



ERPUG

BUDAPEST,
HUNGARY
2015

HiSPEQ - **H**i-speed survey **S**pecifications, **E**xplanation and **Q**uality

Alex Wright, TRL
Darko Kokot, Zag

HI-SPEQ



- Hi-speed survey **SP**ecifications, **E**xplanation and **Q**uality
- Funded under the CEDR Transnational Road Research Programme
 - **CEDR Call 2013: Ageing Infrastructure Management - High Speed Non-destructive Condition Assessment**
- 6 project partners (leader)
 - TRL (Alex Wright, Emma Benbow)
 - AIT (Roland Spielhofer)
 - VTI (Leif Sjogren)
 - ZAG (Darko Kokot)
 - COWI (Gregers Hildebrand)
 - Fugro (Mark Thomas, now TRL)
- CEDR sponsor: Rolf Rabe
- Duration: 24 months (Apr 2015-)
 - Project is 75% through
 - A number of deliverables and recommendations to report



**Conférence Européenne
des Directeurs des Routes**
**Conference of European
Directors of Roads**

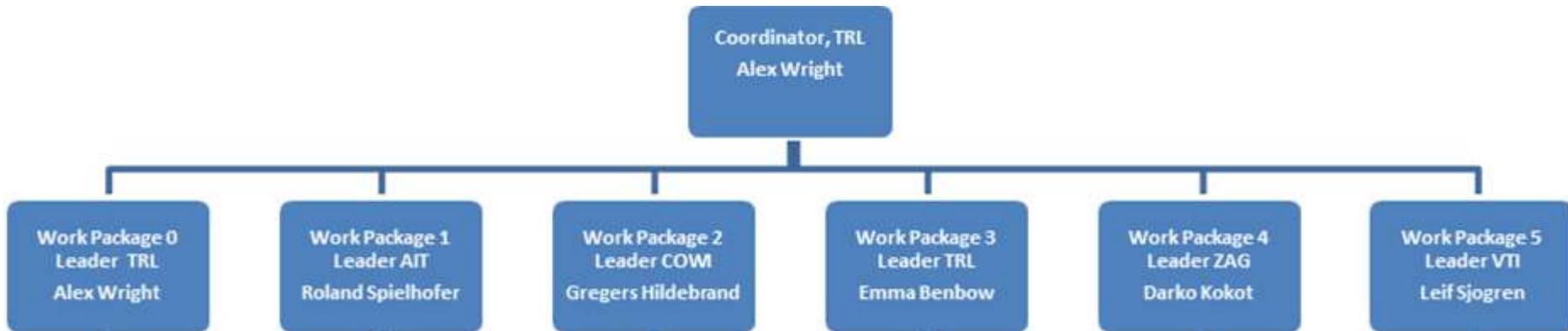
Stimulus for HI-SPEQ project



- High speed non-destructive condition assessment
 - Need for reliable consistent asset data
 - Collected in a way that minimises impact on users, traffic etc.
 - Surface condition surveys widely undertaken at high-speed
 - Recently, introduction of TSD for structural surveys
- Call requirement:
 - Guidance on traffic-speed measurement of surface and structural condition
 - Consistent descriptions of equipment
 - Consistent survey specifications
 - Define QA requirements
 - Data processing and interpreting



HI-SPEQ – project structure



HI-SPEQ – Overall Approach

- What data is/can be collected on road networks at high speed?
 - Surface Condition
 - Structural condition
 - Road structure

- How are/can network surveys can be specified to deliver the needs of road Authorities

- Develop templates for specifying surveys on the European road network
 - Surface condition
 - Structural condition

- And guidance to help NRAs complete their own specifications



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Conference of European
Directors of Roads



HiSPEQ: Project Plan

Project Plan Version Control

Date	Notes/Reviewer	Date for next review
June 2014	Initial version	November 2014
Nov 2014	Emma Benbow	March 2015
		July 2015
		November 2015
		March 2016

Project overview

Name	HiSPEQ: Hi-speed survey Specifications, Explanation and Quality			
Start date	14 th April 2014			
Duration	24 months			
Partners	TRL (coordinator)	UK	Euro	NL
	AIT	AU	ZAG	SI
	COWI	DK	vti	SE
Programme Manager	Albert Daly, NRA, IE			
PER Project Manager	Rolf Rabe, BaSt, DE			
NRAs participating in Ageing Infrastructure	UK, DE, IE, NL, UK and SI			

HI-SPEQ – Overall Approach

- What processes can/should be applied to ensure surveys meet expected levels of quality?
 - Develop guidance to help Authorities specify QA regimes

- How can the way that high speed survey equipment is described be tuned to complement specifications?
 - Develop templates for describing equipment
 - Guidance to help developers complete these, and for NRAs to understand them

- How can the data be converted into meaningful condition parameters for input to asset management systems?
 - Guidance on the delivery of condition parameters



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HI-SPEQ – Activities

- Establish scope - traffic-speed measurements linked to structural condition
 - Longitudinal Profile
 - Transverse Profile
 - Visual assessment (Cracking/imaging)
 - Deflection (TSD) and structure (GPR)
 - Not texture, friction etc.
- Establish knowledge base
 - Establishment of stakeholder/review group
 - Sourced current specifications from across the world
 - Drawing on previous research and knowledge of consortium



HI-SPEQ Progress – “Stakeholder group”

Name of contact	Representing	Name of contact	Representing
Karl Gragger	Austrian Road Administration	Ian Butler	WDM
Paul Rees	CSS Wales	Manish Jethwa	Yotta
Bjarne Schmidt	Danish Road Directorate	Roger Möller	Ramboll
Susanne Baltzer	Danish Road Directorate	Timo Saarenketo	Roadscanners
Alex Tam	Highways Agency	Brian Ferne	TRL
Ramesh Sinhal	Highways Agency	Adam Cook	TRL
Richard Wix	ARRB	Willem van Aalst	TNO
Michael Moffat	ARRB	Brian Ferne	DaRTS
Matt Smith	New Zealand	Alex Wright	SCANNER contractor liason group
Wim Van Ooijen	Rijkswaterstaat (Netherlands NRA)	Erica Utsi	EuroGPR
Graeme Ferguson	Scottish Road Maintenance Condition Survey	Leif Sjögren	ERPUG
Bojan Leben	ZAG	Leif Sjögren	CEN
Amanda Richards	UK Roads Board	Dr Carsten Karcher	EAPA
Damion Orsi	Fugro	Stefan Bald	EAPA
Martyn Stonecliffe Jones	Dynatest	Barbara Koch	EAPA
Jørgen Krarup	Greenwood	Tanja Altemeier	BaST
Vaquero García Julio José	Spanish Ministry of Public Works and Transports	Jean-Michel Simonin	IFSTTAR

Exploring existing specifications



- Many specifications for network wide surveys
- Including Europe, North America, North Africa and Australasia
- Survey requirements ranging from 375km to 150,000km

What length is the network that is surveyed?	
Australia	Several requirements from 3,500km to 35,000km
Austria	4400 km carriageway length
British Columbia, Canada	n/a
France	n/a
Germany	52.000 km (12900 km motorways, 39100 km primary roads)
Ireland	5400 km
Morocco	1024km (Fez-Oujda 321km)
Netherlands	376 km (national); 5000km (Regional)
New Zealand	22,000 lane km
Slovenia	1320 km (national); other roads: 5960 km
Sweden	Yearly 75 000 km (total paved network ~ 98 500 km)
UK	>150,000km
UK 2	40,000 lane km
USA: California	About 4,500 miles (72,400km)
USA: Louisiana	20,600 directional miles

HI-SPEQ – Activities

- “Consultation and review” exercise
 - Team review of specifications
 - Critical assessment
- Review and assessment lead to “key requirements” documents for specifications for
 - Measurement of surface condition
 - Measurement of structural condition
 - Ensuring data quality
- Key requirements documents issued for stakeholder review early 2015
 - Stakeholder comments - “Summary of review of key requirements for survey specifications”
 - 72 comments offered and taken into account
- These are published on the Website



