# Roadroid References

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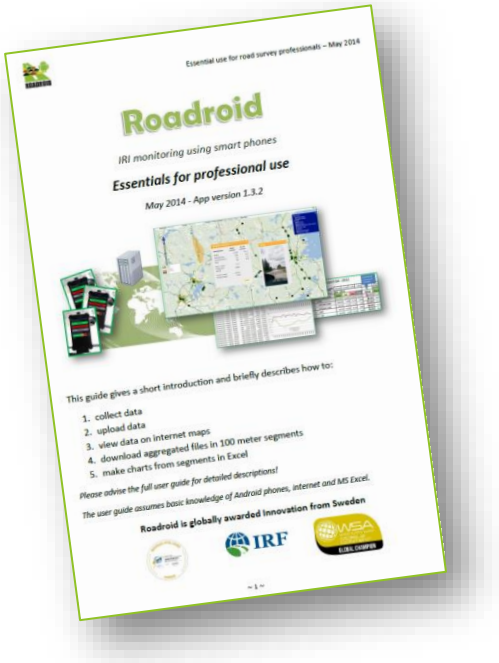



Please note that this is not a user guide.
Our essential guide, describes how to operate the system.

www.roadroid.com

## The Roadroid system

*Roadroid is a system to monitor road conditions by the use of a smartphones.*

Its consists of:

1) **an app**, that picks up the vibrations from the road with the smartphone's built in accelerometer - and the GPS to position it.
2) **an internet service** to monitor the road condition data and transfer it to road maintenance management systems.

## The app

The Smartphone application analyzes the road vibrations 100 times per second (in 90 km/h this is one signal every 25 cm).

From these 100 samples, one road condition value is calculated and saved with GPS coordinates.

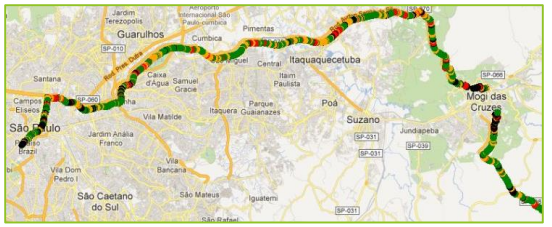
There are complex formulas behind the signal analysis and the result is expressed in a global standard - International Roughness Index (IRI).

So, every second an IRI value is saved with an X, Y and Z coordinate from the GPS.

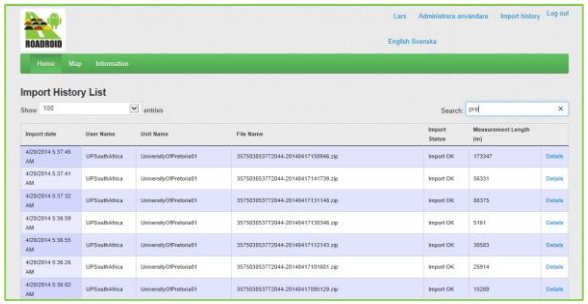

Data is stored on the phone and then transferred by WiFi or 3 G to a cloud server.

## The internet service

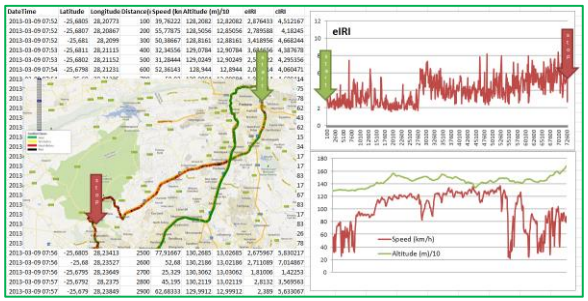
After the data has been transferred to the cloud service it can be monitored on a map.




The data is assigned 4 colors depending on the road condition. Green for good, Yellow for Satistfactory, Red for Unsatisfactory and Black for Poor.




Data is also aggregated in 100 meter sections, and can easliy be downloaded to create analyses and charts in Excel.

