions in vehicle operating costs (fuel, tyres and maintenance) and productivity over the life cycle of the road.



A primary principle of good road maintenance practice is that one is not simply focused on maintaining the road to its best condition, but on its optimum functional condition when considering the combination of safety, usage cost and maintenance cost.

*Your road maintenance management strategy has a significant impact on your operation's carbon and energy footprint:*

*Upwards of 6% reduction in fuel and CO<sub>2</sub> is achievable using the ECS SMART ROAD maintenance management and performance monitoring solution.*

This is the driving force behind the ECS SMART ROAD maintenance management solution and its associated features. Simply, without adequate information on road defects, their deterioration and impact on road traffic activities, optimal road maintenance management and cost reduction cannot be achieved.

The solution capabilities, operating principles and benefits of ECS SMART ROAD are highlighted in the sections that follow – where you can get further information on the solution application.



## What solutions are needed to effectively get the road maintenance job done?

It is well known that road condition is critical to road functionality – however, typical maintenance management techniques present specific deficiencies that result in ineffective road maintenance activity and cost. To minimise road use and maintenance costs, the key features of an effective road management solution must include:

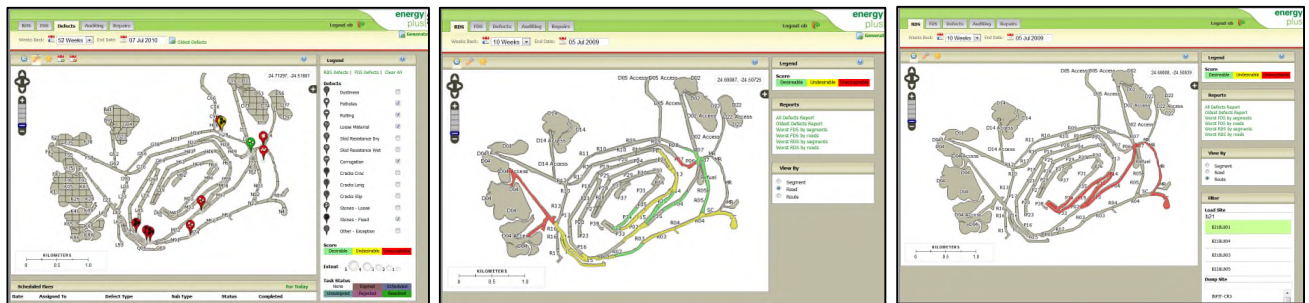
- A method for auditing and surveying road defects – as a roughness defect
- The ability to identify localised road defects together with the ability to classify defects in terms of type, size and extent (different defect types have different cost impacts on road use)
- The ability to assess the cost impact when the defects are combined (the combination of types and sizes of defects determine the maintenance strategy)
- User friendly maintenance workflow management systems and processes
- Cost and other information (including safety and water consumption)

These key features can be further highlighted by comparing various road management solutions:

Key features of an effective road maintenance management solution	Paper Based (survey sheets) and ad-hoc	Vehicle Based and High Speed Profilers	ECS SMART ROAD SOLUTION
<b>Condition Audit:</b>			
Speed of audit and defect capture		√	√
Standardised defect types and interpretation	√		√
Accurate GPS location of defect		√	√
Defects displayed visually on map			√
Automated post processing of data			√
Continuous process	√		√
Defect progression			√
Safety condition capture	√		√
<b>Workflow management:</b>			
Defect weighting (impact)		√	√
Segment impact scoring			√
Road impact scoring			√
Route impact scoring			√
Web based maintenance scheduling – using a mapping server			√
e-Job carding with defect location user interface			√
Scheduling of audits directly from defect mapping			√
Context aware management of repairs and audits			√
Maintenance quality control and management			√
<b>Road Condition and Functionality Cost Profiling:</b>			
Fuel cost impact by road and route			√
Historical road scores – evidence of success/improvement		√	√
Maintenance cost information - related to specified activity			√
<b>Value and Performance Reporting:</b>			
Performance dashboard – performance visualisation			√
Full road condition reporting by period, activity, cost			√
Sustainability measures and metrics (CO2, water)			√
Cost savings verification			√
<b>Quality Assurance</b>			
Road safety management	√		√
Road Quality Management System		√	√
Road maintenance contract management information	√		√
<b>Data Costs versus Data Value</b>	Low Cost, Low Value	High Cost, Low Value	Low Cost, High Value

## How does ECS SMART ROAD address the problem of effective road maintenance management?

At its core, the ECS SMART ROAD solution has the minimum features defining an effective road maintenance solution. Further to this, it provides a live visualisation of the road network via an intuitive, visually interactive and easy to use dashboard (mapping server). The reporting dashboards provide a unified gateway to access timely and relevant road condition, audit and repair information. They allow users to monitor and analyse road performance via specific sets of Key Performance Indicators (KPIs).