CEDR Transnational Road Research Programme
Call 2013: Aging Infrastructure Management

funded by Denmark, Germany, Ireland,
Netherlands, UK and Slovenia



**HiSPEQ: Hi-speed survey
Specifications, Explanation and Quality**

**Key Requirements to Include in
HiSPEQ Specifications**

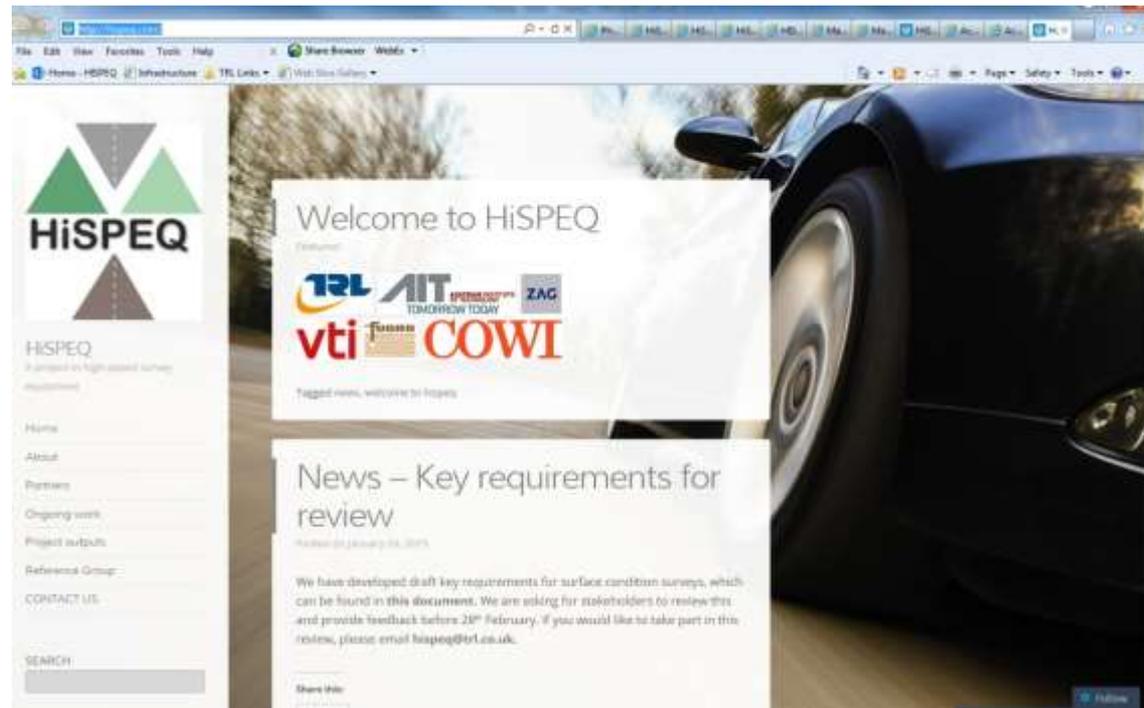
Report No 1
Month, Year



HI-SPEQ Activities – Website



- HiSPEQ Documents are available on website established at www.hispeq.com
- Will hold all project documents
 - Documents for consultation and Review are present
 - Final outputs will be
- Stakeholder contacts



Hi-SPEQ Activities – Specification Templates



- The “key requirements” were used to develop Specification Templates for network surveys
- The Templates draw on the Australian structure for survey specifications:
 - A specification document for each technical measurement area
- What should be in them?
 - The review identified clear need for specifications to include
 - » How to generally specify a survey
 - » Defining a network
 - » Location referencing, Survey conditions etc.
- Additional specification documents proposed for these



1 Scope

Who is commissioning the survey?
What do they want to use the data for?
Description of the survey objectives e.g. to collect data for pavement condition assessment.

2 Referenced documents

List of other documents referenced e.g. HiSPEQ3: SPECIFICATION FOR PAVEMENT RUTTING MEASUREMENT.

3 Definitions

Definitions for terms used in this specification e.g. longitudinal profile, GPS, Laser profilometer, IRI, TSD_{xxxx}.

4 Description of network to be surveyed

What kind of network is to be surveyed?

- Type of roads (e.g. motorways, strategic roads)
- Length of the network (preferably split by road type)
- Which lanes need to be surveyed, what doesn't need to be surveyed e.g. roundabouts
- Typical minimum width of the roads to be surveyed (if likely to be <3.2m).

5 Timescale of surveys

- What is the duration of the survey contract?
- How much of the network is expected to be surveyed for each time period of the contract? E.g. only Lane 1 surveys in year 1 everything else in year 2. Note, this may be different for data types to be collected.

6 Deliverables of the contract

Describe the data to be delivered

- Raw data i.e. transverse profiles, longitudinal profiles, images, GPR time data, or processed data i.e. rutting, or a mixture of both.
- Reference separate documents that describe the requirements for these measurements and/or parameters.

Data format

- What format should the data be delivered in e.g. Access database, comma separated file, bespoke format?
- The format has to define:
 - o The location and content for each data value
 - o The meta-data e.g. time of survey, contractor etc.

Hi-SPEQ Activities – Specification Templates



- Review also made recommendations on specifying accreditation and QA regime
- Parameters to check (compulsory and recommended)
 - Specific requirements for testing of each of the areas
 - » Location
 - » Transverse, Longitudinal Profile
 - » Surface defects
 - » Structure (GPR)
 - » TSD
- Use of test sites
- Frequency
- Role of auditor
- QA&A recommendations to be included within each specification template



1 Downward facing image collection

Surface deterioration, collected by high-speed surveys, is commonly obtained from analysis of 2D or 3D downward facing images.

1.1 Requirements for downward facing image collection

- Requirements for the minimum width of pavement surface to be captured by the images;
- Requirements for the minimum resolution per pixel in the longitudinal direction;
- Requirements for the minimum resolution per pixel in the transverse direction;
- For 3D images, requirements for the minimum resolution in the vertical direction;
- Location referenced to network, in accordance with HISPEQ2: SPECIFICATION FOR LOCATION REFERENCING MEASUREMENT.

1.2 Accreditation of downward facing images

- What data will be used for the assessment (e.g. survey of network routes, special image board);
- Range of conditions that the data will be collected in (e.g. dry, clean road, wet road, low light levels, low sun) for the network routes;
- Repeat surveys of the network routes at a range of constant speeds (chosen to give a reasonable range but not present safety issues for the survey crew or surrounding road users);
- What the images will be assessed for: Resolution, Focus, Contrast, Illumination.
- For 3D images: survey of special texture or profile mats and assessment of accuracy of height measurement.

1.2.1 Accreditation tests for resolution and illumination of downward facing images

- How the images will be assessed for resolution e.g. subjective test using visual inspection of images: Can the features of interest be easily identified;
- Subjective assessment of images collected at different speeds and determination of minimum or maximum survey speeds that need to be implemented;
- How the images will be assessed for illumination e.g. subjective test using visual inspection of images collected in varying light conditions e.g. low levels, night time, full sunshine, low sun: Are the images evenly and sufficiently illuminated in all of these conditions.

1.2.2 Accreditation tests using image board

- What does the image board look like e.g. 5m of plain grey, 5m of squares, of varying size,....;
- What tests will be carried out on the images collected.
- Requirements for the images, in terms of footprint, focus, resolution, contrast.

