Development and Implementation of a Simplified System for Assessing the Condition of Irish Regional and Local Roads.

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ABSTRACT

The surface condition of road pavements is a vital element in pavement management to prioritise projects, select appropriate treatments and make the best use of available resources. In Ireland, the overall road network of 99,008 kilometres includes 5,415 kilometres of National Roads and 93,593 kilometres of Regional and Local Roads. To evaluate the condition of the Regional and Local Roads, a simplified pavement inspection methodology, the Pavement Surface Condition Index (PSCI) rating system, has been developed.

The PSCI system is outlined in a new Rural Flexible Roads Manual published by the Department of Transport, Tourism and Sport. The manual describes types of defects for Irish roads and provides a simple 1 to 10 scale based on pavement defects to visually rate pavement surface condition. The condition survey is carried out from a moving vehicle and the assigned PSCI rating is recorded and geo-referenced using an innovative tablet and App device. The results of the rating system provide a standardised approach to link pavement distress to specified maintenance treatment measures for Irish roads.

The implementation of the Rural Flexible Roads Manual and PSCI rating system involved the development of new IT solutions and the training of local authority personnel in 31 Local Authorities. The simplified system and App device is being used by local authorities to visually rate their rural road networks with over 45,000 kilometres of network rated to-date. In addition, the PSCI was successfully used as part of a major study in 2011/12 to survey the entire network of 13,121 kilometres of Regional Roads. The overall objective is to use the results of the 1 to 10 rating to establish the existing pavement condition, and the lengths of roadway requiring various types of remedial works, both nationally and at county level.

This paper describes the development and implementation of a new Rural Flexible Roads Manual and PSCI rating system using an innovative tablet and App device for Irish roads. In addition, the key role of the PSCI data in the management of the Irish roads network and experience to-date of local agencies in the use of the system is discussed.

1. ROAD NETWORK MANAGEMENT AND FINANCIAL BACKGROUND

In Ireland, the overall road network comprises 99,008 kilometres (61,521 miles) and includes 5,415 kilometres (3,365 miles) of National Roads and 93,593 kilometres (58,156 miles) of Regional and Local Roads. The length of public road per 1000 population is 21.46 kilometres per 1000 which is over two and a half times the EU (European Union) average of 8.51 kilometres per 1000. The maintenance and upkeep of this network is thus very challenging, and in particular against a background of reducing funding and resources over recent years.

The National road network of 5,415 kilometres (km), including the motorways, dual carriageways, national primary and secondary routes, is less than 6% of the total public road length and carries around 45% of the total traffic. The National Roads Authority (NRA) has responsibility for this network. The data collection surveys carried out annually on the National network are totally automated using Road Surface Profiler (RSP), Sideways-force Coefficient Routine Investigation Machine (SCRIM), Laser Crack Measurement System (LCMS) and Digital Video. In the current year, €349 million (c. $475 million) is budgeted for expenditure on the National road network (1).

The nature of Regional and Local roads is fundamentally different to the National road network. The Regional and Local roads, at 93,593 km, account for 94% of the total road network and carry around 55% of all road traffic. There is 13,121 km of Regional road and 80,472 km of Local roads. The Local road network is classified into three sub-groupings; local primary (24,373 km), local secondary (33,222 km) and local tertiary (22,878 km). Typical road widths by road classification are c.6 metres for regional roads, c.4.5 metres on local primary roads, c.3.5 metres on local secondary roads and c.2.5 metres on local tertiary roads. Most of the roads carry low volumes of traffic, less than 100 commercial vehicles per day, with many local roads providing cul-de-sac access to a few households (2). Hence, the management of this network requires a different approach.

Ireland has 31 Local Authorities who are responsible for the maintenance and upkeep of the Regional and Local roads network. Funding is provided through a combination of central government from the Department of Transport, Tourism and Sport (DTTAS), and locally generated funding by local authorities. In 2014, a total of €332 million (c. $451 million) is being made available by the DTTAS for expenditure on the Regional and Local roads network (1), with another c. €120 million (c. $160 million) of expenditure from local authority resources, yielding a total expenditure of around €552 million (c. $750 million).

In 2011, a major pavement condition study was carried out on the entire Regional road network based principally around machine-based data (RSP, SCRIM) in conjunction with visual rating using the newly developed PSCI system (3). However, the cost of automated data collection as a proportion of the available maintenance budget on the Regional, and in particular, the Local road network is much too high to be economically viable on a routine basis. A very high proportion of the roads are limited in width, have poor geometrics, poor surface condition and many are cul-de-sac roads making them unsuitable for machine surveys. In addition, it is uneconomical to perform a detailed manual distress survey on such lower class roads as the available budget per kilometre is at a low level, and the costs of data collection per kilometre would become excessively high as a percentage of the available budget. Accordingly, a simplified system for applying a condition rating index whereby greater lengths of road can be surveyed using a geo-referenced mobile application is obviously attractive for these road classes.

