

UKPMS and RoadBotics by Michelin: A Comparison

Introduction

RoadBotics by Michelin offers a universal 1-5 pavement surface condition rating based on the visual assessment of high quality roadway image data. To help road managers in the United Kingdom better understand this 1-5 RoadBotics by Michelin rating system, the following analysis compares the United Kingdom Pavement Management System (UKPMS) rating system with RoadBotics by Michelin. The specific case that is detailed in this study compares RoadBotics by Michelin pavement data and UKPMS data in Westminster, London.

The results of this analysis show that the metre-by-metre granularity of the RoadBotics by Michelin assessment data offers inspectors with unprecedented imagery and detailed insights into the surface condition of the carriageway. With more comprehensive data for every metre of a section of carriageway, the resulting RoadBotics by Michelin section ratings offer a more representative view into the overall condition of the carriageway than past UKPMS DVI ratings.

Scope Of Study

The area of data included in the comparison consists of 2,267 pre-defined sections, totaling 320 kilometres. To ensure the highest quality of comparison both data sets in the comparison were produced in 2019. This comparative analysis includes 1,670 sections of Westminster because these sections have both UKPMS DVI and RoadBotics by Michelin rating generated for them. 597 sections were excluded from this comparison because they lacked comparable 2019 data sets. These excluded sections are listed as "N/A".

RoadBotics by Michelin & UKPMS Defined

RoadBotics by Michelin's machine learning analysis process assesses 1080P high definition image data of road networks that is collected using a smartphone device. An image frame is collected for every 3 metres of roadway. Each image is analyzed pixel-by-pixel using RoadBotics by Michelin's machine learning process to result in a 1-5 condition rating for every 3-metres of roadway. Each resulting rated image is called a 'point data'. A 'section rating' is then created by taking an average of each individually scored "point data" on the applicable section. 'Section ratings' are generated to three decimal points precision (e.g. 3.453), while 'point data' ratings are always integer based (e.g 4).

UKPMS Detailed Visual Inspection (DVI) survey is a walked survey that includes trained inspectors traversing and generating an inspection rating based on the surface conditions that the inspector sees. UKPMS DVI assessments, unlike RoadBotics by Michelin, create a quality assessment for both footpaths and carriageways. DVI surveys typically target roads that were identified previously as being defective or failing.









COMPARISON METHODOLOGY

To compare the RoadBotics by Michelin to UKPMS ratings, the UKPMS section average of the UKPMS DVI scores were first transposed onto the 1-5 RoadBotics by Michelin rating score using the following guidelines provided by FM Conway.

UKPMS DVI Scores	RoadBotics Score
0 - 9.99	1: Excellent No surface damage, no critical issues.
10 - 29.99	2: Minor Defects Beginning to show typical wear and tear.
30 - 49.99	3: Fair Appearance of pervasive surface distresses. Important issues on the surface are beginning to show.
50 - 69.99	4: Poor Significant damage or emerging critical failures. The road damage is beginning to exacerbate.
70+	5: Critical Major surface damage and/or critical surface failures are present on the road surface.

Initial Comparison Results

Using the resulting equivalent ratings, we conducted an analysis to understand the similarities and differences between the RoadBotics by Michelin and UKPMS ratings included in the study. The results of the comparative analysis follow two general trends:

- 1. For sections with a DVI score 0-29.99 (1158 sections), the RoadBotics by Michelin score agreed 94.5. This would mean that there was very little discrepancy between the RoadBotics by Michelin and UKPMS DVI condition ratings when the carriageways are of higher quality.
- For sections with a DVI score ≥30 (531 sections), the RoadBotics by Michelin score agreed 0%. At first glance, this figure would appear to show a high level of discrepancy between RoadBotics by Michelin and UKPMS ratings when the carriageways are of poorer condition. Further analysis, however, shows otherwise (see below).

The graphs below represent these trends based on the UKPMS DVI scores that have been transposed into RoadBotics by Michelin' ratings.











The 0% rate of agreement of UKPMS and RoadBotics by Michelin's rating agreement UKPMS DVI ratings ≥30 appears alarming when compared to the extremely high rate of agreement for the other higher quality sections with DVI scores ranging from 0-29.99. However, the discrepancy is more a qualitative difference than a quantitative difference in ratings: RoadBotics by Michelin's assessment is both more granular and more comprehensive than the UKPMS rating data.

In other words, the more detailed point data that RoadBotics by Michelin uses to generate the section ratings, takes into account the condition of every 3-metres of a section's carriageway surface. The data would suggest that because the UKPMS DVI section scores lack a comprehensive image library and granular 3-metre ratings, that distresses along a given section can stilt the resulting overall condition rating of a given section.

In all observed cases, we can use the comprehensive library of high definition imagery (representing every 3-metres of each section) to identify the likely representative sampled subsection that generated the overall UKPMS DVI section scores. This means that by using RoadBotics by Michelin image data and corresponding ratings for every 3-metres, we can conduct further analysis to pinpoint why the ratings discrepancies occurred for the UKPMS DVI ratings.

The following analysis reveals convincing evidence that RoadBotics by Michelin Point Data ratings (and resulting Section Ratings) provide a more representative view of the actual section condition than UKPMS DVI ratings because the granularity in ratings enable a more comprehensive view into the condition of the entire section than what is captured through DVI ratings.