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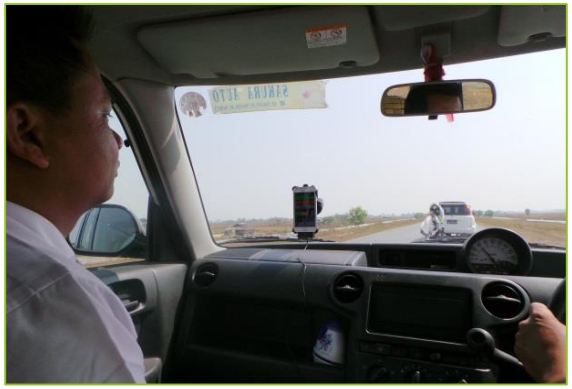
# Myanmar Sweroad/MOC/ADB

Myanmar Ministry of Construction (MOC) use 5 Roadroid units to collect roughness data about their entire road network.



The Roadroid training was held as a 1-day introduction for ~25 operators and managers, and a 3-day hands-on training for 15 operators.

The training focused on the roughness data collection, but also had brief introductions to GPS-video data collection and a road inventory application for smartphones.

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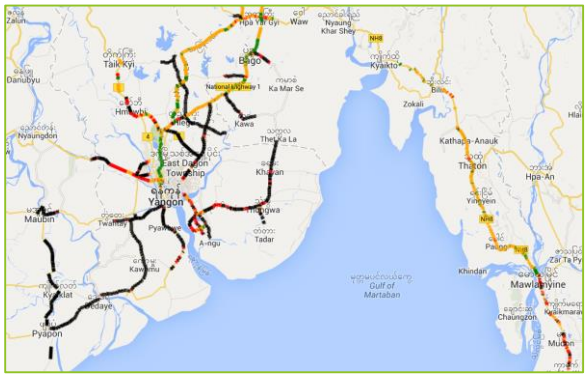
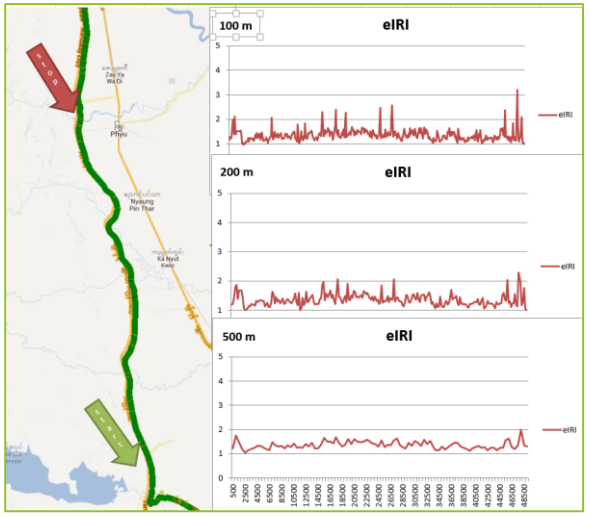
The MOC roads vary from 2 lanes concrete roads, paved roads with different widths and down to flexible pavement DBST. There are also some gravel roads in the network.

Except from roughness values, the spatial data collected can be used to build a road database.




For trimming and learning the adjustable constant for cIRI (calculated IRI), a test was made with 2 different cars and 4 units. Two units were mounted on left/right side of the cars to see how the cIRI constant changed.

During the training we agreed on suitable speeds depending on road type (ranging from concrete expressway to DBST and gravel road).




The training was done in cooperation with Sweroad and the local consultant Myanmar international consultants (MMiC), with funding from ADB (Asian Development Bank).

## Contact references:

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ADB Asian Development Bank
Fighting Poverty in Asia and the Pacific

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# Afghanistan UNOPS/PWD

In Afghanistan, Northern region, UNOPS runs a road project funded by SIDA. The project's focus is gravel roads in the four provinces of Balkh, Sari Pul, Samangan and Jawzjan. Local partner is Public Works Department (PWD).


Roadroid was tested and evaluated during 2013 and then procured in late 2013.

