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Evaluating the quality of inter-urban cycleways

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ABSTRACT

This paper presents the results of research into the development of a decision support tool for use in the route selection stage of inter-urban cycle routes. The study initially focuses upon designing routes for commuter and/or leisure purposes and the differences in the routes required for each user type. The evaluation tool developed was trialled through application to different candidate route options on the Dublin to Mullingar section of the National Cycle Network. A desk study was carried out to develop a list of key design considerations, which was used to inform an initial criteria matrix for the decision support tool. This tool was tested on two candidate route options between Dublin and Mullingar.

A survey of experts in the fields of planning, design and cycling promotion was undertaken to identify the relative criteria weightings and tolerance thresholds for each type of cycle route. The results were then integrated into the criteria matrix framework. The candidate route options were reclassified using the new matrix.

The results of this paper show that safety is the highest ranked concern when designing a cycle route for either commuters or leisure cyclists. The requirements for each differ thereafter however, resulting in a different order of importance for the criteria headings.

1. Introduction and background

Globally, there is a drive to try and reduce the level of carbon emissions with the promotion of sustainable modes of transport. These developments have seen increased attention paid to travel mode alternatives to the private car; with public transport, walking and cycling receiving improved focus. In recent years the Irish Government has outlined its commitment to the promotion of sustainable transport modes such as cycling. In 2009, the Department of Transport (DoT) published Ireland's first 'National Cycle Policy Framework' (NCPF) (DoT, 2009a). In the same year the DoT also published a document that outlines the national commitment to 'Smarter travel' (DoT, 2009b). The NCPF document outlines several policy positions on the provision of cycling in Ireland and goals for achieving an increase in the use of this mode (DoT, 2009a). Responses to the public consultation for the 'Smarter travel' document found that there was a need for investment in safe cycleways, secure bicycle parking and bicycle rental schemes. It was felt that such investments would support cycling. As well as these responses, support was expressed for encouraging cycling to school, provided children could do so safely.

In 2008, the DoT launched a public consultation called '2020 Vision' (DoT, 2008). The results of this consultation process were then taken on board in forming the policy for achieving more sustainable travel by 2020. This consultation identified the need to support "healthy" modes of travel, and the support of cycling policies was identified as one way in which this can be achieved. The '2020 Vision' consultation document reports that the benefit/cost ratio for a cycleway is 20:1 (DoT, 2008). The document acknowledges the benefits of developing the National Cycle Network (NCN) as a network which is a "well-signed cycle network with good connections between urban areas on traffic-free paths, quiet lanes, and traffic-calmed roads". There is also encouragement for the development of school travel plans which incorporate cycling. Previous research on the NCN have shown the economic, tourism and health benefits of investing in these cycleways (Deenihan and Caulfield, 2015, 2014; Deenihan et al., 2013).

The Irish government has proposed the development of a National Cycle Network. It was stipulated that the routes designed within the network should allow people to travel between "urban centres" around the country (NRA, 2011). With the requirements of "access for all" on the routes and that the routes would be attractive to those embarking on both long and short distances. It was decided that a subsequent action would be to select a "major route corridor" such as the Dublin to Galway leg, or the route for a subsection of this leg (NRA, 2011).

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The provision of facilities for cyclists must take into account many aspects regarding what it is that a cyclist requires in order for them to be willing to use the facilities, or to be attracted to cycling in the first place. van der Waerden et al. (2005) found, in a stated preference survey on the provision of facilities for pedestrians and cyclists, that, for the most part, cyclists prefer "smooth pavement, lighting from the top, a small slope", the presence of exits from buildings, and "the absence of pedestrians", while pedestrians similarly prefer there to be no cyclists. As such, it is concluded that shared-use facilities are not preferable and where applicable, the facilities for each user should be separated. However, Tolley (2003) suggested that rural cycleways could afford to be shared use between cyclists and pedestrians, as there was likely to be fewer pedestrian users. Vehicular traffic is highlighted by the author as the greatest danger to the cyclists outside of urban areas. A survey and subsequent analysis of data in Calgary, Canada, found that cyclists considered cycling on a residential road 1.9 times as onerous as cycling on a path in a park (Abraham et al., 2002).

Parkin et al. (2007) found that the presence of special facilities, such as a dedicated bicycle lane, at junctions did not greatly improve the sense of risk associated with cycling. They found that facilities on "trafficked routes contribute only a little to moderation of perceived risk", but that making facilities that are off road, or "adjacent to the road" would be a significant factor in improving perceptions regarding cycling risks. Cho et al. (2009) revealed that there is an increased perception of risk in areas in which the density is low, and areas which are "single-family residential neighbourhoods". However, the authors ultimately could conclude that where there was an "actual crash risk", there would be a corresponding increase in the perception of the risk of crashing. Conversely, where there was a heightened sense of "perceived crash risk", and a reduction in the "actual crash risk". It is also suggested that implementing both marketing and "physical projects", targeted at suburban dwellers, will aid in encouraging them to cycle and walk more.