2. DEVELOPMENT OF THE PSCI RATING SYSTEM

The Rural Flexible Roads Manual - PSCI was developed to provide a simple condition rating index for the evaluation and rating of the surface condition of Irish roads at network level (4). The manual outlines the different types of pavement defects for Irish roads, and provides a simplified 1 to 10 system to visually rate pavement surface condition. The manual provides detailed descriptions of the distress types, how to link them to the 1 to 10 rating scale, and includes high resolution colour photographs of the distress types and of road pavements in each of the 1 to 10 rating categories. The manual provides a standardised approach to rate pavement condition and to link the pavement distress to specified treatment measures for Irish roads.

This manual and software technologies were developed in collaboration with a Steering Group of the DTTAS including members from the DTTAS, Local Government Management Agency (LGMA) and Senior Engineers from South Tipperary, Carlow and Donegal County Councils. In developing the PSCI system, substantial use was made of the template provided by the PASER (Pavement Surface Evaluation and Rating) methodology originally developed by the Wisconsin Department of Transportation for local roads in the US (5). The PASER system was significantly modified for Irish road conditions including pavement defects and remedial work types to produce the Rural Flexible Roads Manual for Irish Roads.

2.1. Pavement Defects

Based on the results of very considerable research and field trials in Ireland (6, 7), there are 10 pavement distresses outlined in the Rural Flexible Roads manual as they are by far the most common flexible road distresses encountered on Irish roads. The first half of the manual provides detailed descriptions and high resolution colour photographs of the ten distress types. The distresses are grouped into four main categories as follows:

Surface Defects
Ravelling
Bleeding

Pavement Deformation
Rutting
Surface Distortion (shape problems, bumps, sags and depressions)

Cracks
Alligator Cracking
Edge Cracking/Breakup
Other Cracking (longitudinal, transverse, reflection, slippage, etc.)

Surface Openings
Patching
Potholes
Road Disintegration

The ten pavement defects can be re-classified into three causative groups, namely, surface-related, structural-related and other-related pavement defects. **Surface defects** com-

prise ravelling and bleeding; **Structural defects** (i.e. load-related) comprise rutting, alligator cracking, edge cracking/breakup, potholes, poor/failed patching and road disintegration; while **Other Pavement defects** include other cracking, good/fair patching and surface distortion. With an understanding of the surface defects, structural defects and other pavement defects categories, the PSCI 1 to 10 system can be used to evaluate and rate flexible pavement surfaces.

2.2. The PSCI Rating System

Figure 1 shows PSCI rating system as outlined in Table 1 of the Manual. The PSCI provides a numerical rating of road condition using a simplified 1 to 10 rating scale. The PSCI scale ranges from 10 for a pavement in excellent condition to 1 for a pavement in failed condition. For consistency of approach, the rating is assigned based on visible pavement defects only. The rating manual provides detailed descriptions on how to link the pavement defects to the 1 to 10 scale, and includes high resolution colour photographs of road pavements in each of the 1 to 10 rating categories. Figure 2 shows an extract of Rating 7 from the manual.

The 1 to 10 system is colour-coded with Ratings 1 to 4 coloured Red, Ratings 5 and 6 coloured Amber, Ratings 7 and 8 coloured Blue, and Ratings 9 and 10 coloured Green. This colour-coding follows throughout the manual, and is also used in the Mobile App, and in mapping the PSCI ratings within the DTTAS MapRoad pavement management system.

As shown in Figure 1, the rating is assigned using Primary- and Secondary- rating indicators based only on visible pavement distress. A primary rating indicator is a defect that must be present on the road, a secondary rating indicator is a defect that may or may not be present in conjunction with the primary defect(s). The significance of the surface-related, structural-related and other-related pavement defects in the 1 to 10 rating system can also be seen from Figure 1, with surface-related defects mapping to ratings 7 & 8, other-related defects mapping to ratings 5 & 6, and structural-related defects mapping to ratings 1 to 4.

To rate pavement surface condition using the 1 to 10 system, one needs to understand the pavement distresses and become familiar with the photos and descriptions (primary and secondary rating indicators) of the individual rating categories in the 1 to 10 rating scale. The impact of surface-related distresses, structural-related distresses and other defects should be identified. The purpose of the survey is to rate the overall condition of a roadway, rather than collect detailed distress data on individual short segments or isolated events.

