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HiSPEQ: Hi-speed survey Specifications, Explanation and Quality

Final Report

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CEDR Call 2013: Aging Infrastructure Management
HiSPEQ
Hi-speed survey Specification, Explanation and Quality

Final Report

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Executive summary

Road administrations rely on high quality condition data to understand the condition of the pavement asset and plan and undertake maintenance programmes on the network. High speed surveys have become a key source of this information, providing data on the shape and condition of the road surface and, in recent years, the structural robustness and the structure of the pavement itself. These high speed systems bring the advantage of network wide data collection without interfering with the traffic flow. They can provide coverage of the network which would be impractical for traditional surveys to achieve. They have lower survey costs per km than slow speed surveys and bring data that does not suffer from the subjectivity or inaccuracy of manual surveys.

High speed surveys therefore bring significant practical advantages to condition assessment, to support robust asset management. However, there are a wide range of policies across countries to define the requirements for the survey equipment, the survey frequencies and the data delivered. Each country appears to adopt its own requirements, each subtly different from one another. A factor that contributes to this situation is the lack of standardisation for many of the measurements. Where standardisation does exist (e.g. for profile) it is limited in its practicality and may be too complex for road administrations to understand.

Therefore, in May 2014 the HiSPEQ project was commissioned under the CEDR 2013 Ageing Infrastructure Management programme with the objective of developing the guidance and advice required to assist road administrations to understand high-speed road survey equipment, and to help them in specifying the survey requirements, quality regimes and processing procedures. HiSPEQ has concentrated on the aspects of high-speed survey data collection that contribute to the assessment of pavement structural robustness, in particular pavement shape, pavement visual condition, pavement structure and pavement deflection. The underlying objectives of HiSPEQ have been to

- Develop templates and guidance to help road administrations define their requirements for high speed condition surveys on their networks
- Develop templates and guidance to help road administrations understand the equipment that will be used to collect condition data at high-speed on their networks.
- Provide guidance on the achievement of high quality data collection on their networks

To support the establishment of the content for these templates HiSPEQ has undertaken a detailed review of existing and emerging practice in order to propose a set of core requirements for high-speed surveys of pavement surface and structural condition. These requirements include the data to be collected and the condition parameters derived from the collected data to evaluate pavement structural condition. Following review and comment by a HiSPEQ stakeholder group, the key requirements identified in the review have been used to develop survey specification templates to assist road administrations developing survey requirements for their own networks. Guidance has been developed to accompany the templates, to assist road administrations understand the technical requirements and the implications of different levels of resolution and accuracy on the use of the data. The project has also proposed a set of quality assurance processes to consider when specifying condition surveys.

It is anticipated that the HiSPEQ guidance and template specifications could help reduce the wide range of policies that exist across countries with regard to high-speed survey equipment, survey frequencies and the data delivered. It will contribute to improving the value of these surveys and the efficiency of the commissioning process, whilst also assisting in the delivery of higher quality survey data that will support more robust decision making.

1 Introduction

Road administrations rely on high quality condition data to understand the condition of the asset and plan and undertake maintenance programmes on their networks. High speed surveys have become a key source of this information, providing data on the shape and condition of the road surface and, in recent years, the structural robustness and the structure of the pavement itself. These high speed systems bring the advantage of network wide data collection without interfering with the traffic flow. They can provide coverage of the network which would be impractical for traditional surveys to achieve. They have lower survey costs per km than slow speed surveys and bring data that does not suffer from the subjectivity or inaccuracy of manual surveys.

High speed surveys therefore bring significant practical advantages to condition assessment, and to support robust asset management. However, research (Benbow and Wright, 2012) has found a wide range of policies across countries to define the requirements for the survey equipment, the survey frequencies and the data delivered. Each country appears to adopt its own requirements, each subtly different from one another. This is perhaps unexpected, given that the equipment used to collect this data within different countries is likely to be quite similar. A factor that contributes to this situation is the lack of standardisation for many of the measurements. Where standardisation does exist (e.g. for profile) it is limited in its practicality and may be too complex for road administrations to understand.