HI-SPEQ Survey specifications - status



- HiSPEQ hence has produced 7 survey specification templates:
 - HiSPEQ1: Specification for Pavement Condition Measurement
 - HiSPEQ2: Specification for Referencing Data to the Network
 - HiSPEQ3: Specification for Transverse Evenness Measurement
 - HiSPEQ4: Specification for Longitudinal Evenness Measurement
 - HiSPEQ5: Specification for Surface Deterioration Measurement
 - HiSPEQ6: Specification for Layer Thickness Measurement
 - HiSPEQ7: Specification for Traffic Speed Deflection Measurement
- Concept is that a road administration would always issue HiSPEQ1 and 2, and then pick which of the others to include depending on data need
- HiSPEQ3 to 7 consist of four sections
 - 1 Measurement Data
 - 2 Parameters
 - 3 Accreditation
 - 4 Quality Assurance
- There is a **single guidance document** to support all seven templates

HI-SPEQ Survey specifications - Status



- HiSPEQ1: Pavement Condition Measurement – spec and guidance for review *on Website*
- HiSPEQ2: Referencing Data to the Network - spec and guidance for review *on Website*
- HiSPEQ4: Pavement Longitudinal Evenness Measurement - spec and guidance for review *on Website (parameters section due end October)*
- HiSPEQ3: Pavement Transverse Evenness Measurement - spec and guidance for review *on Website (parameters section due end October)*
- HiSPEQ5: Pavement Surface Deterioration Measurement- spec and guidance ready for review by **December**



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HiSPEQ1&2: General requirements

- Discussion

- Review found focus is often on technical detail
 - “Survey strategy” has inconsistent/poor detail
 - The NRA’s wider need for defining their specification is unclear
 - Describing where and when to survey?
 - How to deliver the data?
- inconsistent requirements for location referencing
 - Range of approaches (GPS, events, distance)
 - From vague to tight accuracy requirements
 - Jeopardises multiple application of the data?
- Inconsistency over issues affecting performance
 - e.g. speed, contractor capability
 - Do these influence on quality and consistency?
- Various requirements for
 - types, detail, accuracy etc. of the delivered data

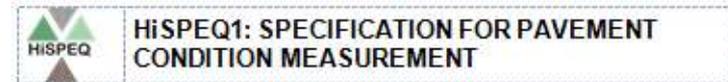


HiSPEQ1: General requirements

– Summary Content



- Based on review recommendations propose to include sections on:
 - Definitions of terms
 - Description of the Network to Survey
 - Which parts to survey – timescale and coverage
 - The Deliverables of the contract
 - Overview of Quality assurance Requirements
 - Survey Conditions (limitations)
 - General/Other Requirements



1 Scope

This document describes the general requirements for high speed road condition surveys.

This section should describe

- Who is commissioning the survey
- What the data will be used for and the survey objectives e.g. data to calculate performance indicators, maintenance decisions.

The following documents are referenced herein:

HiSPEQ2: Specification for Location Referencing Measurement

HiSPEQ3: Specification for Pavement Rutting Measurement

HiSPEQ4: Specification for Pavement Ride Quality Measurement

HiSPEQ5: Specification for Pavement Surface Deterioration Measurement

HiSPEQ6: Specification for Pavement GPR Surveys

HiSPEQ7: Specification for Pavement Traffic Speed Deflection Surveys

2 Definitions

The following subsections list the technical terms, along with the definitions of the terms as they will be used within this Specification.

Accreditation

Accreditation is a process that is usually implemented at the start of a survey regime. The aim of the process is to demonstrate whether high-speed survey equipment is capable of delivering the data required by the survey, and to the level of accuracy required.

Accuracy

Accuracy is the closeness of the agreement between the result of a measurement and a true value of the measure i.e. a system's accuracy is how closely its measured data reproduces reference data.

Coverage

Survey coverage is the proportion of the network to be surveyed for which data has been provided. Data coverage is the proportion of data delivered that can be considered to be valid.

Driving line

The driving line is the path taken by the survey vehicle as it travels along the road.

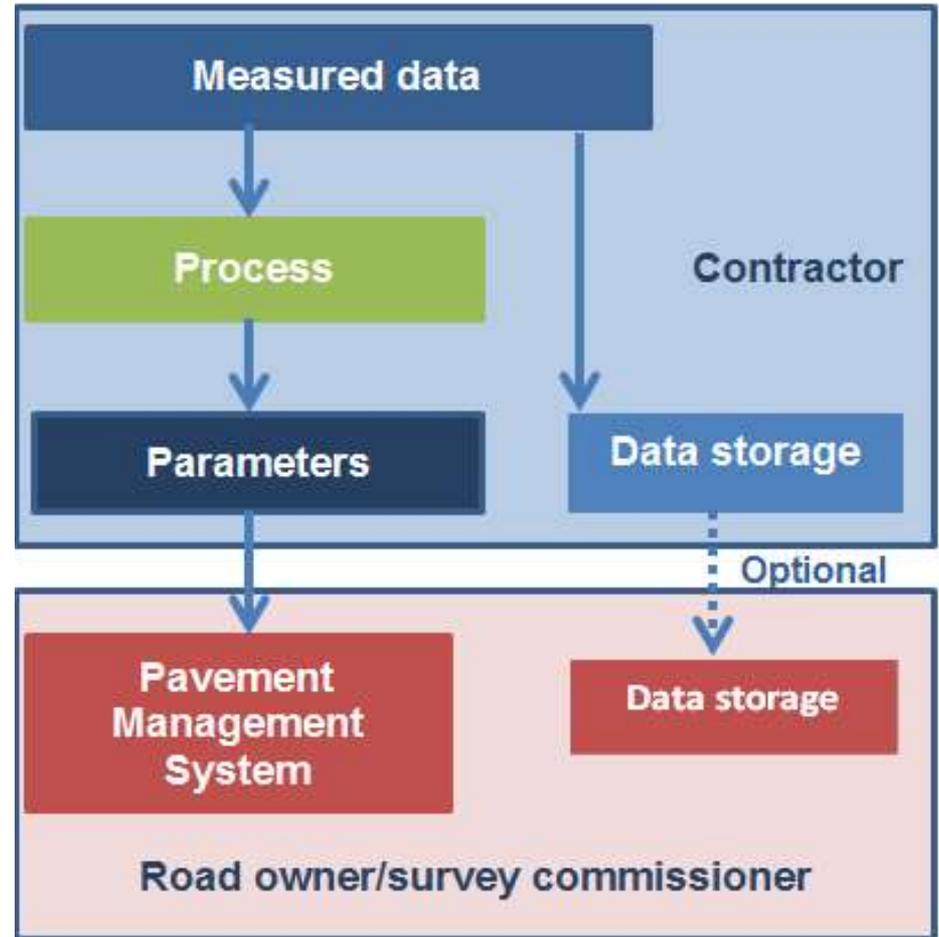


HiSPEQ1: General requirements

- Example Recommendations



- Deciding what data to deliver
- Spec must clarify definitions!
- **Measured data**
 - Images, profile, texture, time of flight, deflection velocity
- **Processed data**
 - Parameters (rutting, IRI, area of cracking, layer thickness)
- Advantages of having both...
 - Defining algorithms
 - Future changes
 - Enhanced QA
- Disadvantages....
 - Skills required
 - Data handling



HiSPEQ1: General requirements

- Example Recommendations



- Coverage, need to define:
 - the extent to be surveyed
 - **and** the extent for which valid data should be provided
- By measure..

Type	Extent for which Data will be collected
Main Carriageways Lane 1 or 2	99%
Lane 1 of Slip Roads	99%

- What to survey?
 - E.g Is there a need to survey both directions on 2-way roads?

Parameter	% for which	
	Valid survey data shall be provided	Invalid/missing data permitted
Longitudinal Profile, Rural Areas		
3m LPV	96	4
10m LPV	96	4
Longitudinal Profile, Urban Areas		
3m LPV	95	5
10m LPV	92	8

- How often to survey?
 - Profile - annually
 - Deterioration - annually
 - Structural - 3 yearly
 - GPR - 5 yearly

	Cat.	One direction				Total
		1	2	3	4	
Other direction	1	77.52%	6.61%	0.51%	0.01%	84.65%
	2	6.18%	6.25%	0.94%	0.02%	13.39%
	3	0.79%	0.58%	0.48%	0.05%	1.90%
	4	0.06%	0.01%	0.00%	0.00%	0.07%
	Total		84.55%	13.45%	1.92%	0.08%

- For 1100km of strategic 2 way roads

HiSPEQ2: Network Referencing

- Example Recommendations



- All measurements uniquely referenced to network
 - Road name, section name, direction and lane
 - Road operator must provide a network definition
- All surveys should provide
 - Data referenced to Section and Distance
 - Unaffected by speed or “warming up”
 - 3D spatial coordinates at 5m spacing
 - Survey speed data
- **Synchronisation:** consistent alignment
 - Feature “A” must occur at the same distance and transverse position within all the measurements, within a tolerance of $\pm 0.1\text{m}$, at all survey speeds
 - Accreditation should test this
 - Important for multiple application of the data?

