BUS TRANSIT SERVICE QUALITY MONITORING IN UK: A METHODOLOGICAL FRAMEWORK

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ABSTRACT
Transport stakeholders face many challenges in providing transit services that satisfy customer demands. Three main obstacles have been identified both in the transport literature and governmental publications including traveller behavioural intentions, service quality, and the quality monitoring process. Recently, the focus of public transit service provision has been shifted towards improving the quality monitoring process, prioritising development schemes, and reducing car dependency. In order to address these demands, different approaches have been proposed using indicator-based evaluations of bus service quality. Due to the wide range of indicators associated with this exercise, there is a need to define a concise set of bus service quality indicators that can be readily implemented by operators and managers, moreover, to constitute an integrated framework that involves all stakeholders’ perceptions and demands under one roof.

This research aims to develop a methodological framework for monitoring bus service quality within the UK context. This framework addresses both traditional quality parameters (subjective indicators) and system performance parameters (objective indicators) in a combined single output measurement model. The service quality loop has been investigated and gaps in quality schemes have been derived. In addition, a short list of service quality indicators has been derived from different expert perspectives including those of academics, operators, users, policy makers and local authorities. A key outcome of this research is the development of an integrated evaluation framework for monitoring bus service quality.

**Keywords:** bus transit quality, quality loop, bus quality indicators

1. INTRODUCTION
Improving and monitoring the quality of bus transit service holds a great priority for all stakeholders associated with the transport context [1]. The international literature on public transport – specifically on bus transit service – revealed the great value of improving the quality of the service and offered numerous applications [2,3]. The transport literature review emphasised the essential need to identify concise methods of measuring and evaluating bus transit quality based on different perspectives not only to overcome the multidimensionality of bus transit stakeholders, but also to identify the relative impacts of the service quality over all bus transit service stakeholders.
This paper, as a part of ongoing research, represents the development of methodological framework for monitoring bus transit service quality in the UK context. The paper derives its structure from two main sections. The first part investigates the concept of bus service quality linked to users’ behavioural intention, and the methods of using bus quality indicators based on the literature review. The second part presents methods to verify the structure of the proposed quality monitoring framework. The framework comprises three combined models in the context of integrated measurement of bus service quality.

2. BUS SERVICE QUALITY MANAGEMENT

The term service quality in the transport literature context has long been investigated and has been defined in many forms. It has been defined as; the quality criteria and the accurate measures for which the providers are responsible to provide [4], the measurement process of how the service quality level delivered matches the customer satisfaction [5,6,7], the measurements that reflect users’ perceptions towards the service [3], the pre-defined standard of service attributes relative to the actual service quality [8,9], the measuring of customer expectation on a constant service standard base [10]. These definitions have opened the door for further in-depth analysis of the quality process in the context of bus transit service.

2.1. QUALITY LOOP

In order to understand and monitor bus transit service quality, the process of quality monitoring must be broken down into manageable items and the correlation between these items must be investigated [10]. Based on that fact, CEN (2002) has developed and proposed the service quality loop which explains the process of quality management. The quality loop has identified three basic aspects which influence the overall quality process including; quality, satisfaction, and management [4,7]. Furthermore, the quality loop has introduced in-depth analysis for these three aspects. This analysis has identified four different types of quality aspects, two levels of satisfaction, and different proposals for quality management processes [5,7].

However, CEN (2002) – and further [5,7] – has identified the different correlations between the quality loop aspects. This correlation analysis has revealed sixteen different correlations. Firstly, CEN (2002) identified the positive correlations between the individual items of the service quality, on one hand, and the correlations between the overall service quality and these items – desired, targeted, delivered, and perceived – quality on the other hand. Nathanail (2008) identified the positive one direction correlation between the overall service quality – desired, perceived, targeted, and delivered – and the overall user satisfaction. While, Lai and Chen (2010) broke down this conclusion into more detailed analysis in which they have identified that, service quality has a positive correlation with perceived quality, and overall quality with perceived quality have a positive correlation with user level of satisfaction. Users’ satisfaction has a major impact on both level of involvement and user loyalty (behavioural intentions). However, the entire correlation analysis for bus transit quality loop is illustrated in Figure 1.