In May 2014 the HiSPEQ project was commissioned under the CEDR 2013 Ageing Infrastructure Management programme with the objective of developing the guidance and advice required to assist road administrations to understand high-speed road survey equipment, and to help them in specifying the survey requirements, quality regimes and processing procedures. The project has concentrated on the aspects of high-speed survey data collection that contribute to the assessment of pavement structural robustness, in particular

- pavement shape
- pavement visual condition
- Pavement structure
- Pavement deflection

The underlying objectives of HiSPEQ have been to

- Deliver templates and guidance to help road administrations define their requirements for high speed condition surveys on their networks
- Deliver templates and guidance to help road administrations understand the equipment that will be used to collect condition data at high-speed on their networks.
- Provide guidance on the achievement of high quality data collection on their networks

The purpose of this final report is to provide a summary of the HiSPEQ project and its deliverables. The report also provides direct links to the published deliverables, which are shown as **underlined bold text**.

2 Review of key requirements

The technical approach taken in HiSPEQ has been to draw on expertise from the project consortium, reviews of previous research and existing survey specifications, and a reference group containing stakeholders (equipment manufacturers, road administrations, researchers etc.) to determine the key requirements that should be considered by a road administration

when developing a specification for high-speed condition surveys of their network. This lead to the delivery of three key requirements documents describing the needs of high speed surveys of surface and structural condition, and the requirements for quality assurance of these surveys. These are described in the following sections.

2.1 Key requirements – pavement shape and visual condition

The assessment of durability using high speed surface condition surveys is usually achieved through the assessment of visual deterioration (e.g. fretting and cracking) and transverse and longitudinal road surface shape. Although these measurements are not sufficient per se to completely determine pavement durability, these parameters are generally incorporated in the estimation of how long a pavement will last and what measures are to be taken to extend its lifetime. Thus, the surface properties considered to be important for the high-speed assessment of pavement durability in the HiSPEQ project were:

- Pavement shape (both transverse and longitudinal)
- Surface deterioration, including potholes, cracking, fretting or ravelling.

Fifteen specifications for high-speed routine monitoring were collected and reviewed to identify the current key measurement practice in the collection of surface shape and visual condition. The specifications covered the measurement of longitudinal evenness, transverse evenness and surface defects. A total of over 0.5Million lane km of surveys were currently being undertaken against these specifications.

To review the specifications in a consistent manner a set of questions were developed and each specification was reviewed against those questions. This enabled a set of tables to be populated for each specification and conclusions and recommendations to be drawn. The review of the key requirements document hence delivered a set of recommendations for the key areas that should be considered by a road administration when defining a network survey, including:

- General survey requirements:
  - Whether the NRA should select a data or an equipment specification:
  - The minimum requirements for defining the network to be surveyed
  - How the data should be locationally referenced to the network, and the use of geo-referencing
  - The need to specify limits on the survey conditions (environment, measurement speed etc)
  - The requirements for defining the data formats
  - Whether an administration should request the delivery of the raw data or processed parameters
- Measurement of transverse evenness:
  - The measurement width, the minimum number of transverse profile measurement points, the distribution of points, the longitudinal spacing etc.
  - The importance of eliminating the effect of road markings measured within the profile on the calculation of the derived parameters.
  - The key derived parameters (e.g. rutting)
  - The need to specify minimum requirements for accuracy and repeatability of both the raw data and the derived parameters.
- Measurement of longitudinal evenness:
  - The required wavelength range that must be measured by the longitudinal profiler.

  - The longitudinal spacing of the data, the need for collection in both wheel paths, and the need to specify the distance between the wheel paths.
  - The key derived parameters (e.g. IRI)
  - The need to specify minimum requirements for accuracy and repeatability of both the raw data and the derived parameters.
- Measurement of Surface deterioration:
  - The minimum measurement width
  - The minimum resolution per pixel in the longitudinal and transverse directions.
  - The requirements for image quality
  - The types of deterioration to be identified and the need to define each of these deterioration types.

These recommendations were delivered in the document **"Identifying the key requirements for surface condition measurements"**.