An onsite training held in June 2014 included a 3-day planning followed by a 6-day training for 15 road engineers.

The training was performed in coordination with a project team from UNOPS (SIDA/RAIP III/NTH/RMMS - Project No. 00084840).

A local project team from UNOPS coordinated the training, which was performed by a Swedish Road Engineer and Roadroid expert.

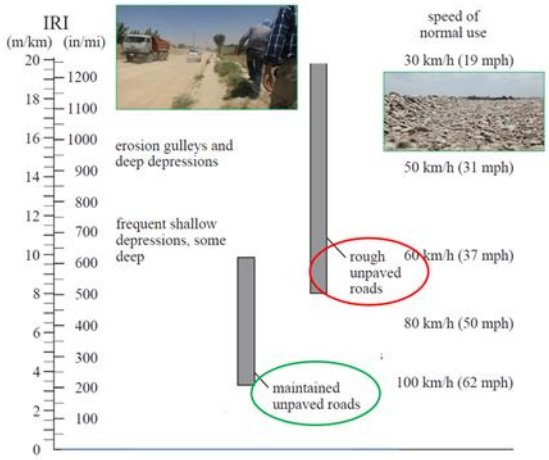
The training focused on the roughness data collection but included also GPS-video data collection and an introduction to our road inventory application for smartphones.

Training also included a workshop of future needs: Road Weather Information Systems, Traffic Counting and Traffic Management.

A great challenge was the rough gravel roads, and the extreme type of damages.

- *An extreme surface roughness is caused by the use of natural material, round stones mixed with sand. The sand gradually blows or wash away and the big round stones remain.*
- *"Potholes" sometimes was bathtub size, needing creeping speed to pass. Its was not possible to classify that in terms of IRI.*

We have functional requirements to register these type of damages, and the discussions progressed the thinking and possible solutions.




***References:***

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# Sweden
# Trafikverket/Motormannen

During 2014 Roadroid runs a Research and Innovation project on behalf of the Swedish Transport Administration (Trafikverket).

Questions to be answered is how the data can be further automated and what kind of decisions to be made from the information.

The project is carried out in cooperation with Motormännen (M), a Swedish Motorist club with some 115.000 members.

Motormännen use Roadroid in their inspection routes organized in 17 districts of Sweden.


www.roadroid.com

12 brand new Volvo V40 D2 cars will collect up to 15.000 km of road each. This results in a total road survey of possibly up to 180.000 km.

The results will be matched and compared with data from the ongoing national road surveys with the IQL 1 survey vehicles (RST). These surveys only partially cover the road network.

In September 2014 Motormännen prepare an independent national report of the Swedish National roads from the collected data. They will share this with both media and road users.

Both a quantitative correlation study towards the IQL1/RST measurements, and a qualitative evaluation with the drivers of the twelve cars will be performed.

After some 15.000 km in each car, they can share valuable experiences of how “accurate” Roadsroid’s expression of the road condition is.



The collected data is exported in intervals to Motormaännen’s own website and monitored through a Cartodb service: https://www.motormannen.se/klubbar/inspekterade-vagar/

***References:***

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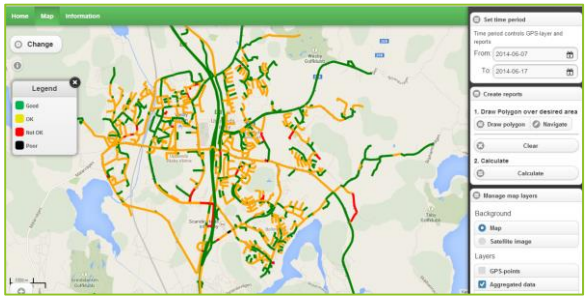
# Sweden
# The City of Upplands Väsby

Roadroid have several Swedish cities as clients, and one early adopter with active users is the city of Upplands Väsby, north of Stockholm.