![Service Quality Loop Correlation Analysis](image-url)
2.2. QUALITY GAPS

The transport literature has identified several gaps associated with bus service quality loop. These gaps include the issues of identifying the level of satisfaction for potential and current users, the difference between operational and physical quality measurements, and the integration between strategic policy direction and targeted quality [1,8,11]. Several studies have been generated in attempts to overcome and address these issues [1,2,6,7,11]. Eboli and Mazzulla [8] proposed a methodology to evaluate the service quality through the division of subjective and objective measurements. Iseki and Taylor [2] identified the effect of an individual service attribute on the overall level of satisfaction. Lai and Chen [5] explored the relation between passenger intentions and the different service attributes.

Out of all these studies five individual gaps – not previously combined in one study – have been identified within the service quality context including; the lack of physical and operational measurements [8,10], the lack of individual attribute impact on the overall level of satisfaction [2], the lack of policy integration within the targeted quality [9,11], the dilemma of perceived and desired level of satisfaction for both current and potential users [1], and the lack of integration between transport dynamic and detailed complexity [12]. The quality process gaps are illustrated in Figure 2. Although these gaps have been identified from previous studies in bus transit service quality context, each study has investigated only individual gaps without taking into consideration the effect of other gaps on the overall quality process. Until now there are no studies in which these gaps are jointly combined in a single output framework.

3. BUS SERVICE QUALITY INDICATORS

A review of the literature explored and investigated the methods of measuring bus transit service quality. This highlighted the dominance of quantitative over qualitative methods especially in using indicator based evaluation for bus transit service quality monitoring process [1,3,4,6,7,9,10,11,13,22]. Service quality indicators have long been recognised in both mobility and travel behaviour research as powerful tool for monitoring bus service quality [2]. The transport literature has concluded that SQI (Service Quality Indicators) based applications are the most comprehensive methods for measuring the ability of a bus transit service to deliver the stated objectives [1,9,14].

During the last two decades there have been numerous studies in which bus transit quality indicators were investigated. Despite the previous efforts of [15,16,17,18,19] the TRB handbook for measuring customer satisfaction and service quality [10] has notably created a solid base for both academics and operators for further investigations. It has also introduced a wealthy detailed process for measuring customer satisfaction and transit service quality. These efforts were followed by Hensher and Prioni [9] in identifying a service quality index. Based on these efforts, the European Committee of Standardisation [4] developed a comprehensive methodology for measuring service quality. This methodology included an analysis of different approaches and illustrated a list of service quality indicators. All these previous efforts have opened the door for further investigations of bus service quality indicators to understand the link between quality indicators and users satisfactions [1,5,7,8,10,11,12].

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1 Detailed bus transit complexity refers to the multi-input factors which are used for service assessment, while dynamic complexity refers to the interaction between these factors.
Two main types of bus transit service quality indicators have been identified including; operational (subjective) and physical (objective) indicators [8]. Operational indicators are aiming to measure the performance aspects of service utilities and evaluate the operational and managerial performance of the service attributes. Operational indicators are usually linked with users’ satisfactions towards bus service attributes [1,8,12]. Physical indicators aim to measure and evaluate the design aspects of the service utilities. These types of indicators are used by operators and local authorities in order to evaluate the service attributes from a design perspective [8,12,19]. Physical indicators have been introduced in the literature in the form of transit service assessment tools for benchmarking, standardisation, and certification.

However, the literature also identifies a wide range of indicators associated with this exercise [20]. The selection of concise sets of quality indicators is a challengeable task for two main reasons: the wide range of indicators available in the literature, and the variation in definition associated with different indicator sets. Litman [21] concluded that a single perception based evaluation always leads to biased results, and the trade off between consistency and comprehensiveness in selecting quality indicators should consider all stakeholders associated with bus transit. Table 1 shows the wide range of quality indicators associated with the quality assessment exercise.