2.2 Key requirements – pavement structure and deflection

The amount that a pavement flexes under load is linked to how resilient the pavement is to this loading/unloading i.e. the pavement's bearing capacity. Road authorities need information on structural pavement condition and structure to be able to deliver safe, effective and sustainable pavements to their customers, and to support structural pavement performance prediction. In general, bearing capacity information is more important at the project level than at the network level. However, road authorities have a desire for high-speed testing devices to deliver information on the bearing capacity of their networks at the network level. The most common devices for bearing capacity testing are the deflectograph and the falling weight deflectometer (FWD). Neither of these operates at high-speed but recent development in high-speed measuring techniques has delivered a promising high-speed device called the Traffic Speed Deflectometer – TSD. Analysis of the data provided by these devices can be used to determine bearing capacity (structural condition).

However, the pavement layer thickness and material type has a strong influence on the calculation of stiffness, and therefore the structural condition. There is a clear need for any administration wishing to undertake a network level structural condition survey to have a robust understanding of the pavement structure to ensure final data accuracy. Unfortunately most administrations lack detailed information on pavement layer thickness and material type, and the slow speed method to provide this data (coring) is expensive and impractical. As an alternative, to reduce the need for coring whilst increasing the density of pavement structure information, Ground Penetrating Radar (GPR) can be used. This technology can survey at traffic speed and provides layer thickness information. Thus, the structural properties considered to be important for the high-speed assessment of pavement durability in the HiSPEQ project were:

- Pavement deflection measured at high speed using the TSD
- Pavement structure measured at high speed using GPR.

To investigate the use of the TSD and GPR for the provision of structural condition data HiSPEQ investigated the current specifications for high-speed routine monitoring of structural condition (TSD) and pavement structure (GPR). To support the review additional information was also sourced from the research, including the HeRoad reports into pavement condition assessment and the FORMAT reports. For the TSD in particular the review included investigation of the experience gained to date in the use of the TSD as a survey device in Denmark, UK, Italy, Poland, South Africa, China, USA and Australia, and the two national survey specifications already in place for TSD surveys in UK and Italy. For the GPR a detailed technical review was undertaken on the various approaches to measuring structure

with GPR and how the method can be applied. The review found that GPR is not widely applied at the network level, but survey specifications were available from the UK, Ireland, Sweden and the USA to support the assessment of key requirements.

The review of requirements for structural assessment presented a set of recommendations for the key areas that should be considered by a road administration when defining a network survey using the TSD and GPR, including:

- General survey requirements. It was found that these are often similar to the general requirements discussed above for the assessment of the pavement surface, but further recommendations were made on
    - Specifying the measurement position in the lane.
    - The survey frequency (which may be lower than that required for surface assessment due to the longer term stability of the road structure in comparison with the road surface).
    - Specifying the survey temperature (which affects structural assessment more than surface assessment)
    - The higher levels of complexity in the reporting of raw data from GPR systems and the complexity in interpreting this data.
- Measurement of structural condition (TSD)
    - The equipment requirements (number of lasers, sample frequency)
    - The key raw data to be delivered, including ancillary information such as road temperature, tyre pressure etc.
    - Options for data analysis to estimate structural condition (e.g. Surface Condition Index).
- Measurement of structure (GPR)
    - The survey scan interval spacing
    - The requirements for measurement depth
    - The legal and conformity issues (due to GPR's RF emissions)
    - The requirements for interpretation of the data to determine construction (layer thickness)

These recommendations were delivered in the document **"Identifying the key requirements for structural condition measurements".**

2.3 Key requirements – Quality Assurance

Because of the complexity of collecting and delivering the survey data there can be problems obtaining accurate, high quality and consistent measurements across different survey devices and different networks. Indeed, there are many examples, from established high speed condition survey regimes, of delivered data being inconsistent between devices (either owned by the same survey contractor, or a different one), and delivered data not being accurate, despite a high equipment specification. There are also examples of the data quality deteriorating, or changing through the duration of a survey contract, due to wear of the equipment. The experience gained from these well-established survey regimes suggest that there is a great need for both Accreditation of survey equipment and continuing Quality Assurance, in order to obtain confidence in, and good value for money from, the data that will be delivered from network surveys. When developing a specification for survey equipment or survey data, a road Authority must therefore consider how they will obtain confidence in the data that will ultimately be delivered. Questions that should be answered by a road Authority commissioning a survey may include:

- What are my technical requirements for the consistency/accuracy and how will I ensure that the data is provided to a suitable level?
- How will I ensure that the data remain consistent during the survey?