The city is growing and has several industrial projects ongoing that they want to monitor

With Roadroid the city´s personnel can do the surveys by themselves. For the entire street network – and for the bike paths as well!



It is not a coincident that the City of Upplands Vasby has been awarded as the most developed IT-city of Sweden, and they have been an excellent early adopter of our new technology.

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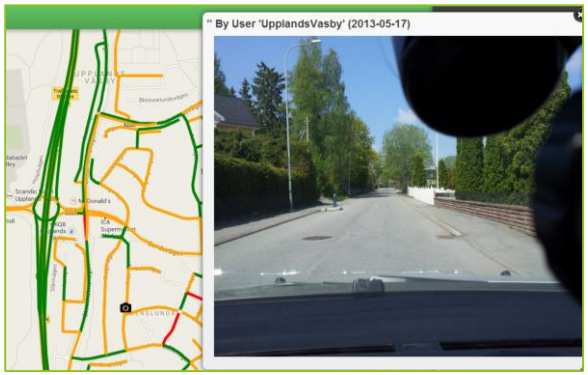
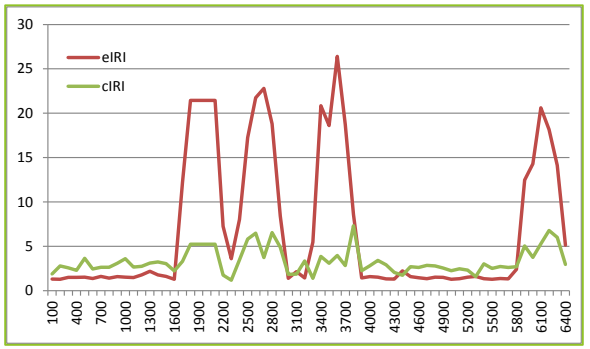


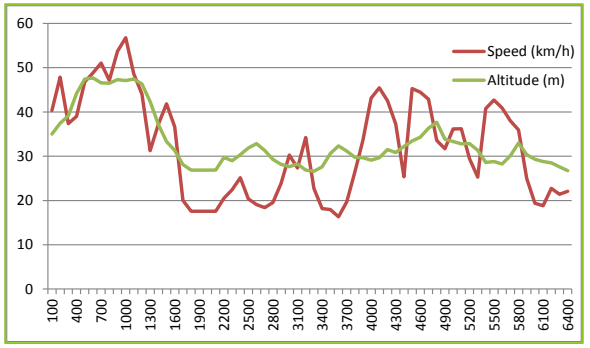

As they now manage to do the survey by their own staff, Upplands Väsby can reduce the cost for expensive surveys made by consultants = more money for the actual pavement work!

Roadroid produces automated road condition reports from the street register, and Upplands Väsby have used the data in dialogues with their contractors also on detailed object level.