Table 1: The PSCI Rating System

Overall PSCI Rating	Primary Rating Indicators*	Secondary Rating Indicators*
10	**No Visible Defects.**	Road surface in perfect condition.
9	**Minor Surface Defects[1].** **Ravelling or Bleeding ≤10%.**	Road surface in very good condition.
8	**Moderate Surface Defects[1].** **Ravelling or Bleeding 10% to 30%.**	Little or No Other defects.
7	**Extensive Surface Defects[1].** **Ravelling or Bleeding ≥ 30%.**	Little or No Other defects. **Old surface with aged appearance.**
6	**Moderate Other Pavement Defects[2].** **Other Cracking ≤ 20%.** **Patching generally in Good condition.** **Surface Distortion requiring some reduction in speed.**	Surface defects[1] may be present. No structural distress[3].
5	**Significant Other Pavement Defects[2].** **Other Cracking ≥ 20%.** **Patching in Fair condition.** **Surface Distortion requiring reduction in speed.**	Surface defects[1] may be present. **Very localised structural distress[3]** (< 5 m^2 or a few isolated potholes).
4	**Structural Distress[3] Present.** **Rutting, Alligator Cracking or Poor Patching for 5% to 25%.** **Short lengths of Edge Breakup/Cracking.** **Frequent Potholes.**	Other defects may be present.
3	**Significant Areas of Structural Distress[3].** **Rutting, Alligator Cracking or Poor Patching for 25% to 50%.** **Continuous lengths with Edge Breakup/Cracking.** **More frequent Potholes.**	Other defects may be present.
2	**Large Areas of Structural Distress[3].** **Rutting, Alligator Cracking or Very Poor Patching for ≥ 50%.** **Severe Rutting (≥ 75mm).** **Extensive Very Poor Patching. Many Potholes.**	Very difficult to drive on.
1	**Extensive Structural Distress[3].** **Road Disintegration of surface. Pavement Failure.** **Many large and deep Potholes.** **Extensive Failed Patching.**	Severe Deterioration. Virtually undriveable.

** Individual pavements will not have all the types of distress listed for any particular rating. They may have only one or two types.*

Note 1: Surface Defects = Ravelling or Bleeding.
Note 2: Other Pavement Defects = Other Cracking (longitudinal, transverse, reflection or slippage), Surface Distortion (Shape problems, depressions/sags, shoving, bumps, settlement or heave), Good/Fair Patching.
Note 3: Structural Distress = Load-related defects comprising Rutting, Alligator Cracking, Edge Breakup/Cracking, Poor/Failed Patching, Potholes or Road Disintegration.

FIGURE 1 The PSCI Rating System (Table 1).