- How will I ensure the data, or problems within it, do not introduce changes to the way the condition of the network is reported (for example in comparison with the regime that it has replaced)?
- How will I ensure that the data continues to cover the network at the level of performance required in the specification?

HiSPEQ reviewed several specifications containing descriptions of Quality Assurance and/or Accreditation regimes. These included thirteen specifications for surface condition, but only one specification was identified in which network level structural condition surveys were being carried out, and in which routine Quality Assurance testing was being applied.

The review of requirements for accreditation and quality assurance presented a set of recommendations for the key quality areas that should be considered by a road administration when defining a network survey for either surface or structural condition, including:

- The parameters and measurements that should be tested within Accreditation and QA regimes
- The aspects of data quality that should be tested
- How the data could be collected for testing
- The frequency of quality testing
- Who should be responsible for checking the data – including the concept of the independent auditor
- How you might test for the effects of external influences on the data
- The specific technical requirements for accreditation and Quality testing of each parameter (e.g. the accuracy of rutting, profile etc.)

These recommendations were delivered in the document **"Identifying the key requirements for Accreditation and Quality Assurance".**

2.4 Key requirements – stakeholder group and review

HiSPEQ has been supported by a stakeholder group of researchers, road owners, survey practitioners and experts in the field of condition assessment. This stakeholder group was primarily established during the first quarter of the project with additional members joining as the project proceeded. Over 80 stakeholders were contacted to ask if they would like to support the project through the provision of advice and review of the outputs, with 34 volunteering to join the reference/stakeholder group (Table 1).

The key requirements documents were sent to the 34 responding members of the reference group and also made available on the project website (http://www.hispeq.com), with a general invitation given to review and submit comments to the project team. By the autumn of 2015 six detailed reviews had been received for the key requirements document for surface condition, seven on the key requirements document for structural condition measurements and three on the key requirements for Quality Assurance. These were taken into account in the development of the equipment and survey specification templates and guidance.

These reviews were summarised in the document **"Summary of Review of Key Requirements for Survey Specifications**".

Table 1 Stakeholder / reference group members

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

3 Survey and Equipment Specifications

Having determined the key requirements for high speed surveys HiSPEQ sought to translate this information into a form that could be used by road administrations to help in the development and implementation of surveys on their networks. The approach of the project has been to develop templates that can be used by the administration to procure surveys, covering two broad areas:

- Templates that can be used to define the survey data requirements. These are called *the survey specification templates*, they define the requirements for the data to be collected and delivered. They are accompanied by a guidance document that explains the content of the specification.
- Templates that can be used to define the equipment itself. These are called the *survey equipment templates*. They have been developed to allow survey providers to explain how their equipment works in a common format that contains sections directly relevant to the data being requested in the survey specification. They are accompanied by a guidance document that explains the content.

The following sections summarise the content of these templates.

3.1 Survey Specifications

The survey specification requirements were developed from results of the key requirements work, and the peer review of those findings. A set of templates has been developed defining each area of collection of pavement condition data. The survey specification templates are delivered in “volumes”. The core items that a road administration should always include within any survey specification are included in the first “volume” of the survey specification, called ***HiSPEQ1: Specification for Pavement Condition Measurement***, which contains:

- The definition of the network and the survey strategy, to include: The location and length of each road section to be surveyed, the direction of survey, number of lanes to be surveyed, time frame and frequency of the survey etc.
- The location referencing method. HiSPEQ recommends that geographic coordinates are used for location referencing if a geographically defined network is available, as this can result in improved locational accuracy. To achieve high locational accuracy it is necessary to stipulate accuracy requirements to the level of a few metres or better. This is achievable in practice.
- The environmental conditions for conducting the survey, covering road condition (dry road surface for laser devices, clean road surface), survey speed (e.g. minimum speed for measuring longitudinal profile with inertial profilers), pavement temperature (for TSD data) etc.
- The data formats. HiSPEQ found that although defined data formats are already in use for (national) road administrations, there is no internationally recognized format.
- Coverage requirements. This is the percentage of the surveyed network for which valid data will be delivered. It allows the specification to recognise that no survey equipment can measure and deliver valid data all the time and some survey equipment can deliver more valid data than others