| Gatunamn | Antal | | | | Tot | % | % | % | % | BRA | SÄMRE | AvgeIRI | AvgSpeed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Abborrgränd | 19 | 2 | 1 | 0 | 22 | 86,4% | 9,1% | 4,5% | 0,0% | 95,5% | 4,5% | 1,75 | 24 |
| Aklejavägen | 47 | 2 | 0 | 0 | 49 | 95,9% | 4,1% | 0,0% | 0,0% | 100,0% | 0,0% | 1,58 | 26 |
| Allévägen | 36 | 4 | 2 | 1 | 43 | 83,7% | 9,3% | 4,7% | 2,3% | 93,0% | 7,0% | 2,19 | 28 |
| Allhelgonavägen | 30 | 2 | 0 | 0 | 32 | 93,8% | 6,3% | 0,0% | 0,0% | 100,0% | 0,0% | 2,13 | 22 |
| Almungevägen | 314 | 18 | 6 | 0 | 338 | 92,9% | 5,3% | 1,8% | 0,0% | 98,2% | 1,8% | 1,69 | 42 |
| Alvägen | 21 | 3 | 1 | 0 | 25 | 84,0% | 12,0% | 4,0% | 0,0% | 96,0% | 4,0% | 2,37 | 26 |
| Anevägen | 11 | 2 | 1 | 1 | 15 | 73,3% | 13,3% | 6,7% | 6,7% | 86,7% | 13,3% | 2,50 | 27 |
| Anton Tamms väg | 98 | 4 | 0 | 0 | 102 | 96,1% | 3,9% | 0,0% | 0,0% | 100,0% | 0,0% | 1,52 | 30 |
| Ardennergatan | 70 | 3 | 0 | 0 | 73 | 95,9% | 4,1% | 0,0% | 0,0% | 100,0% | 0,0% | 1,70 | 29 |
| Aspvägen | 19 | 1 | 0 | 0 | 20 | 95,0% | 5,0% | 0,0% | 0,0% | 100,0% | 0,0% | 1,66 | 24 |
| Backvägen | 18 | 4 | 0 | 0 | 22 | 81,8% | 18,2% | 0,0% | 0,0% | 100,0% | 0,0% | 1,74 | 24 |
| Baldersvägen | 22 | 1 | 1 | 2 | 26 | 84,6% | 3,8% | 3,8% | 7,7% | 88,5% | 11,5% | 2,44 | 30 |
| Barrstigen | 38 | 5 | 1 | 1 | 45 | 84,4% | 11,1% | 2,2% | 2,2% | 95,6% | 4,4% | 1,99 | 24 |
| Bendans bro | 90 | 13 | 19 | 10 | 132 | 68,2% | 9,8% | 14,4% | 7,6% | 78,0% | 22,0% | 2,88 | 44 |
| Bergklintvägen | 80 | 7 | 5 | 2 | 94 | 85,1% | 7,4% | 5,3% | 2,1% | 92,6% | 7,4% | 1,88 | 25 |
| Bergstigsvägen | 87 | 7 | 6 | 5 | 105 | 82,9% | 6,7% | 5,7% | 4,8% | 89,5% | 10,5% | 2,38 | 27 |
| Bergsvägen | 78 | 2 | 6 | 5 | 91 | 85,7% | 2,2% | 6,6% | 5,5% | 87,9% | 12,1% | 2,00 | 24 |
| Besvärsvägen | 41 | 4 | 0 | 1 | 46 | 89,1% | 8,7% | 0,0% | 2,2% | 97,8% | 2,2% | 1,64 | 24 |
| Bills backe | 22 | 0 | 0 | 0 | 22 | 100,0% | 0,0% | 0,0% | 0,0% | 100,0% | 0,0% | 1,32 | 25 |

As they run a continuous license, they are able to effectively monitor the change of the pavement condition from year to year – and even between different seasons.




***References:***

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# Sweden
## Bike paths in the City of Lund

The city of Lund is maybe most recognized for its famous University.

A famouns university, means a lot of students. And a lot of students means a lot of bicykles.

So Lund is a biking city, with high utlilization and demands on the bike paths.

The municipality made a survey using Roadroid and got input to keep the bike paths of Lund in a continuous good condition.



*- And more cities are following this good idea, such as Gavle, Uppsala, Pitea, Skelleftea and Upplands Vasby!*

***References:***

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CYKLA I GÄVLE

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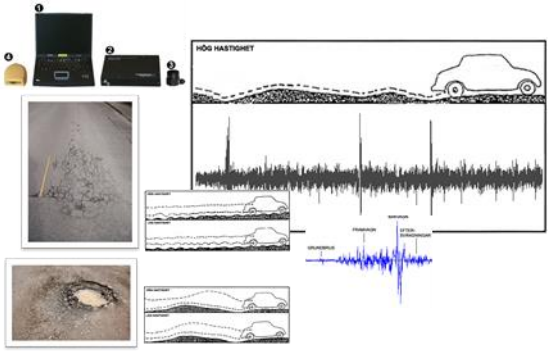
# Roadroid – the story. So far.

Our first sketch was made in 2001 and the prototype saw the first light in 2002. At that time smartphones were not yet invented, so we used a PC with an external accelerometer, a signal amplifier and a GPS unit.