The fully integrated Workflow Management System ensures seamless allocation of road audit and maintenance tasks among the road management team, and all activities are logged for review and analysis.

### ECS SMART ROAD Solution Capability

<p><b>Condition survey and maintenance management tools</b></p> <ul style="list-style-type: none"> <li>Mobile auditing (visual inspection) software and rugged handheld computers</li> <li>Maintenance and auditing scheduling (e-job carding and assignment) – based on spatially contextualised information</li> <li>Maintenance workflow management (e-job execution)</li> <li>Maintenance equipment availability and materials</li> <li>Maintenance process control</li> <li>Loading floor conditions</li> <li>Condition and work flow reason codes</li> <li>Automated workflow scheduling for safety and other critical condition flagging and action</li> </ul>	<p><b>Performance visualisation and analytics</b></p> <ul style="list-style-type: none"> <li>Web based mapping server</li> <li>Road defect location (type, degree, extent, age, service condition)</li> <li>Road defect and road functionality scoring (segment, road, route)</li> <li>Functionality and cost based decision tools</li> <li>Historical defect mapping and defect progression (demonstration of effectiveness and support for advanced road design)</li> <li>Reports and reporting tools (current, scheduled, repaired)</li> </ul>
<p><b>Sustainability and value demonstration</b></p> <ul style="list-style-type: none"> <li>Value (energy and cost reductions) verification that feeds into sustainability reporting</li> <li>Energy and emissions reporting</li> <li>Maintenance and road integrity knowledge – for decision support</li> </ul>	<p><b>Road network utilisation cost management</b></p> <ul style="list-style-type: none"> <li>Road and route use costs by vehicle fuel, tyre and maintenance impact</li> <li>Integrated data into production information systems – route selection criteria</li> <li>Road maintenance cost versus use cost optimisation tools</li> <li>Historical cost information - provides the foundation for advanced road design</li> </ul>

## What are the Principles of Operation?

**Road Network Geographical Information System:** This involves but is not limited to sourcing of relevant geographic data for a road network and operations and converting these into geospatial models and spatially enhanced databases. This allows for extensive location-informed reporting and visualisation tools.

**Mobile/Wireless Technologies:** Audit and workflow data are moved across wide geographic areas with the aid of wireless mobile intelligence systems. Specialised handheld computers with a Wi-Fi and network independent GPS receiver are deployed for the capture of haul road defects, auditing and repair activities.

**Web Interface (Internet Mapping Server):** This provides a visual gateway to the acquired geospatial data and the performance information. Several GIS data layers are skilfully used to create the road network website with a high level of usability, visualisation, functionality and accessibility.

**Workflow Management System:** This workflow management utility enables road network auditing, repair and general maintenance. Based on road condition information, the system enables real-time scheduling of audit and repair tasks. This is an unconstrained solution, as tasks can be allocated over a wide geographical area

**Performance Models:** To accomplish most of the functionalities of the road maintenance management solution, a number of specialised process and scoring models are applied to the data streams. These have been specifically developed to enhance the decision support needed for effective management of the road and maintenance assets.

## Services Provided

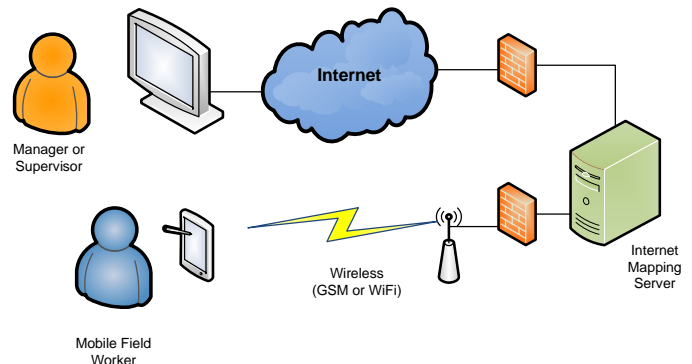
**Operational Establishment:** Converting the road network survey data and road information into the geospatial model used by the mapping server.