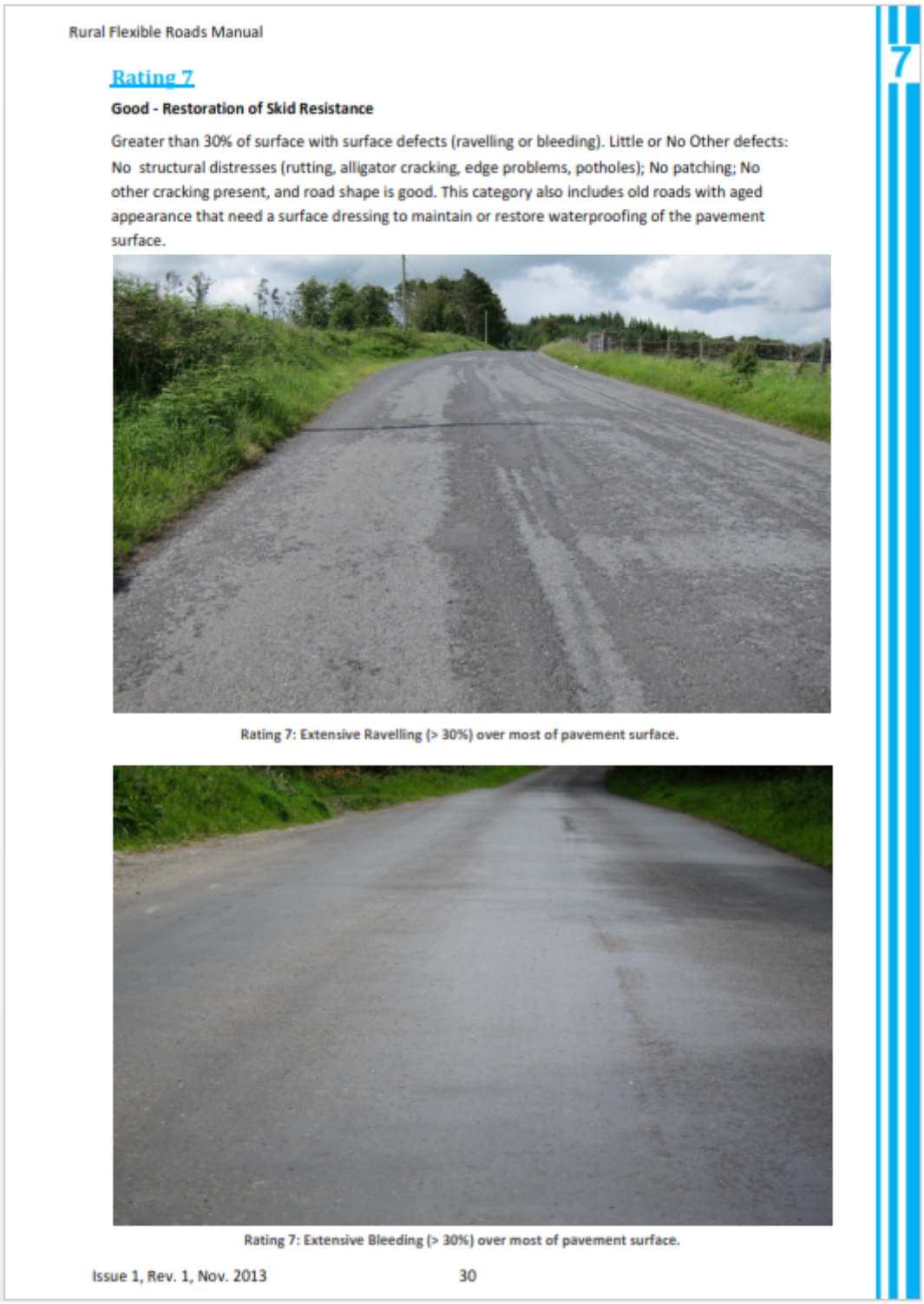

FIGURE 2 Extract of Rating 7 Photos in the Manual.

2.3. Mapping Distress to Treatment Measures

The PSCI 1 to 10 rating is directly linked to four maintenance treatment categories specified for use on Irish Regional and Local roads by the DTTAS. The four maintenance treatment categories are Routine Maintenance, Restoration of Skid Resistance, Surface Restoration and Road Reconstruction. Figure 3 shows the mapping of the 1 to 10 rating to the different treatment measures as outlined in Table 2 Treatment Measures of the Manual, where ratings 1 to 4 map to the Road Reconstruction category, 5 and 6 map to the Surface Restoration category, 7 and 8 map to the Restoration of Skidding Resistance category, and 9 and 10 map to the Routine Maintenance category.

Table 2: Treatment Measures

Overall PSCI Rating	Treatment Measures	Surface	Structure
10	**Routine Maintenance**	Excellent	
9		Very Good	
8	**Resealing & Restoration of Skid Resistance**	Fair	Good
7		Poor	
6	**Surface Restoration** — Carry out localised repairs and treat with surface treatment or thin overlay.	Fair	Fair
5		Poor	
4	**Structural Overlay** – Required to strengthen road. Localised patching and repairs required prior to overlay.	Poor Overall	
3			
2	**Road Reconstruction** - Needs full depth reconstruction with extensive base repair.	Very Poor Overall	
1		Failed Overall	

FIGURE 3 Mapping PSCI Rating to Treatment Measures (Table 2).

2.4. Pilot Surveys

Several refinements were made in developing the Rural Flexible Survey Manual and PSCI condition rating system. A number of preliminary field trials on a variety of different roads were carried out by personnel with experience of pavement defects and condition rating manuals. Following these initial trials and consultations with the DTTAS Steering Group, the draft survey manual and 1 to 10 system was trialled by pilot survey for the first time with Local Authority road staff in Carlow County Council in October, 2011. The pilots involved discussions with senior road engineers and a field trial to assess the application of the manual and 1 to 10 rating system by 4 engineering staff (2 Executive Engineers, 1 Engineering Technician and 1 Area Supervisor). Prior to the field trials, two routes of Regional and Local roads with a range of road condition categories over a relatively short length were identified. The pilot routes were 13.5 kilometres (Loop 1) and 16.2 kilometres (Loop 2) in length.

An instrumented van with GPS and Distance Measuring Instrument (DMI) connected to a forward view HD digital video camera and a laptop was provided for the trials. As the Tablet and Mobile App were still in development at this stage, the laptop was loaded with the underlying road mapping, and with logging and recording software which was specially developed for the field trials. The software allowed continuous condition rating using the 1 to 9 keys on the laptop keyboard, with 0 representing condition rating 10. When the rater decided that a new condition rating was appropriate, the rater pressed the relevant numeric key. The digital video, chainage and GPS coordinates were simultaneously logged with the rating for subsequent analysis.

All four raters carried out a condition rating survey on each of the loops. The ratings were applied based on visual condition for continuous stretches of road and the rating was only changed when the condition of the road and defects changed. The typical lengths over which a rating was applied ranged from 187 metres to 1481 metres. The intention of the pilots was primarily to see how the system worked in practice rather than to train all users to come to an agreed outcome. Although, the raters had no prior knowledge of the rating system and only had the manuals for a short period of time before commencing the survey, there was in general good agreement across the four raters in relation to identification of stretches with different ratings. Most of the variation between raters arose from the frequency that individual raters changed the rating, with one rater changing the rating very frequently, at intervals of less than 100 metres. The site trials indicated that a minimum length to justify a change in rating of circa. 200 metres was the most appropriate, differing from the initial Steering Group suggested minimum length of c. 300 to 350 metres

Significant improvements were made to the manual and rating system based on the outcomes from the pilot surveys. Overall, the pilots showed that the manual and continuous rating system was simple to understand, and had very good acceptance from the raters. The continuous rating hardware/software also worked well in the field. There was general agreement that the 1 to 10 system was easy to use. The pilots also indicated that a training course would be needed to train learners in the use of the 1 to 10 rating system and Mobile App.