When specifying a survey an administration would always include the areas recommended in the first volume, HiSPEQ1. The remaining volumes may then be included if the administration requires the inclusion of that data within the survey (e.g. ride quality). A set of survey data specification templates have been developed for each data type, each

containing sections the administration should include to ensure all core requirements are covered. These include:

- The core decision on how the data is to be delivered (processed/raw data). Requiring the delivery of raw data provides the benefit that derived values (rutting, ride quality) can be calculated consistently over all contractors.
- The raw data to be delivered, including the technical requirements (resolution, accuracy, frequency etc)
- The parameters that will be delivered, for example rutting, IRI, TSD deflection slope
- Accreditation requirements, including suggested tests, reference devices or methods to provide reference data, the frequency with which the test will need to be repeated, suggestions for who will be responsible for checking the data and requirements for the accuracy of any parameters delivered or calculated from delivered data.
- Quality assurance requirements to be employed by the survey contractor on the data, including a description of the tests (calibration, surveys of road network sites, number of repeat surveys required, whether accuracy and fleet consistency will be tested, in addition to system consistency), a description of the road network sites (i.e. length, characteristics etc.) to be surveyed and the frequency with which they should be surveyed, suggestions for who would be responsible for assessing and checking the data, how the data would be assessed etc.

These HiSPEQ survey data specification templates have been labelled as follows:

- **HiSPEQ2: *Specification for Referencing Data to the Network***
- **HiSPEQ3: *Specification for Pavement Transverse Evenness Measurement***
- **HiSPEQ4: *Specification for Pavement Longitudinal Evenness Measurement***
- **HiSPEQ5: *Specification for Pavement Surface Deterioration Measurement***
- **HiSPEQ6: *Specification for Pavement Structure Measurement***
- **HiSPEQ7: *Specification for Traffic Speed Pavement Deflection Surveys*.**

A guidance document has been developed for road administrations to help them understand the requirements of each template volume (**HiSPEQ: *Guidance for Road Administrations for Specifying Network Surveys***). It is intended that each section in the guidance can be used by road administrations to assist them in completing the requirements in the corresponding specification document. The Guidance is split into two parts – **Part 1** covering HiSPEQ1, 2, 3 and 4 and **Part 2** covering HiSPEQ 5, 6 and 7.

The guidance includes suggested specific requirements that a road administration may wish to use within their specifications (Figure 1). These requirements have been obtained from examples of common and good practice observed in Europe and elsewhere. Therefore the guidance is supported by 110 Case Studies and 90 Examples to demonstrate the application of good current practice, or emerging new approaches in data collection (e.g. Figure 2). The suggestions have also been derived from knowledge of existing equipment availability and capability, to assist administrations in ensuring that the requirements they define are achievable in practice. However, administrations will inevitably have their own requirements as a result of specific concerns on their networks, and therefore the ultimate selection of a certain requirement remains the decision of the administration.

HiSPEQ recommendations for transverse profile measurements:
- minimum width:3 m, maximum width: 4 m (full lane width coverage)
- recommendation for major network roads (highways): 3.5 m to 4 m .
- the required width should be chosen according to the predominant lane
- transverse profile shall contain at least 20 measurement points (maximum spacing: 150 mm i.e. 27 measurement points for a 4 m width coverage
- for rutting assessment alone 50 measurement points are considered to be

Figure 1 Example HiSPEQ recommendations for specifying transverse profile measurement

Case Study: The effect of number of transverse profile measurement points on the rut depths calculated

The effect of the number of transverse measurement points on the rut depths calculated was analysed on ~450km of data from the English road network, including motorways, main roads and some minor roads. The roads were surveyed with a high resolution transverse profile measurement, capable of 1000 scans per second (an approximate longitudinal spacing of 22mm at normal survey speed). Each scan consists of 1000 measurement points over a width of 4.3m.

Tests on a site specific basis showed that the rut depths calculated for each 10m were consistent when using between 100 and 1000 transverse points. When using less than 100 points, the lack of detail in the profile meant the reported rut depths decreased – see figure below, taken from a 14km survey of the M27 motorway.