Distance Error	Error in 500ft (ft)	Cross-correlation with SurPRO
0	0	95.6
0.1%	0.5	94.4
0.15%	0.75	93.5
0.25%	1.25	91.2

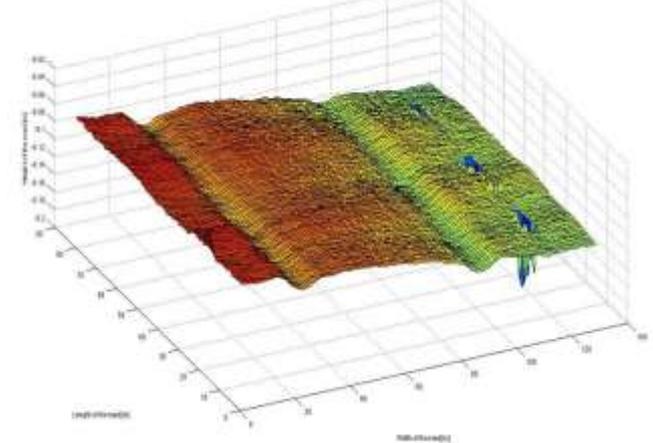
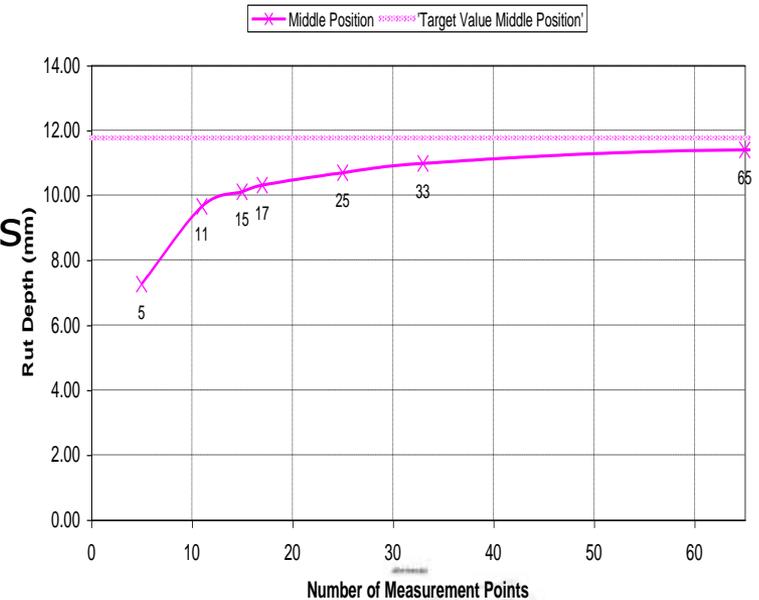
HiSPEQ3: Transverse Evenness

- Discussion

- Review found nearly all surveys specify rutting
 - Few discuss the transverse profile from which it is derived
 - Transverse profile range of requirements high for (3-200 points, 2.5-5m, if specified)
 - Previous work has shown the effect of this on the consistency of rutting
 - There is some consistency in the requirements for rutting (e.g. 2m SE)
 - Algorithms are not discussed
 - A minority discuss the actual (laser) equipment requirement
 - not consistent, is this needed?
- So, we saw both good and unclear practice
 - A common observation across specs



Average Rut Depth and Number of Measurement Points
Measurement Width 3,2 m



HiSPEQ3: Transverse Evenness

– Recommendations



- Measurement width
 - Must cover full lane
 - Minimum 3m
 - Maximum 4m
 - Closer to upper range on highways
- Reporting interval
 - Maximum 0.1m longitudinal spacing
- Vertical accuracy
 - Better than 0.1mm
 - Reporting to max 2 decimal places

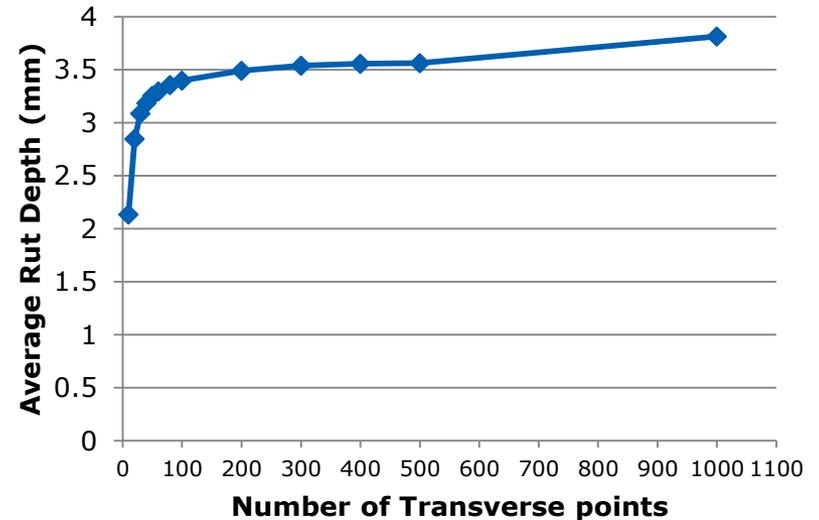


HiSPEQ3: Transverse Evenness

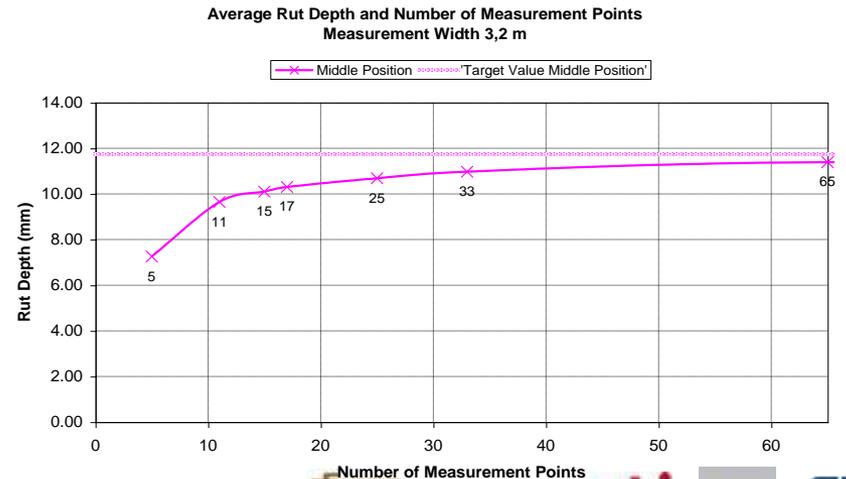
– Recommendations



- Number of points
 - Minimum 20 points
 - Maximum 100 points
 - Evidence that
 - >50 points does not improve rutting calculation
 - >500 potential adverse influence of texture?