The draft manual used in the pilots had the 1 to 10 scale, the visible distress description and the treatment measures all combined in a single table. As the rating is based on visible defects only and not on the rater's judgement of the repair required, and based on the field trials, separate tables were introduced to the manual to link pavement defects to the 1 to 10 rating (Table 1), and subsequently link the rating to the treatment measures (Table 2). Figures 1 and 3 show the final Table 1 and Table 2, respectively, in the final version of the manual.

3. DATA COLLECTION USING THE MAPROAD MOBILE APP

A key objective of the system was to be able to record survey data electronically without the use of paper, and to be able to upload the data in the field directly to the DTTAS pavement management system. An innovative mobile survey App, called MapRoad Mobile, has been specifically developed to facilitate the visual condition rating of roads and the rapid capture of the PSCI data from a moving vehicle. The smart mobile solution operates on a Tablet device based on the Android operating system (8).

The recommended tablet device for the MapRoad Mobile App is the Samsung Galaxy 10.1 tablet. The Mobile App uses the internal GPS device on the tablet and, when available, mobile data connection (3G) to acquire location and to capture and display data. Typical location accuracy with the internal GPS device on the tablet is 5 to10 metres. An external Bluetooth GPS device can be used to improve this accuracy to 2 to 3 metres.

In the field, the assigned PSCI 1 to 10 rating and associated GPS data are recorded in real-time using the underlying Local Authority Road Network Schedule (GIS Shapefile), the Tablet device and Mobile App. The PSCI and associated GPS data are automatically saved on the Tablet device and the data can be uploaded directly to the DTTAS MapRoad pavement management system by connecting to the internet using WiFi or mobile data connection (3G).

With the MapRoad Mobile App, the operator has the ability to create a new project, upload a project, load a project, and check for updates. Once a new project has been created, MapRoad Mobile will display a ratings keypad on the right of the screen, with a map panel on the left showing the Local Authority Road Schedule as shown in Figure 4. The numbers on the keypad are colour-coded to match the 1 to 10 rating system of red (1 to 4), amber (5 & 6), blue (7 & 8) and green (9 & 10).

The PSCI condition rating survey is a continuous driven visual condition survey carried out from a moving vehicle by a two-person team, the driver and the rater. To start recording, or dropping points on the map, the rater chooses an initial rating (1 to 10), and then starts the survey. Once the driver starts driving, points will be dropped on the map approximately every 2.5 seconds or every 35 metres (38 yards). The points dropped on the map are also colour-coded to match the 1 to 10 rating system. For a PSCI rating of 3, red points will be dropped on the map, if changed to 7 the points being dropped will change to blue and so on. The rating is applied to the full width of a road segment based on its overall condition and the defects present on the road. Moreover, the rater assesses the total length of a road section, there is no sampling involved. While the rating assigned and GPS coordinates are linked to the road schedule and recorded for every 35 metres, the visual rating is only changed once the condition of the road and defects observed change. Roughly a length of at least 200 metres (219 yards) is required to justify recording a change in the condition rating category. The operator can stop, pause or resume dropping and capturing points at any time.

The PSCI survey is reasonably fast with a high daily output. Typically, the survey speed is in the range of 30 to 50 km/h depending on the condition of the roadway. From experience to-date, once the rater has become familiar with the photos and descriptions in the manual, and built up a mental “database” of the condition categories based on rating a number of roads, the speed of rating generally increases. The higher end of the speed range is suitable where visibility is clear and the road appears to be in good condition. As the condition of the road deteriorates, the survey speed should be reduced. Typically, 150 to 200 km of road can be surveyed per day in this speed range.

4. TRAINING OF LOCAL AUTHORITY STAFF

As the Rural Flexible Roads Manual, comprising the PSCI 1 to 10 rating system and mobile App, was a completely new approach to visual condition surveys in Ireland, it would be necessary to train Local Authority roads staff nationally. In addition, the successful implementation of the new system relied heavily of achieving cooperation from Local Authority roads staff across the country and on ensuring an understanding of the role of the PSCI within the overall approach to pavement management both at local and national level.

4.1. Training Workshops

As part of the implementation of the system, National and Regional Workshops were held as well as the development of a dedicated Training Course. The Regional workshops and training course were run through five Road Service Training Group (RSTG) Regional Training Centres located around Ireland.

In May, 2012, the manual was launched at a one day National Workshop in Dublin which was organised by the DTTAS and Local Government Management Agency (LGMA). The workshop was attended by over 90 senior engineering personnel with representatives from 29 Local Authorities, 5 City Councils, 2 Borough Councils and 4 Town Councils. In addition, prior to the role out nationally of a full scale training course, four other 1-day regional workshops were held in November, 2012. Over the four days, the workshops were attended by 204 Local Authority roads staff who would be directly involved in the use of the PSCI manual and mobile App.