### Table 1. The wide range of quality indicators available in the literature

<table>
<thead>
<tr>
<th>Author</th>
<th>Source</th>
<th>No. Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eboli and Mazzulla [8]</td>
<td>A methodology for evaluating transit service quality based on subjective and objective measures from the passenger’s point of view</td>
<td>13</td>
</tr>
<tr>
<td>Dell’Olio et al. [6]</td>
<td>Modelling user perception of bus transit quality</td>
<td>6</td>
</tr>
<tr>
<td>Dell’Olio et al. [1]</td>
<td>The quality of service desired by public transport</td>
<td>10</td>
</tr>
<tr>
<td>Lia and Chin [5]</td>
<td>Behavioural intentions of public transit passengers - The roles of service quality, perceived value, satisfaction and involvement</td>
<td>18</td>
</tr>
<tr>
<td>Ceder [23]</td>
<td>Public Transit Planning and Operation Theory, modelling and practice</td>
<td>26</td>
</tr>
<tr>
<td>Hensher [22]</td>
<td>Service quality—developing a service quality index in the provision of commercial bus contracts</td>
<td>13</td>
</tr>
<tr>
<td>(CEN [4]</td>
<td>Transportation – Logistics and services – public passenger transport – service quality definition, targeting and measurement</td>
<td>103</td>
</tr>
<tr>
<td>TRB [10]</td>
<td>Transportation Research Board; a handbook for measuring customer satisfaction and service quality.</td>
<td>48</td>
</tr>
<tr>
<td>DfT Annual survey</td>
<td>User satisfaction annual survey (Department for transport, London, UK)</td>
<td>11</td>
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</table>

### 4. METHODOLOGY

There are limitations associated with the process of monitoring bus service quality. These limitations are addressed in three main stages of the quality monitoring process including; indicator selection, quality gaps, and measurement methods. In each stage, these limitations represent the detailed complexity of quality monitoring process. The combination of these detailed complexities creates the dynamic complexity between all stages of the service quality monitoring process.

In developing a bus quality monitoring framework, the proposed methodology is defined through three main aspects including: the required fields of investigation (derived gaps), the proposed measurement methods, and the expected outcomes as illustrated in Table 2. A three stage methodology is developed to address the defined limitations of the current quality monitoring applications. These stages include; indicator selection, comprehensive quality scheme development, and operational measurement methods.


Table 2, Methodology overview

<table>
<thead>
<tr>
<th>Derived gaps</th>
<th>Proposed methods</th>
<th>Expected outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator selection</td>
<td>Focus group discussions including; (Current and potential users, different segment areas, different socio-economic profiles).</td>
<td>Define the desired quality indicators for current and potential users.</td>
</tr>
<tr>
<td>Quality Scheme</td>
<td>Utilises the factors arising from the defined quality gaps.</td>
<td>Define the required quality aspects for both current and potential users in relation to the service operation level.</td>
</tr>
<tr>
<td>Measurement methods</td>
<td>Combining both subjective and objective aspects for each indicator.</td>
<td>Investigate the impact of subjective measures on user satisfaction when combined with the objective measures.</td>
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</tbody>
</table>

Firstly, a method of indicator selection is proposed by combining both qualitative and quantitative approaches in defining the desired quality indicators by involving all stakeholders in the selection process. Secondly, a comprehensive quality scheme is structured by considering both current and potential users demands from the same process. Thirdly, an integrated measurement method is developed by addressing both subjective and objective indicators in a single output method. The overall method aims to identify the impacts of individual indicators on users' level of satisfaction.

4.1. DEVELOPING A FRAMEWORK FOR INDICATOR SELECTION

The proposed framework for indicator selection comprises two main steps which includes both the analysis of bus transit users’ demands and the analysis of transit experts’ perception towards quality indicators. The framework is defined in a hierarchical manner — where both users and experts have equal impacts on the selection process (Figure 3). Analysis of user demand comprises of focus group discussions for both current and potential users, while the expert panel analysis includes individual indicator analysis by academics, operators, policy makers, and local authorities.