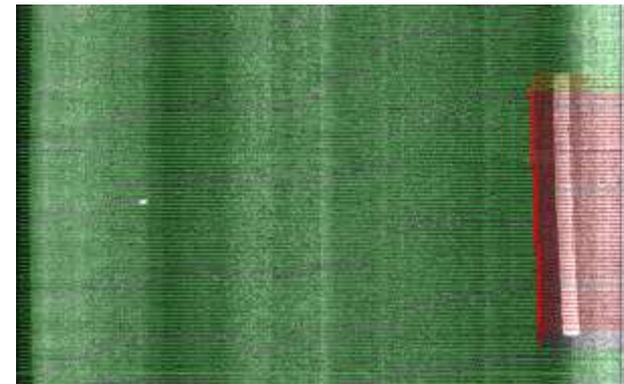
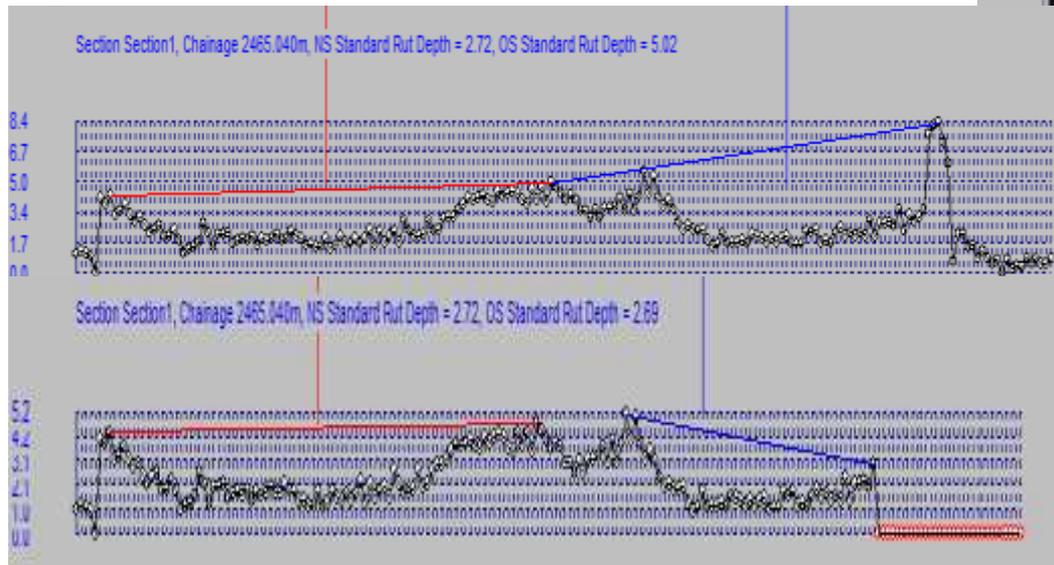
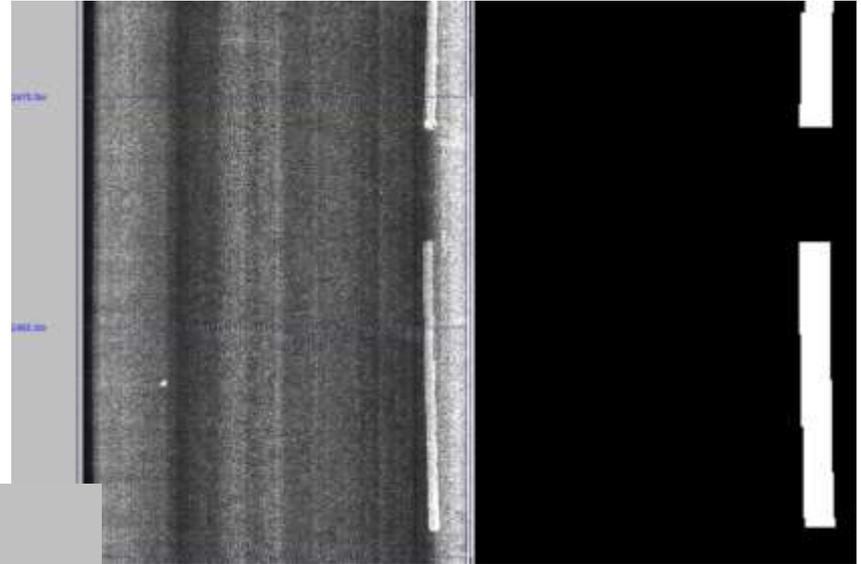
- Transverse Spacing
 - Even is recommended
 - Not clustered at the wheelpaths



HiSPEQ3: Transverse Evenness – Recommendations



- Road marking recognition and reporting
- Removal of markings prior to rut calculation
- HiSPEQ is still investigating approaches to transverse parameter calculation

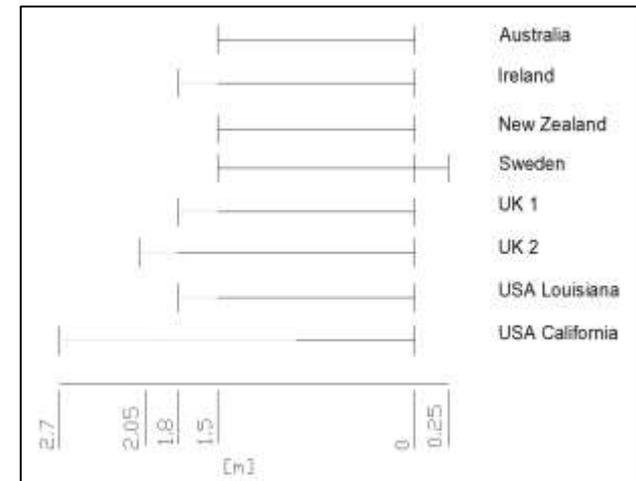
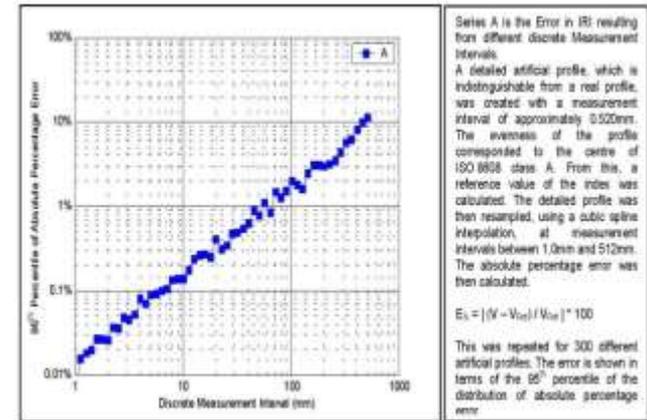


HiSPEQ4: Longitudinal Evenness

- Discussion



- Review found that nearly all surveys specify ride quality,
 - <half require the longitudinal profile from which it is derived
- There are a range of approaches
 - Number of measurement lines
 - Spacing of data
 - Location of wheelpaths
- Inconsistency in the approach to defining the performance (equipment focussed, or raw data focus)
- Most require IRI as the reported parameter but other parameters specified (LPV, NAASRA)

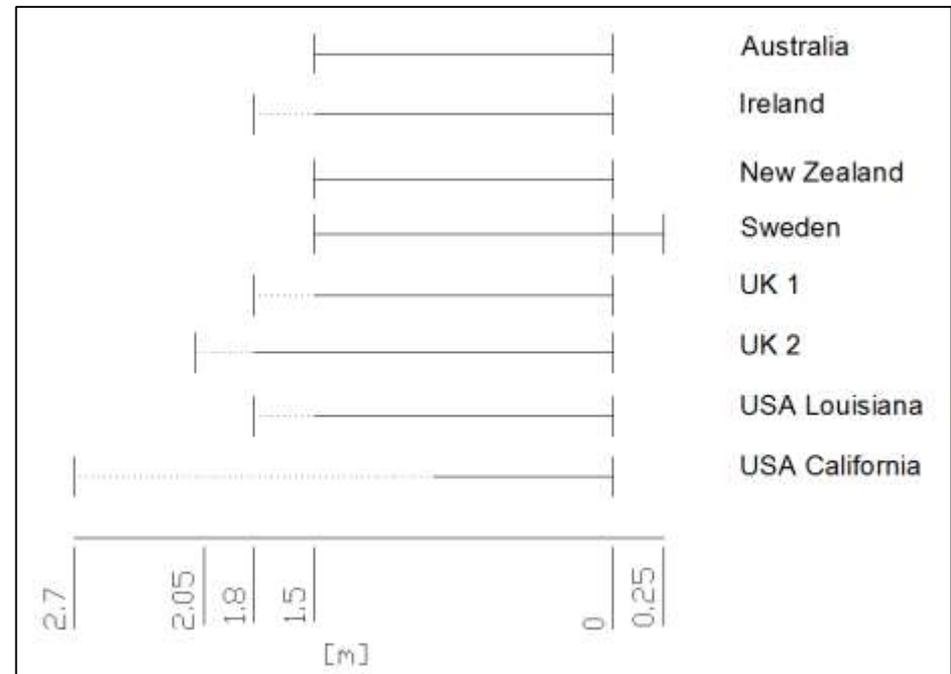
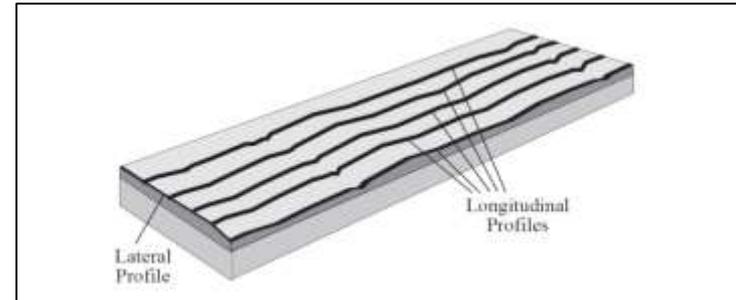