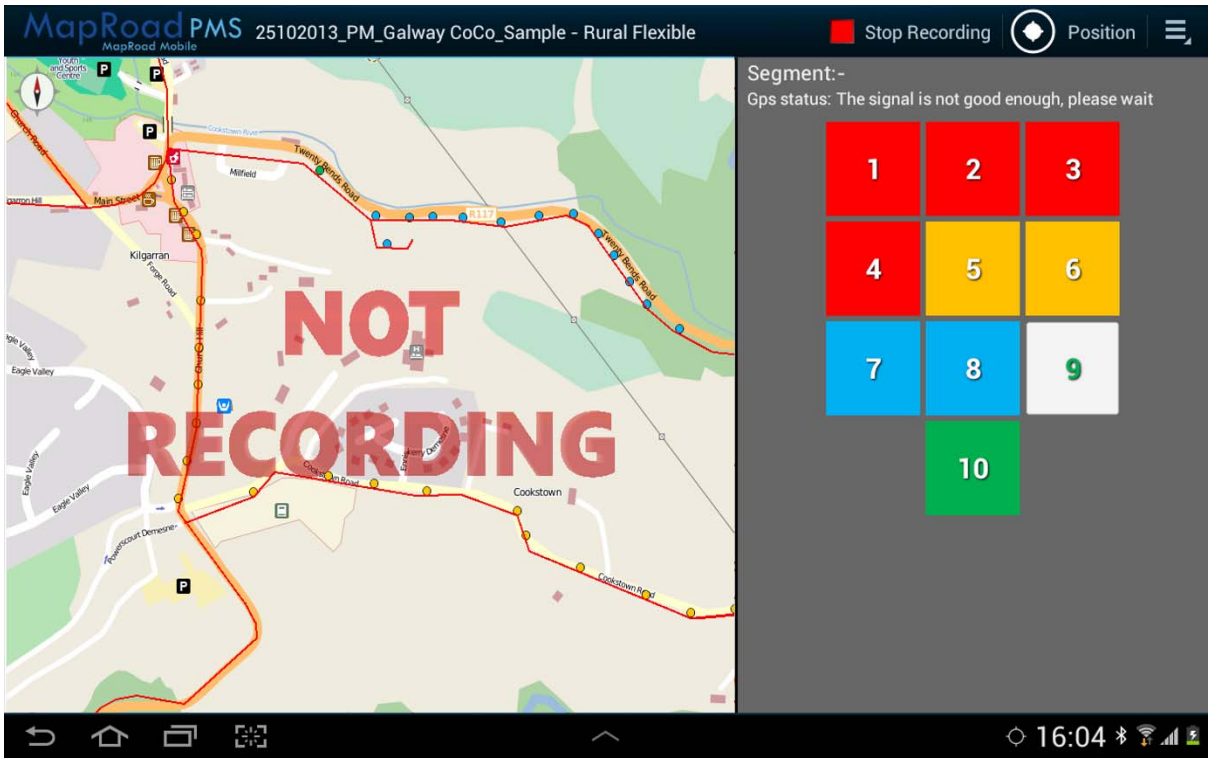

FIGURE 4 MapRoad Mobile App.

4.2. Training Course

A detailed Course Specification, entitled the 'Road Pavement Condition Rating Surveyor', was published by the Local Authority Service National Training Group (LASNTG) in September 2012 (9). The aim of the training course was to train Learners in the correct and safe methodology to carry out a PSCI condition rating survey in accordance with the DTTAS Rural Flexible Roads Manual. The training course was delivered through the five RSTG Regional Training Centres.

The Training Course consisted of 2 parts:

- Part 1 consisted of a 1-day of theory in the classroom.
- Part 2 consisted of a subsequent site assessment exam whereby the Learner would rate a pre-approved sample road network using the tablet and mobile App device.

4.2.1 Training Course Part 1: Classroom Training

The Classroom part of the course was confined to 10 persons per training day and consisted of five units. In Unit 1, training was provided on the content of the Rural Flexible Roads Manual and the PSCI 1 to 10 condition rating system including the types of pavement defects, and mapping the defects to the 1 to 10 condition rating categories. A wide range of images and high-resolution forward view video clips of defects and roads in the 1 to 10 categories are used in Unit 1.

In Unit 2, the Learners use a Simulation Programme to demonstrate on a desktop computer the ability to properly rate road segments using the 1 to 10 rating system. The software programme presents a windshield survey to the Learner using video clips of road segments in each of the 1 to 10 rating categories, and allows the Learner to record their rating as per a live survey. A screen grab of the desktop interface for the simulation programme is shown in Figure 5. The training circuit video clips are pre-rated by experienced personnel to establish the standardised underlying condition rating for the training video clips. The Learner desktop ratings are compared against the underlying rating to measure learning in the classroom.

In Unit 3, the Learners are trained in how to input pavement condition ratings on the tablet using the MapRoad Mobile App, and how to upload a completed project. Unit 4 deals with the safety requirements for carrying out the condition rating survey. In Unit 5, the Learners receive information on the Part 2 Site Practical Exam.

4.2.2 Training Course Part 2: The Site Practical Exam

An assessment route was identified close to each of the five Training Centre locations for use in the Site Practical Exam. The five assessment routes comprised both Regional and Local roads which had a range of conditions in the 1 to 10 rating categories. The assessment routes were surveyed in the field by experienced personnel using the Tablet and App device to firstly establish the underlying condition rating for comparison with the Learner ratings. In addition, the condition of the assessment routes was recorded using high definition forward view digital video referenced to both chainage and GPS coordinate systems to maintain a permanent record of the road condition.