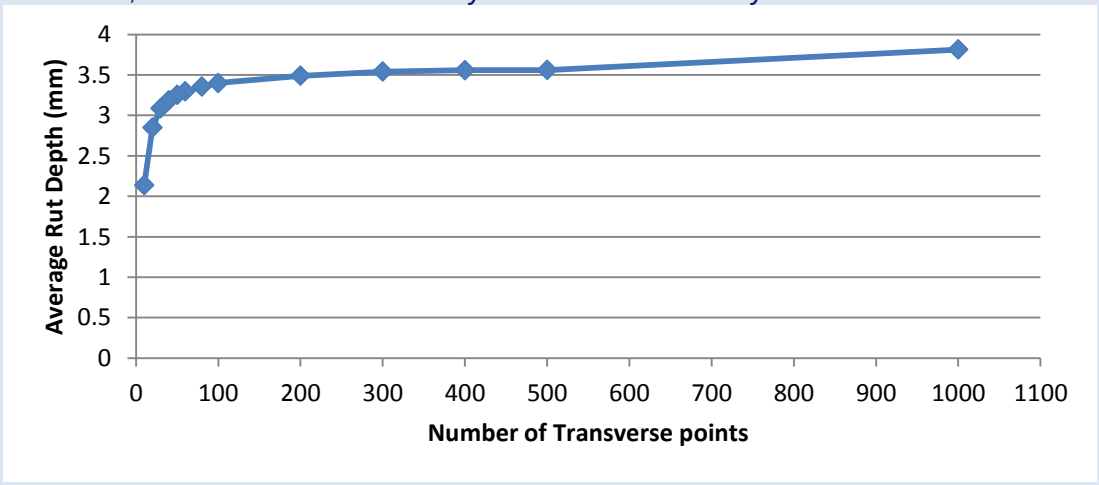

Figure 2: Example case study from the transverse evenness guidance

3.2 Equipment Specifications

The equipment specification templates have been developed to allow survey providers to explain how their equipment works in a format that is directly relevant to the data being requested in the survey specification for that data. There are six Equipment templates:

- **HiSPEQ2E: Equipment to measure location**
- **HiSPEQ3E: Equipment to Measure Transverse Evenness**
- **HiSPEQ4E: Equipment to Measure Longitudinal Evenness**
- **HiSPEQ5E: Equipment to Record Downward Facing Images**

- **HiSPEQ6E: Equipment to Measure Pavement Structure**
- **HiSPEQ7E: Equipment to Measure Traffic Speed Deflection**

The Equipment templates were developed after the structure for the survey specification template had been determined so that sections could be included that could be cross referenced to the data requirements defined in the survey specification, as explained in Table 2.

Table 2 Stakeholder / reference group members

Section in Equipment Template	Relevant to Survey Specification Template section	Comment
Summary of Equipment	N/A	Provides outline details of the equipment
Description	N/A	Provides a description of the equipment explaining the general approach taken to collect measurements, written in a way that does not require a high level of technical pre-knowledge in the reader.
Technical capability	Measurement data Parameters	A table is included in the equipment description that relates directly to the technical requirements included in the measurement data and parameters sections of the specification.
Data formats	Relevant to HiSPEQ1:5.3	Describes the standard data formats delivered by the device and the options for customised data formats.
Evidence of performance	Measurement data Accreditation	Requires the equipment supplier to provide evidence to support the performance claims stated in technical capability section.
Calibration regimes	Measurement data Accreditation Quality Assurance	Summarises the calibration regimes for the equipment - any processes required to ensure that the equipment is able to meet the performance claims stated in technical capability section.
QA regimes	Quality Assurance	Describes the providers own processes for quality assurance of the equipment.
Other	N/A	Presents any other information about the equipment that the provider considers to be of relevance to understanding the equipment and its performance.

Each equipment template includes guidance to assist the equipment provider in completing the template. In addition, a guidance document, “”, has been prepared that explains the technical content of the templates for road administrations. As for the guidance document for the survey specifications, the equipment template guidance includes Case Studies and Examples to help explain the technical content (e.g. Figure 3).

Example: The Pavemetric LRMS system

The Laser Rut Measurement System (LRMS) is a profiling device that detects and characterizes pavement rutting. This system uses two laser profilers, mounted to the rear of a vehicle. The profilers use high-power pulsed infrared laser line projectors and specially designed cameras to create a transverse profile of the roadway surface. The system can operate in full daylight or at night time.