**Equipment:** Handheld (rugged) computers for condition audit and maintenance workflow management.

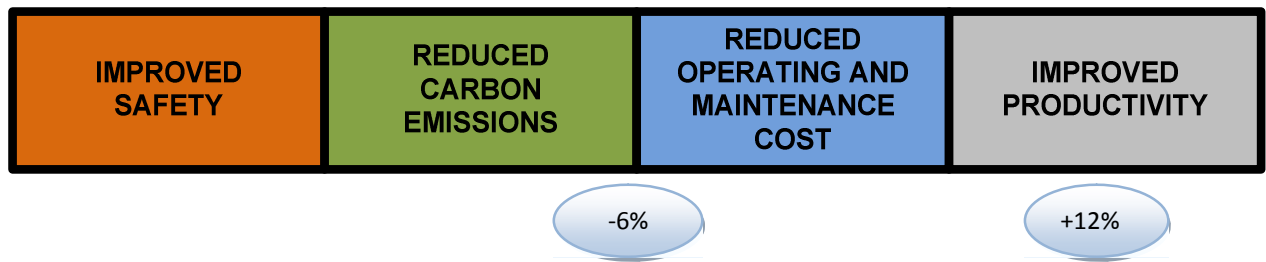
**System Operational and Services:** The solution is provided as a hosted web service (SAAS – software as a service) with the following:

- Operational map server and reporting dashboard
- Workflow scheduling and management
- Handheld computer application – based on Windows Mobile 6 and software as a service
- User training and help line for system operational support
- Road and network extension services together with upgrades and special purpose developments (mapping server and mobile workflow management).
- Bi-annual value review and report

**User responsibilities:** For the solution to deliver the benefits and value, the user is required to execute the auditing and maintenance task scheduling. Since the solution is effectively a decision support tool for road maintenance and cost management, it supports action, rather than takes action. Therefore acting on the solution's information is critical to benefits and value being derived from its implementation.



## What value and benefits does the solution deliver?



The ECS SMART ROAD solution offers specific benefits to production road users and owners. These are due to the ECS SMART ROAD solution being an easy to use and intuitive system that is designed to apply the combined power of GIS together with road condition performance models and workflow management.

The solution is premised on a high data value and low total cost of ownership model, where the following benefits can be expected:

**Improved Safety:** Road conditions and events that potentially impact on safe operation are captured and immediately shared with those that can mitigate the risks (e.g. reduced visibility due to dust and road-side viewing obstructions).

**Reduced Carbon Emissions:** Early detection, analysis and timely repair of the significant defects that impact on fuel consumption and hence carbon footprint is enabled by the system. Upwards of 6% reduction in emissions is achievable.

**Reduced Operating and Maintenance Costs:** Easily accessible and visible road condition impact on fuel consumption, tyre consumption and vehicle maintenance, supports prioritised maintenance and effectiveness. The result is a net improvement in road condition and cost. Further, the solution provides contextually based information for improved maintenance equipment (graders, water carts) scheduling and utilisation.

**Improved Productivity:** Management and decision support information, such as road functionality deterioration impact on productivity and road condition by route, allows for improved vehicle scheduling and maintenance prioritisation. Upwards of 12% improvement in productivity is achievable.

Further to these, a number of other benefits are delivered by the astute utilisation of the solution:

**Improved use of advanced road design and surfacing technologies:** Information and decision support reports are provided that can be used for assessing the benefits and value of road surfacing technologies and improved road design methods e.g. dust suppression for water savings and road functional deterioration progression.

**Improved maintenance service provider contract management:** The solution provides facts on service levels and maintenance effectiveness. These include Totally Productive Maintenance metrics such as “mean time to repair” and “mean time between failures”, together with maintenance productivity – thereby supporting your maintenance contract management processes.

**Verified reductions and improvements:** Services offered as part of the solution include verification of the savings and improvements. This is because the solution is supported by a team of analysts, continuous improvement specialists and certified energy managers together with measurement and verification professionals.

## About ECS and the Solution

### About ECS

Energy and Combustion Services (ECS) is a focused technology company delivering high-performance energy and emissions management solutions to industry, and has been in operation since 1996. We pride ourselves in being expert energy management and measurement and verification specialists who are able to help our customers to connect energy efficiency to sustainable business performance. We have a reputation for innovation and are able to use cutting-edge technology such as performance visualisation tools to provide verifiable and understandable results. ECS has been ISO 9001 certified since 2006, and our management processes and services consistently meet the requirements of ISO: 9001:2008.



### What makes ECS different?

- Energy and emissions management is what we do: we have years of experience and highly specialised professionals: Certified Energy Managers (CEM), and Certified Measurement and Verification professionals (CMVP), analysts and engineers.



- We specialise in making sense of process data and creating knowledge from analysed information.
- You will receive understandable, verifiable and auditable results, enabling you to support proof of reductions.
- We can help you to do more than measure and monitor, but to find ways of reducing emissions – turning compliance into opportunity.
- We have the habit of focusing on what is important to you.
- We report recognised GHG protocols and of a standard that is associated with your sustainability reporting.

*We not only promise savings when we implement a solution but more importantly, we provide verifiable evidence of success.*

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### About the Solution Development

Extensive research and development has gone into the solution development – that was funded with the assistance from the Department of Trade and Industry via the National Research Foundation on THRIP. Further, the excellent foundational research work of the University of Pretoria and solution application proof of De Beers (Jwaneng Diamond Mine) is acknowledged.