FIGURE 5 Simulation Programme for Desktop PSCI Rating in the Classroom.

Under Part 2 of the course, each Learner is required to independently rate the assessment route using the Tablet and App, and to upload the data. It is recommended that the site assessment should be undertaken within 3 weeks of completing Part 1 of the course. The Learner ratings are compared against the underlying rating to assess Pass/Referred standard.

4.2.3 Outcomes From the Training Course

The rating system and training has been implemented over a wide range of survey personnel as shown in Table 1. From November 2012 to June 2014, there were 30 training courses delivered to 257 staff from 29 Local Authorities. The vast majority of the training took place from January to June 2013 with 220 of the 257 Learners attending the training course. In addition, four supplementary regional training workshops were held in October 2013 for Learners who had completed the training day but not yet completed or passed the test loop exam. The workshops were attended by 90 Local Authority staff. Of the 257 Learners trained, 219 (85%) have undertaken the site practical exam with 177 (81%) having passed the exam to become approved raters and 42 (19%) who did not pass and were referred. The implementation of the PSCI system will be supported through "refresher" training workshops and blended learning to ensure raters maintain competence in using the 1 to 10 system. The blended learning will include a combination of classroom training and e-learning using online videos and presentations hosted on the Moodle open-source learning platform.

TABLE 1 Range of Personnel Who Have Undertaken Training

Learner Type	Number of Learners
Senior Engineer	5
Senior Executive Engineer	33
Executive/Area Engineer	124
Assistant Engineer	35
Graduate Engineer	5
Engineering Technician	48
Area Manager/Supervisor	7
Total	**257**

5. ANALYSIS AND USE OF THE PSCI DATA NATIONALLY

Since the launch of the Manual and Mobile App in November 2012, and the subsequent large scale training programme, the PSCI system has become well established across all local authorities and is a key element of the DTTAS MapRoad pavement management system (10). The simplified system and Mobile App are being used by Local Authority personnel to visually rate their rural road networks and develop works programmes based on the condition data.

From an economic perspective, the implementation of the PSCI system provides technical data which allows the DTTAS and Local Authorities to demonstrate funding requirements and set programmes in line with available budgets. The Regional and Local Road grant programmes funded by the DTTAS are directly linked to the PSCI and the specified treatment measures. The PSCI data is used to prioritise sections and to create a Roads Programme for the grant applications and annual returns to the DTTAS. Since April 2012, Local Authorities are required to submit 'Before' and 'After' PSCI condition ratings on all rural schemes included in their annual works programme.

By May 2014, over 45,000 kilometres (close to 50%) of the Regional and Local Roads network have been rated by Local Authority road staff in 25 counties. Figure 6 shows the National picture of the PSCI ratings and a breakdown of the length in each rating category completed up to May 2014. In addition, the PSCI system was successfully used as part of a major pavement condition study in 2011 to survey the entire 13,121 km of the Regional Roads network (3, 11). The visual rating was carried out from high definition forward view digital video of the road surface condition collected in the field. The digital video was recorded as individual JPEG images continuously taken at 5 metre intervals.

Table 2 shows the percentage length by PSCI rating and maintenance treatment for each road type for the 2013/2014 data, and the 2011 Regional Road data. The patterns in condition distribution by class are similar to those recorded in previous National surveys, with very good agreement between the visual rating data for the Regional roads from the 2011 and 2013/2014 surveys. The overall objective is to use the results of the 1 to 10 rating for Regional and Local roads to establish the existing pavement condition at network level, and the lengths of roadway requiring various types of remedial works, both nationally and at county level.

TABLE 2 Maintenance Treatment Type By Road Category

			PSCI Rating/Treatment Type Percentages			
			1 to 4	5 & 6	7 & 8	9 & 10
Road Class	% Length Surveyed	Year	Reconstruction	Surf. Rest.	Skid Resist.	Routine Maint.
Regional	100%	2011	10%	22%	43%	25%
Regional	30%	2013/2014	5%	20%	50%	25%
Local Primary	53%	2013/2014	9%	29%	48%	14%
Local Secondary	44%	2013/2014	17%	35%	40%	8%
Local Tertiary	31%	2013/2014	31%	33%	30%	7%