The PC-based system was developed 2002-2006. While PC, cables and accelerometers were not safisfactory, our team learnt a lot about how vibrations can express a roads condition.

Our team shattered into other projects, but in 2010 we realized that modern smartphones now also included an accelerometer!

So the team gathered again:

- **Lars:** Road engineer, process and project manager. Burning force, convinced that now was the time to make old ideas to reality.
- **Hans:** Computer engineer and real time programming expert – now teaching at a university with an edge on Smartphones.
- **Tommy:** Computer engineer and now a road database expert and consultant – in the core of the Swedish Traffic Management Systems.

And we had another 5+ professional years with ITS and mobile location based systems…

When realizing there were accelerometers in the smartphones, we had ideas of how to use them! We knew answers to many questions, but there were also new things to solve, such as:

- Could we use the vibrations inside the car?
- How to handle different car models?
- Would 100Hz sampling frequency be enough.
- Was the accelerometer sensitive enough?
- How would different smartphone models act?


During the summer 2011 Hans and Lars made extensive field tests combining old experience with new technology. With the first data now in the app, we needed to refine it and make it avaliable over the web.

So in the autumn 2011, Tommy started working on a first webspace. At this time, we used Android Road Quality (ARQ) as name for the app and Qtex for the website.

During 2012, early adopter cities started using the system, we were the regional winner of the Europeean Satelite Navigation Competition, and we started international pilots.

In 2013 we got licenced clients in Sweden and won the UN World Summit Award for best mobile eGovernance application.

And now in 2014, Roadroid is starting to catch on in a big way. We are doing international business, still in a small scale but with good results and happy clients. We are extra proud to have clients as the United Nations, and to realize that we create great value out there.

For low volume roads, Roadroid is an accessible, easy-to-use, cost-efficient, objective and extremely portable solution.

On high standard roads, Roadroid's ability to automate surveys gives possibilties for early warnings and to monitor roughness changes over time. This opens new perspetives to asset management and performance based maintenance.

We cooperate with globally known experts and universities, and start pilots on a broad scale.

## Global sponsor of universities

Roadroid company believes in the benefits of cooperating with academia.

Our original prototype 2002 saw its first light through a Master Thesis made by two students of the Swedish Royal Institute of Technology.

We sponsor universities all over the globe with free access to our system, and we participate as guest lecturers whenever we can.

In return, we want to follow the result of their research.

Roadroid is used both in research and training of road engineers.

In February 2013 the Universities of Auckland, New Zeeland and Pretoria, South Africa contacted us. And in a few weeks they both started up research projects with our support by distance.


During the year, both universities produced valuable reserach reports for our development.

We got encouraged by them expressing the performance we knew about - but also challenged with the limitations discovered.

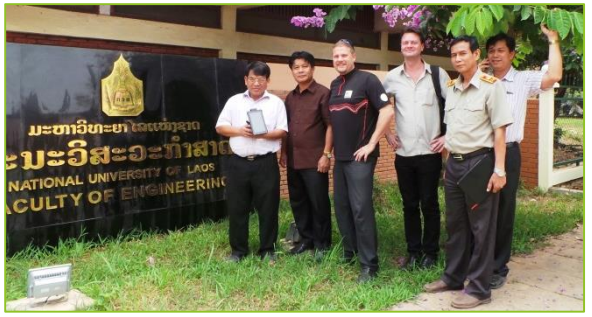
Their constructive fedback has further tuned our algorithms and proceeded our development.

Today we also cooperate with the universities of Twente in the Netherlands and of Luleå in Sweden.

We also develop co-operation with Balkh University in Afghanistan and the National University of Laos

*Balkh University, Mazar-E-Sharif*

It may sometimes be a long process to get results, but these cooperations offer access to state-of-the-art knowledge and competence we could never have in our start-up company. And by coopereting with several institutions, some of them always have something to come up with. To build sustainable development, it is good to not be in too much of a hurry!

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***References:***

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