The initial list of SQI derived from the literature is to be investigated using both qualitative and quantitative methods in order to; define the desired quality indicators by both current and potential users, assign selection priority for each indicator based on different perspectives, define the variation between different groups of experts, and derive concise sets of SQI that could be readily implemented in the UK context. Detailed descriptions of the indicators’ selection process are illustrated in Figure 3.
4.2. DEVELOPING A COMPREHENSIVE QUALITY SCHEME
In developing a comprehensive quality scheme, the paper utilises the factors arising from the defined quality gaps based on the literature review. The scheme, firstly, defines the required quality aspects for both current and potential users in relation to the service operation level. Secondly, it illustrates the required measurements for both subjective and objective aspects of the service. Thirdly, it investigates the impact of subjective measures on user satisfaction when combined with the objective measures. Lastly, it defines the development priorities based on impact analysis for both current and potential users on one hand, and the performance level on the other hand, as illustrated in Figure 4.

4.3. DEVELOPING A FRAMEWORK FOR MEASUREMENT METHODS
In developing a measurement method for bus service quality, the paper combines both subjective and objective aspects for each indicator. Three main measurements are proposed in the framework including the measurement of level of satisfaction, level of importance, and performance level. The first two are defined by both current and potential users in order to investigate both perceptions and attitudes towards individual indicators [1,2,4]. The performance level of each indicator is measured by comparing the actual operational status with the defined service standard [14].

Both subjective and objective measures have equal impacts on the quality monitoring process in order to ensure consistency. The combination of both subjective and objective measures allows the investigation of the impact of performance level for each indicator on the level of user satisfaction. In addition, it investigates the critical gaps of the system performance and assigns priorities for any development schemes. The proposed measurement framework is illustrated in Figure 5.
5. DEVELOPING AN INTEGRATED BUS QUALITY MONITORING FRAMEWORK
An integrated bus quality monitoring framework is developed by integrating the individual models. The quality monitoring framework constitutes all various factors that are derived to overcome the limitation of the current quality monitoring exercise as illustrated in Figure 6.

The apex of the framework includes the three main aspects – indicator selection, quality measurement, and targeted outcomes - of quality monitoring process. The second layer constitutes the components and features required to overcome quality gaps which have been derived from the literature review. The third layer comprises the expected outcomes of each stage.

Two main linkages have been associated with the framework. Firstly, the vertical linkage of the main aspect represents a method for overcoming the detailed complexity of quality monitoring, while the horizontal linkage between the layers represents a clear method of overcoming the dynamic complexity of the quality monitoring process. The framework defines neutral weight (impact) for all users (current / potential) and assigns equal impact for all measurements (subjective / objective) before applications.

6. CONCLUSION
The paper has explored the bus quality concept with consideration of three main aspects including; the linkage between current and potential users’ desired quality, the linkage between subjective and objective measurements, and the interaction of all stakeholders in the quality monitoring process. Three main aspects of the quality monitoring process – indicator selection, quality scheme, and measurement methods – are examined through the literature in order to develop an integrated quality monitoring framework.

The proposed framework has successfully addressed the defined quality gaps. Firstly, it introduced a selection process from a multi-based perspective for service quality indicators, where all stakeholders are involved in indicator selection in equal portions. Secondly, it investigated the required quality aspects for both current and potential users, where the required data for comprehensive quality monitoring schemes are derived and illustrated. Thirdly, it defined the required measurements for both subjective and objective quality aspects in order to define the impact of performance level over user satisfaction on consistent basis.
Indicator selection

Expert Panel Analysis (Quantitative)
Users' Desired Quality (Qualitative)

Academic
Operators
Policy Makers
Local Authorities
Users

Hierarchy of Importance
Desired Quality

Stage One

Defined concise sets of SQI

Stage Two

Performance evaluation
Importance / satisfaction measurements

Current Users
Potential Users

Stage Three

Data Integration

Impact of performance level over desired
Impact of performance level over perceived

Linkage between subjective and objective measurements

Prioritised development schemes

Figure 6, Integrated bus quality monitoring framework
The framework has clearly created a transparent overview of the linkages between performance & satisfaction, current & potential users’ desired quality, and subjective & objective measurements in integrated methods. The paper has defined clear strategic direction for all stakeholders in the quality monitoring process and offered potential implementations for both local authorities and operators. Lastly, the proposed framework is to be applied in different case study areas in future research.

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