In-Depth Analysis: The Power Of Point Data

To determine which ratings (UKPMS DVI or RoadBotics by Michelin) provided a more detailed and accurate







view of the condition of the carriageway sections with UKPMS DVI ratings ≥30, we used the available high definition imagery from RoadBotics by Michelin Point Data and reviewed the highest areas of difference between the two ratings. Using the example cases below, we show that the more granular RoadBotics by Michelin assessment data captures a more accurate, detailed view of the carriageway surface.



Example 1: Berkeley Square

UKPMS DVI section score: 104.48 (RoadBotics by Michelin Rating = 5)

RoadBotics by Michelin by Michelin section score: 1.54 (RoadBotics by Michelin Rating = 2)

Remember that the images are RoadBotics by Michelin' point data. That is to say, they are ratings for individual 3 metre section of road; these individual ratings along a given section are averaged to generate the section rating. The 1.54 section average score from RoadBotics by Michelin consists of 100+ point data ratings that were captured across this particular section of Berkeley Square.

Figure 1.a pinpoints the road failure in the form of a pothole, though this rating is not representative of the surface condition of the entire section as seen in Figure 1.b. As you can see, the detailed nature of the RoadBotics by Michelin point data enables the viewer to see that there is a localized extreme failure within a generally good quality section of carriageway. Figure 1.d shows this granularity of data for Berkeley Square and Figure 1.c shows the corresponding section rating, which is based on the point data that appears in Figure 1.c.

As Figures 1.c and 1.d show, the RoadBotics by Michelin assessment allows for detailed granularity in the survey, pinpointing the exact locations for repair within a carriageway section that has an average rating of good quality (1.66). The UKPMS DVI rating for the section of 104.48 (which equals a RoadBotics by Michelin rating of 5) overemphasizes this localised distress for the total section rating.





Examples 2 and 3 show a similar pattern where the RoadBotics by Michelin point data reveals how localized distresses have an outsized impact on determining the section UKPMS DVI condition rating.









Example 2: Bryanston Place

UKPMS DVI section score: 66.47 (*RoadBotics by Michelin rating* = 4)

RoadBotics by Michelin section score: 1.66 (RoadBotics by Michelin rating = 2)

Figure 2.a and 2.b , show that the carriageway has had some maintenance/utility patching, but the structure of roadway is far from failing. While the section may have some RoadBotics by Michelin point data scores of 3 intermittently throughout the section, the section score of 1.66 is more representative than the UKPMS failure grade.

Example 3: Trevor Square

UKPMS DVI score: 49.32 (RoadBotics by Michelin rating = 3)

RoadBotics by Michelin score: 1.19 (RoadBotics by Michelin Rating = 1)

In Figure 3.a, there is maintenance/utility patching visible. These cuts are sealed and do not damage the surrounding carriageway surface. Although the carriageway surface is in mostly good condition, the patching found in the point data resulting in the RoadBotics by Michelin section data score of 2. In Figure 3.b, we see a point data on this same carriageway section that shows the surface is undamaged, thus resulting in a RoadBotics by Michelin point data rating of 1.









These image examples of the point data show the complexity of the carriageway surface on this section of Trevor Square. As such, when averaging *all* the point data captured for every 3-metres of this section to calculate the overall section rating, it results in 1.19. The UKPMS DVI conversion would calculate this section to be rated a 3. However, this example shows again that by having the comprehensive point data ratings, the resulting RoadBotics by Michelin section ratings provide a more representative depiction of the actual condition of the carriageway along this particular section.

Conclusion

Through the effort to conduct a comparative study between RoadBotics by Michelin and UKPMS ratings, the following key results emerge:

- The comparative analysis between the RoadBotics by Michelin and UKPMS DVI ratings data shows high levels of agreement (94.5%) for carriageway surface condition that is of good quality (UKPMS DVI ratings of 0-29.99 and RoadBotics by Michelin ratings of 1-2). In this way, the RoadBotics by Michelin process and UKPMS DVI process overwhelmingly align.
- In the sections where there was disagreement between RoadBotics by Michelin and UKPMS DVI section ratings, evidence shows that the method that RoadBotics by Michelin uses to generate its section data (averaging all of the 3-metre point data along the given section) prohibits the possibility for a localised distress to impact the overall rating of a given section. The UKPMS DVI data would suggest that localized, individual distresses along a given section have an outsized impact on the overall UKPMS DVI section rating.
- Because RoadBotics by Michelin includes both the point data and section data layers in its assessments, managers and inspectors of carriageways possess both granular and macros views. By possessing the point data for each section, managers and inspectors have access to the 'DNA' that results in the overall condition of any carriageway section.
- The image data provided in the RoadBotics by Michelin assessments is highly valuable. In part it gives the manager of that asset an on-the-ground view of their entire carriageway. This view enables total asset transparency and gives the ability to 'go back' to review the carriageway's surface on-demand.
- It should be noted that RoadBotics by Michelin' only takes into account carriageways, unlike UKPMS DVI, which assesses carriageways and footpaths.









 The UKPMS DVI method was developed specifically to help boroughs systematise the incredibly demanding and complicated challenge of managing carriageway and footpath assets. With the ubiquity of increasingly cheap but powerful smartphones to capture imagery and recent advances in machine learning automation, new tools from companies such as RoadBotics by Michelin represent the next phase in asset management.



Empowering cities to assess roads objectively using artificial intelligence