The LRMS can acquire full 4m width profiles of a highway lane at normal traffic speeds, using two 3D laser profilers that provide transverse profiles consisting of 1280 points.

Laser Rut Measurement System (LRMS), http://www.pavemetrics.com/pdf/laser_rut.pdf

Figure 3: Example from the equipment guidance on transverse evenness

4 Training materials

The final component of HiSPEQ has been to deliver a set of training materials to assist road administrations in the implementation of the HiSPEQ approach – i.e. how an administration could use the templates to support the development of survey regimes on their network. The slide pack “**HiSPEQ training pack**”, includes over 40 slides explaining each part of the process, with included notes for presenters (**Figure 4** and **Figure 5**).

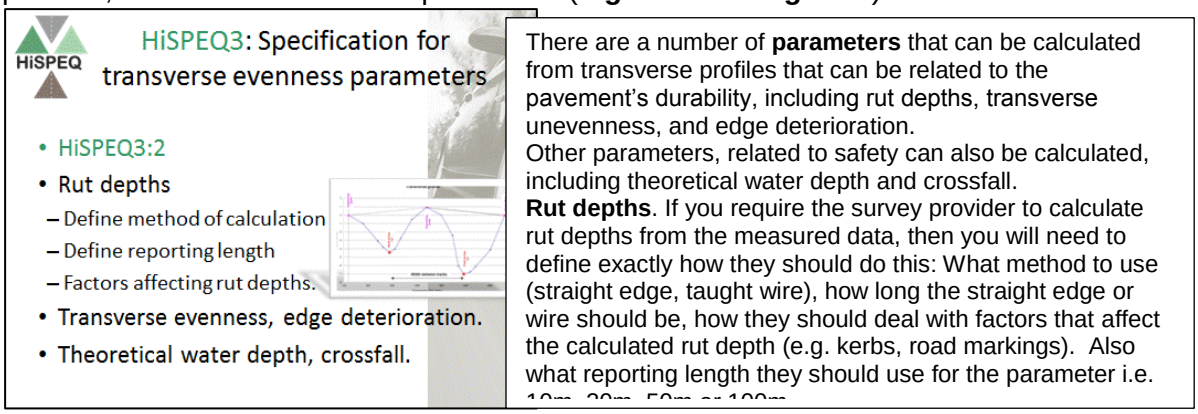

Figure 4: Example slide and notes from the training pack

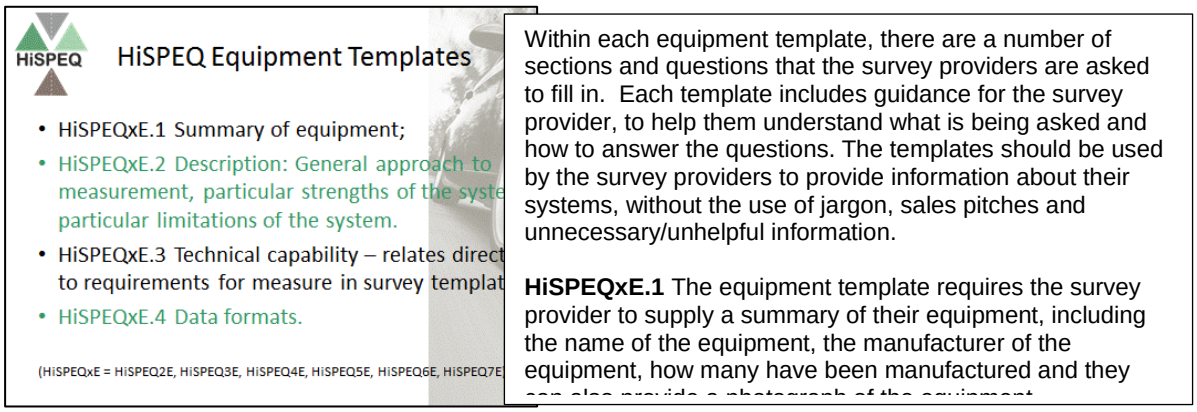

Figure 5: Example slide and notes from the training pack

5 Conclusions

High speed surveys have become a key source of information to support condition assessment and management of pavement assets. These surveys can be applied network wide to obtain data on the surface condition and structural robustness of the pavement. The success of high speed surveys is demonstrated by the growth in the survey industry and the wide range of measurement equipment that has become available. However, these advances bring challenges to road administrations in determining the most appropriate survey to specify for their networks, in selecting the equipment, and in ensuring that the condition parameters delivered will be suitable to support asset management decisions.