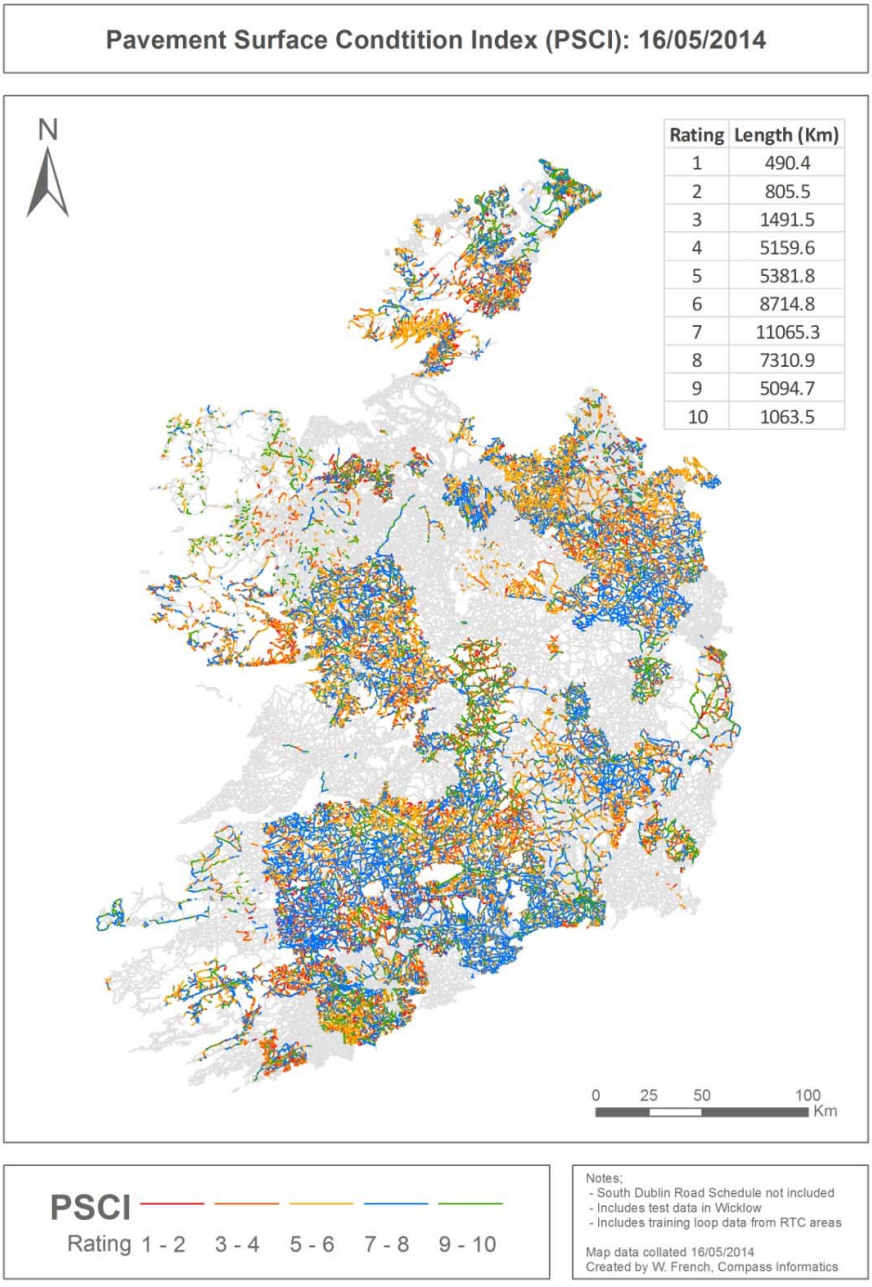

FIGURE 6 National Picture of 2013/2014 PSCI Ratings - May 2014.

6. SUMMARY AND CONCLUSIONS

A simplified pavement inspection methodology, the Pavement Surface Condition Index (PSCI) rating system, has been developed in Ireland to evaluate the condition of the Regional and Local Roads network. The system is outlined in the Rural Flexible Roads Manual (Volume 1 of 3) published by the Department of Transport, Tourism and Sport (DTTAS). The PSCI provides a rating based a simple 1 to 10 scale to visually rate pavement surface condition. The results of the rating system are relatable to specified maintenance treatment measures for Irish roads.

The condition survey is a continuous driven survey carried out from a moving vehicle by a two-person team, the driver and the rater. The assigned PSCI rating is recorded and geo-referenced using a tablet and App device called MapRoad Mobile. Typically, the survey speed is in the range of 30 to 50 km/h depending on the condition of the roadway and 150 to 200 km of road can be surveyed per day.

The simplified system and Mobile App are being used by Local Authority personnel to visually rate their rural road networks and develop works programmes based on the condition data. Since its development, training on the PSCI system has been provided to 257 roads staff from 29 Local Authorities, with over 45,000 kilometres (c. 50%) of the Regional and Local Roads network surveyed in the twelve months to May 2014.

The PSCI condition rating data is immediately available in the DTTAS MapRoad pavement management system, and can be used to priorities projects, to choose the most cost effective treatments, and to demonstrate value for money for the funding provided and the need for increased investment. To provide current data, it is envisaged that the PSCI data will be updated by a National survey (100% coverage) on the Regional roads annually, with Local roads being surveyed every 2 to 4 years.

In addition to the Rural Flexible Manual, a PSCI manual for Urban Flexible roads (Volume 2 of 3) and Urban Concrete roads (Volume 3 of 3) have recently also been developed. The next steps will include the completion and quality assurance of a National survey, the development of a training course for the two urban manuals, and the introduction of blended learning through an online e-learning module to enhance training for all three manuals.

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