HiSPEQ4: Longitudinal Evenness

- Recommendations



- Number of measurement lines
 - As a minimum - in the nearside wheelpath
 - Evidence to support additional lines
 - E.g. Assessing both wheelpaths increases length highlighted as "poor" by 50% (UK)
 - HiSPEQ recommends that Offside wheelpath also included
- Separation / offset
 - Should be specified
 - 1.5 to 1.8m
 - Towards the higher end on highways

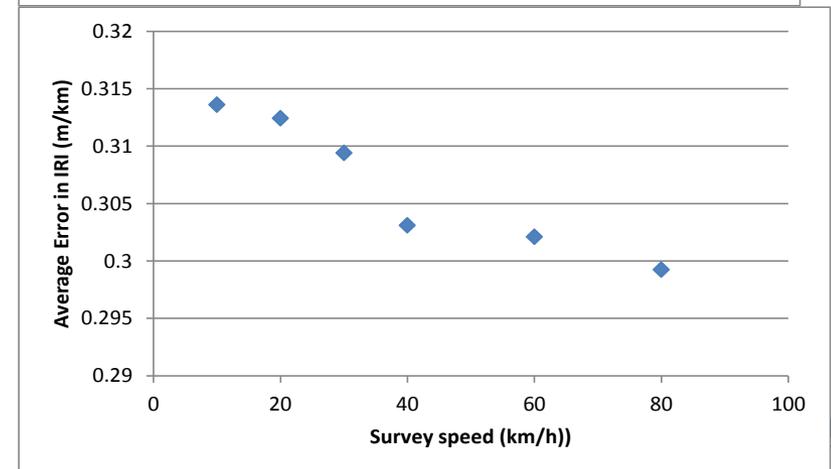
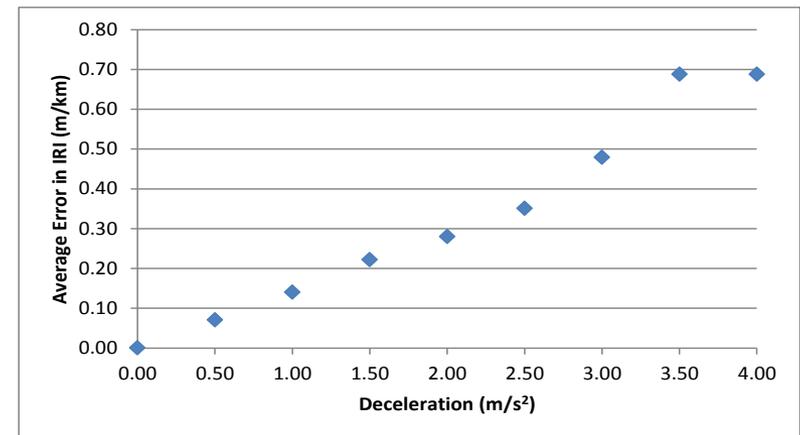
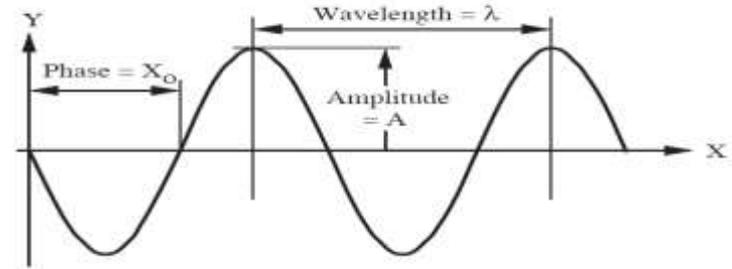


HiSPEQ4: Longitudinal Evenness

- Recommendations



- Vertical accuracy
 - 0.1mm minimum
- Longitudinal spacing
 - 0.1m
 - Cover wavelengths to 0.2m to assess bumps
 - Commonality with transverse profile
- Wavelength range
 - 0.5m to 50m (EN 13036-5)
- Survey speed
 - Capability should be assessed
 - and used to control validity
 - As should (de-)acceleration
 - E.g. -3,-2,-1 m/s²



HiSPEQ4: Longitudinal Evenness

- Recommendations



- Focus on the parameters that are provided by the surveys (wider use in practice in consulted EU countries)
- 3 methods for processing the measured long profile
 - International Roughness Index (IRI)
 - Wave band analysis (WBA)
 - Weighted Longitudinal Profile (WLP) analysis
- Can be used for assessment (approval and performance control) of new and old pavements
- The calculation procedures (mathematical processing) for all three methods are provided in EN 13036-5

IRI	<p>+ Can be computed over several reporting lengths and can be used to characterise general unevenness. IRI is calculated in many countries, thus one road network easily to be compared with another. Well defined, free software can be obtained to calculate it.</p> <p>- Profiles with different properties can give equivalent IRI values. It is not possible to determine the range of wavelengths causing the unevenness. Does not identify lengths containing singular irregularities. Only responds well to wavelengths in the profile between 1.1 and 34.7m</p>
WBA	<p>+ Can be computed over several reporting lengths and can be used to characterise general unevenness. It is possible to determine the range of wavelengths causing the unevenness. Models based on WBA show lower standard errors of estimates than other parameters for evaluating the road serviceability.</p> <p>- Profiles with different properties can give equivalent parameter values. No particular set of parameters are commonly used i.e. eLPV is used in England but CP is used in Belgium. The parameters do not identify lengths containing singular irregularities.</p>
WLP	<p>+ Capable of characterizing general unevenness, periodic unevenness and singular irregularities/defects/bumps. Tries to combine the advantages of geometric and response based approaches. Can be used to assess a large range of wavelengths contained in the profile</p> <p>- Not much experience with it, currently only used in Austria.</p>

HiSPEQ5: Surface Deterioration

- Discussion



- Review found this to be an emerging area where there less experience
 - Demonstrated by inconsistency
 - Image resolution ranges from 0.5mm to 2.5mm
 - Survey widths from 2.9 to 5m
 - Mix of manual and automatic assessment
 - In general algorithms are not defined
 - Emerging requirement for 3D images
- Large range of defects but unclear on how these are defined
 - Does the lack of detail in specifications introduce risk with regard to what will be received / fitness for purpose?