Sener et al. (2010) found that cyclists indicated that they would rather a "general purpose lane" as this avoids them being restricted to the facilities provided. However the authors found that people stated no clear preference for 3.75 feet or 6.25 feet lanes. The results also showed that female cyclists will seek to avoid steep hills on their commute, but they prefer moderate hills to flat routes for leisure routes. Men are shown to prefer moderate hills to steep hills and flat routes on their commute, but look for steep hills on leisure routes. The results also show that experienced cyclists indicate a preference for roads with "moderate" versus "low" speed limits for motor vehicles. The authors assume that travel time considerations need only be taken into account for commute trips. The results show that respondents would rather shorter journey times for their commutes.

Correspondingly, a comparison of surveys previously conducted showed that; where there were more recreational trips in a location (Chicago in this case) the average trip length was longer (Madera and Smith, 2009). The surveys compared had been carried out in Philadelphia, Chicago and Winston-Salem. In Chicago, the median trip length was found to be 60 min, compared with 45 min in Philadelphia. However, in Philadelphia recreational trips were also found to be longer than the average trip length at 76 min. Whereas the average duration of commuter trips in each location was much shorter; at 29 min in Philadelphia and a median of 25 min in Chicago (Madera and Smith, 2009). Both the Philadelphia and Winston-Salem surveys ranked "bicycle lanes" as their most preferred facility, and picturesque/greenway routes as their second most preferred facility. The authors conclude that the similarities between the expressed preferences of respondents in the two locations imply that "the differences in the expressed needs and desires of bicyclists and non-bicyclists are not very great". However, the comparison also revealed that there was very little convergence of opinion across the three locations with regard to the motivations of people for cycling. For the purposes of this study, two types of cyclist were examined; tourists/leisure cyclists and commuter cyclists.

In Ireland, the National Cycle Manual (NTA, 2011) has introduced a quality of service (QoS) scale for cycling, though the manual is mainly targeted at urban design. The QoS scale ranges from a "Level A+" rating, which corresponds to a route satisfying the criteria to the highest standards, down to a "Level D" rating. The rule regarding how a route qualifies for a particular grade is as follows: "To achieve any particular QoS, at least 4 of the 5 criteria must be achieved. The fifth may be no more than one level lower, e.g., a route meeting four criteria at Level B and one at Level C has an overall QoS Level B." The five criteria under which the routes quality of service is judged are:

- "Pavement Condition Index (PCI)".
- "Number of adjacent cyclists".
- "Number of conflicts per 100 m".
- "Journey time delay (% of total travel time)" this takes into account the amount of time lost at junctions on the route. A speed of 15 km/h. is assumed.
- "HGV influence (% of total traffic volume)".

The QoS is clearly laid out in table format with defined thresholds for each "level" under each of the criteria.

As much literature already exists regarding cyclists' preferences, this project will take the existing knowledge and seek to expand on it by integrating it into a decision-support tool for the route selection stage of cycle route design and for the evaluation of existing facilities. This will be complemented by surveying experts in related fields, in order to refine the tool into a usable implement for practitioners.

This paper contributes to the body of knowledge by developing a decision-support tool, which will allow for the research to be structured into a format which can be implemented by planners and designers, as well as tourism officials and marketers. For ease of implementation, the tool will take the form of an appraisal matrix, similar to the level of service tables (TCRP, 1999; NTA, 2011) as this is a format with which professionals will already be familiar. The matrix will provide a heuristic approach for use in the route selection stages of inter-urban cycle routes in Ireland, where, as the literature review has shown, there is a lack of dedicated national policy documents or guidelines. Furthermore, the matrix will contribute to closing the gap identified by Fáilte Ireland (2006) for the development of holidays in Ireland, which include cycling, by giving a structured approach to the rating of cycle routes for the purposes of tourist information and marketing.

The following section details the methodologies used in this study. Section 3 of the paper details the results from the expert survey conducted to determine the weights for the different cycleway attributes. The fourth section details the evaluation matrix used to evaluate each of the route options, the results of which are presented in Section 5. The final section of the paper presents the main conclusions of the study.

2. Methodology

In order to define the design standards for this inter-urban cycle route a number of national and international design standards were consulted (DTO, 1998; CROW, 2007; DoT, 2009a; TFL, 2005; NTA, 2011; Sustrans, 2009). The accompanying lists were recurring themes from a selection of literature about cycling and cycle routes (Fáilte Ireland, 2006; Sustrans, 2009). Listed below are the five "main requirements", of a successful cycle network, used in the