HiSPEQ has proposed a set of core requirements for high-speed surveys of pavement surface and structural condition, covering the data to be collected and the condition parameters derived from the collected data to evaluate pavement structural condition. These requirements have been used to develop survey specification templates for road administrations developing survey requirements for their own networks. Guidance has been developed to accompany the templates, to assist road administrations understand the technical requirements and the implications of different levels of resolution and accuracy on the use of the data. The project has also proposed a set of quality assurance processes to consider when specifying condition surveys.

It is anticipated that the HiSPEQ guidance and template specifications could help reduce the wide range of policies that exist across countries with regard to high-speed survey equipment, survey frequencies and the data delivered. It will contribute to improving the value of these surveys and the efficiency of the commissioning process, whilst also assisting in the delivery of higher quality survey data that will support more robust decision making.

6 Acknowledgement

The research presented in this report/paper/deliverable was carried out as part of the CEDR Transnational Road Research Programme Call 2013. The funding for the research was provided by the national road administrations of Denmark, Germany, Ireland, Netherlands, UK and Slovenia.

The participants of HiSPEQ would also like to thank the members of the HiSPEQ reference and stakeholder group for their support.

7 References

Benbow, E, A Wright, 2012. HERoad (Holistic Evaluation of Road Assessment) Deliverable 1.1 – Pavement performance assessment, ERANet Road.

Specification Templates

https://hispeq.com/projectoutput/survey-specifications-and-guidance/
***HiSPEQ1**: Specification for Pavement Condition Measurement*
https://hispeq.files.wordpress.com/2016/07/hispeq1_pavementdurabilitysurveyspecification.docx
***HiSPEQ2**: Specification for Referencing Data to the Network*
https://hispeq.files.wordpress.com/2016/07/hispeq2_networkrefspecification.docx
***HiSPEQ3**: Specification for Pavement Transverse Evenness Measurement*
https://hispeq.files.wordpress.com/2016/07/hispeq3_transevennesssurveyspecification.docx
***HiSPEQ4**: Specification for Pavement Longitudinal Evenness Measurement*
https://hispeq.files.wordpress.com/2016/07/hispeq4_longevennesssurveyspecification.docx
***HiSPEQ5**: Specification for Pavement Surface Deterioration Measurement*
https://hispeq.files.wordpress.com/2016/07/hispeq5_image_surfdetsurveyspecification.docx
***HiSPEQ6**: Specification for Pavement Structure Measurement*
https://hispeq.files.wordpress.com/2016/07/hispeq6_pavementstructuresurveyspecification.docx
***HiSPEQ7**: Specification for Traffic Speed Pavement Deflection Surveys.*
https://hispeq.files.wordpress.com/2016/07/hispeq7_pavementdeflectionsurveyspecification.docx

Specification Template Guidance

https://hispeq.com/projectoutput/survey-specifications-and-guidance/

HiSPEQ: Guidance for Road Administrations for Specifying Network Surveys Part 1
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***HiSPEQ2E**: Equipment to measure location*
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***HiSPEQ3E**: Equipment to Measure Transverse Evenness*
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***HiSPEQ4E**: Equipment to Measure Longitudinal Evenness*
https://hispeq.files.wordpress.com/2016/07/hispeq4_longevennessequiptspec.docx
***HiSPEQ5E**: Equipment to Record Downward Facing Images*
https://hispeq.files.wordpress.com/2016/07/hispeq5_image_surfdetequiptspec.docx
***HiSPEQ6E**: Equipment to Measure Pavement Structure*
https://hispeq.files.wordpress.com/2016/07/hispeq6_pavementstructureequiptspec.docx
***HiSPEQ7E**: Equipment to Measure Traffic Speed Deflection*
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Training

https://hispeq.com/projectoutput/training