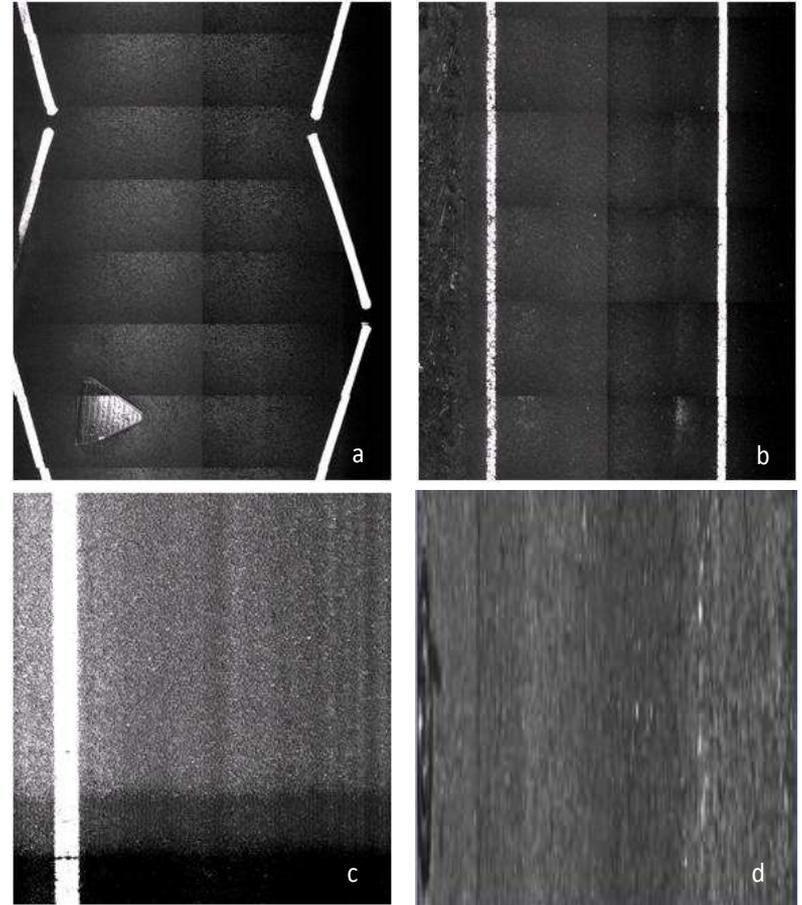


HiSPEQ5: Surface Deterioration

- Example Recommendations



- Hi-SPEQ is assuming “image collection and analysis”
- Image Width
 - Minimum 3.6m
 - Maximum 4m
 - Towards the higher end on highways
- Image Resolution
 - 1mm per pixel or better
- 3D images?
 - Vertical resolution of 0.5mm
- Illumination
 - An even distribution unaffected by ambient light levels is important *and should be checked*
- Ongoing work



HiSPEQ1-5: Accreditation

- Discussion



- Review found that accreditation becoming recognised across NRAs, but varies, E.g.
 - Most test location referencing
 - Longitudinal profile: ~half test the profile, mainly focus on ride parameter
 - Transverse profile: Few test transverse profile, mainly focus on rutting.
 - Only one (of 5) tested images
 - Most test surface deterioration data
- Where accreditation systems specified:
 - Nearly all test accuracy
 - Some test repeatability
 - Mixed approach to track and network sites
 - Only one tests fleet consistency
 - "other criteria" (crew accreditation, driving line, seasonal effects etc.) generally absent



HiSPEQ1-5 Accreditation

- Summary Recommendations



- Use independent auditor for accreditation testing
- Clear process to be defined, with action on failure.

- General approach (measured data):

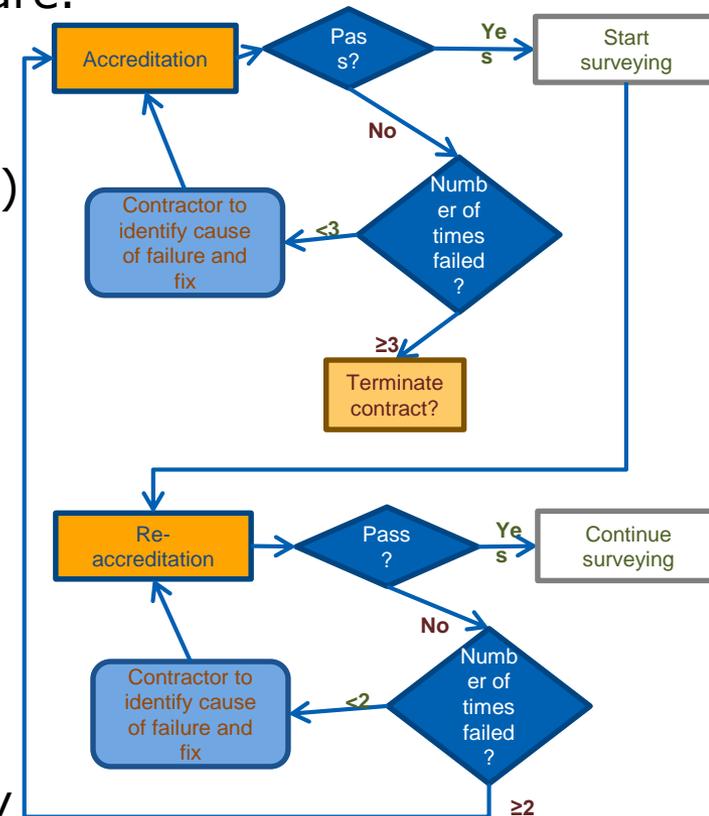
- Describe the tests and the conditions to be applied (e.g. weather, speed, geometry)
- Describe reference method/sites to be used
- Describe the way the data will be tested
- Specify the accuracy requirements
- Specify the frequency of testing

- General approach (parameters)

- Tests as above, but for the parameters
- Specify how parameter calculation will be assessed
- Specify if including repeatability+reproducibility
- Specify if fleet consistency tests will be applied

■ The contractor should also be assessed

- Internal processes and training

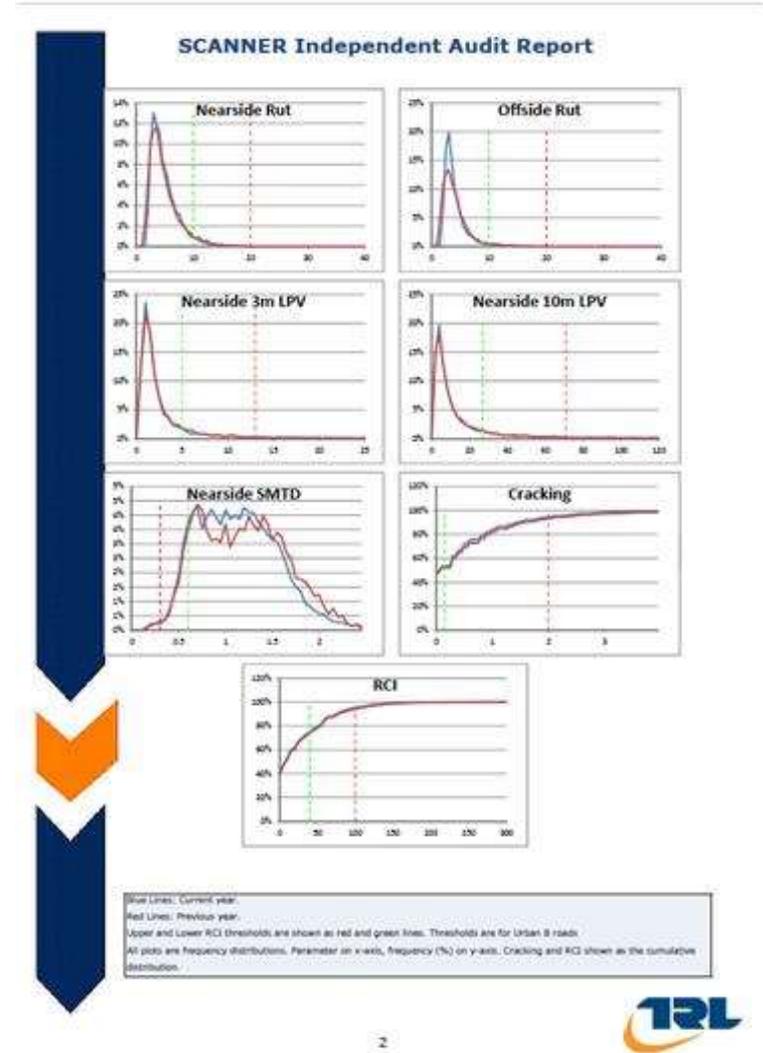


HiSPEQ1-5 QA

- Discussion



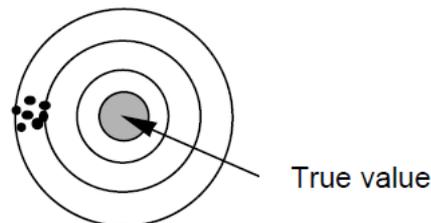
- Review found QA a “developing area”:
 - A reasonable degree of agreement between the core approach to technical requirements,
 - Mix of accuracy / repeatability
 - But several include no QA requirement
 - Examples of all QA left to contractor
 - There are various tests of consistency with
 - Varying lengths
 - Varying frequency
 - Varying roles (contractor, client, auditor)



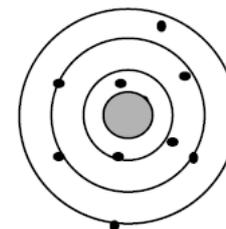
HiSPEQ1-5: QA

- Summary Recommendations

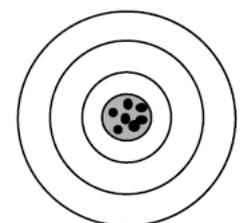
- Formal QA testing highly recommended within the contract
 - For any survey >3 months or more duration
 - Where >2000km to be surveyed
 - Should clearly specify the requirements
- Practicality of QA
 - Test the parameters, not the measured data
 - Test on the road network in same conditions as regular surveys
 - Repeatability easiest to assess
 - Fleet consistency could be practical
 - Ask contractor to perform the assessment and report the results
 - Requires client to check! (independent auditor)
 - Need a clear process for failure of the test



Repeatable but not accurate



Accurate but not repeatable



Accurate and repeatable



Equipment descriptions - Status

- *"Develop templates for describing equipment, Guidance to help developers complete these, and for NRAs to understand them"*
- Equipment description templates will stand alongside the specifications
 - Structured - to aid survey commissioners to determine whether equipment is suitable for the specified survey
 - HiSPEQ2E: for location and network referencing *on Website*
 - HiSPEQ3E: for pavement transverse evenness measurement *on Website*
 - HiSPEQ4E: for pavement longitudinal evenness measurement *on Website*
 - HiSPEQ5E: for pavement surface deterioration measurement *on Website*
 - HiSPEQ6E: for pavement layer thickness measurement – in progress
 - HiSPEQ7E: for high speed pavement deflection measurement – in progress
- Key stakeholders for these are *system providers / operators*

HI-SPEQ

Equipment descriptions

- Summary of Equipment:
 - Name, manufacturer, how many have been manufactured, Photo etc.
- A general description
- Technical capability
 - Of the measurement, using a provided table.
 - Table structured to match the survey specification documents
- Data formats
 - The standard and optional data formats delivered by the equipment

	HISPEQ4E: EQUIPMENT FOR MEASUREMENT OF PAVEMENT LONGITUDINAL EVENNESS
DESCRIPTION AND SPECIFICATION	

NOTE: When completing this description and specification template please refer to the guidance notes provided in the Annex. Once the form is complete, delete the red text and the annex.

1 Summary of Equipment

Name of equipment	Photo of equipment
Manufacturer	
How many have been manufactured	

2 Description

General description of the equipment.

3 Technical capability

Please use HISPEQ2E to describe the location measurement system(s) used with your longitudinal evenness measuring equipment.

Measurement of longitudinal evenness		Comments					
In which line(s) is longitudinal profile measured?							
If measurements in both wheelpaths are made, what is the maximal distance between the two wheelpaths?							
What is the vertical accuracy of each measurement point of the longitudinal profile?	Define the class according to EN-13036-6:2008 (3.3) ¹ – tick on appropriate box below:						
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center;">class 1 ≤ 0.2mm.</td> <td style="width: 3%; text-align: center;">=</td> <td style="width: 33%; text-align: center;">class 2 = 0.2 mm and ≤ 0.5 mm</td> <td style="width: 3%; text-align: center;">=</td> <td style="width: 28%; text-align: center;">class 3 = 0.5 mm and ≤ 1.5 mm</td> <td style="width: 10%; text-align: center;"><input type="checkbox"/></td> </tr> </table>	class 1 ≤ 0.2mm.	=	class 2 = 0.2 mm and ≤ 0.5 mm	=	class 3 = 0.5 mm and ≤ 1.5 mm	<input type="checkbox"/>
class 1 ≤ 0.2mm.	=	class 2 = 0.2 mm and ≤ 0.5 mm	=	class 3 = 0.5 mm and ≤ 1.5 mm	<input type="checkbox"/>		

¹ EN 13036-6 defines classes for the performance classification of transversal and longitudinal profilers.

HI-SPEQ

Equipment descriptions

- Evidence of performance
 - Provide formal evidence to support the claims made for technical capability
 - To help NRA assess claims
- Calibration regimes: The documented calibration process for the equipment
- QA regimes: The documented QA processes for the equipment
- Other: Any further relevant information about the device.
- A guidance section is given to help the contractor complete each of these



HISPEQ4E: EQUIPMENT FOR MEASUREMENT OF PAVEMENT LONGITUDINAL EVENNESS

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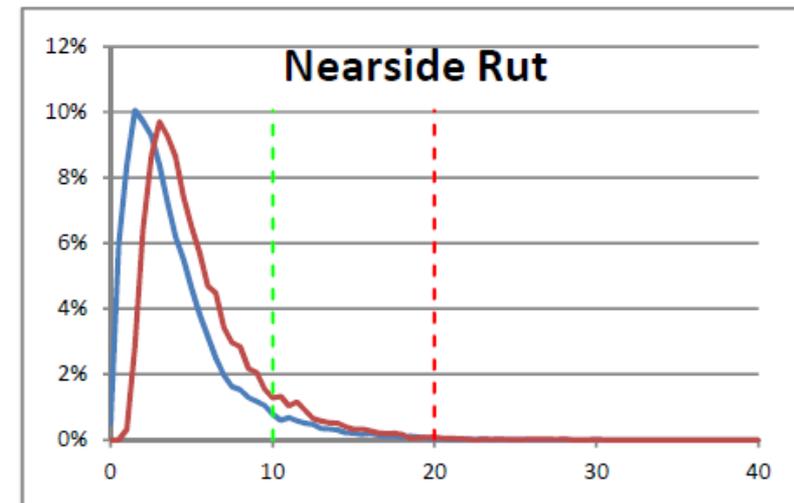
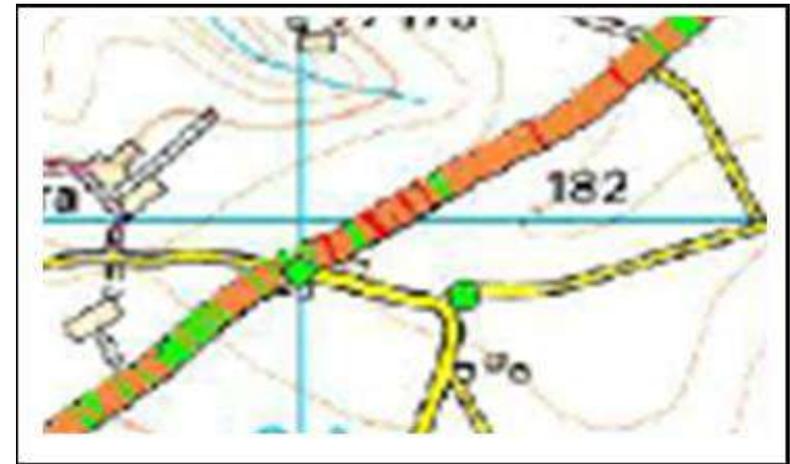
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Measurement of longitudinal evenness		Comments						
In which line(s) is longitudinal profile measured?								
If measurements in both wheelpaths are made, what is the maximal distance between the two wheelpaths?								
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¹ EN 13036-6 defines classes for the performance classification of transversal and longitudinal profilers.

HiSPEQ Ongoing Work

- Completion of the specification and Equipment description documents
 - For Stakeholder Review
- Parameters – a technical focus e.g.
 - Longitudinal Profile – essentially complete
 - Rutting: exploring and defining the various calculation methods, the effect of these on the results
 - Visual: How surface defect parameters might be reported
 - Structural: The options for TSD data processing and application
 - Structure: The various options for GPR data processing and application
- Completion of guidance on these



Finally, a reminder - HI-SPEQ Website



- www.hispeq.com
- Will hold all project documents
 - Documents for consultation and Review
 - Final outputs
- Comments and input welcomed

