Loughborough University
Centre for Innovative and Collaborative Construction Engineering

Evaluating The Impacts On Traffic Congestion And Business Investment Following The Introduction Of A Workplace Parking Levy And Associated Transport Improvements

Simon Dale

Nottingham City Council
Loxley House
Station Street
Nottingham
NG2 2NG

Centre for Innovative and Collaborative Construction Engineering
Department of Civil & Building Engineering
Loughborough University
Loughborough
Leicestershire, LE11 3TU

Evaluating The Impacts On Traffic Congestion And Business Investment Following The Introduction Of A Workplace Parking Levy And Associated Transport Improvements

By
Simon Dale

A dissertation thesis submitted in partial fulfilment of the requirements for the award of the degree Doctor of Engineering (EngD), at Loughborough University

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Centre for Innovative and Collaborative Construction Engineering
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Finally, and by no means least, I would like to reserve special thanks to my industrial supervisor at Nottingham City Council, Peter Warren, whose patience and advice have been crucial in steering this research to a successful conclusion.

Simon Dale, 12th March 2017.

ABSTRACT

For over a decade UK legislation has existed which grants powers to English Local Authorities to implement a Workplace Parking Levy (WPL). Despite positive experiences in Australia of utilising area wide parking space levies to pay for public transport improvements, only one UK local authority to date (2017), Nottingham City Council, has chosen to implement a WPL. The Nottingham WPL scheme is intended to act as a transport demand management measure as well as a core funding mechanism for transport improvements including two new tram lines.

Acceptance by the public and the business community is a key barrier to implementing a WPL. The two major criticisms of the Nottingham scheme prior to its implementation were that a WPL would discourage business investment and thus damage the economy while its intended impact on traffic congestion would be minimal. Therefore, a comprehensive evaluation of the Nottingham WPL scheme's performance is essential in order to facilitate transferability of this approach to other UK and European Cities. This thesis contributes to the wider WPL evaluation project by evaluating to what extent the Nottingham WPL has met three key objectives identified for the scheme which address the impact on congestion, transport mode share and inward investment.

This research utilises a theoretical evaluation approach, a 'Theory of Change' approach strengthened by elements of 'Realistic Evaluation'. This approach provides an appropriate framework for evaluating progress towards the three key objectives by identifying a plausible model for change and expected impacts for the Nottingham WPL and the transport improvements which it part funds. This model or 'Theory of Change', is then tested to understand if the scheme is achieving the desired impacts by analysing appropriate indicators to measure and attribute change to causal factors. Methods used to facilitate this research include, benchmarking indicators against similar UK Cities, questionnaire surveys to assess the reasons for mode switch, time series modelling of the impact on congestion and a consideration of the reasoning behind investment and de-investment decisions made by businesses in Nottingham.

It is concluded that while the WPL and its associated transport improvements are resulting in congestion constraint and mode shift away from commuting by car, these impacts are being reduced by the presence of exogenous change notably, economic and population growth, short term disruption to the road network resulting from roadworks associated with the construction of transport improvements and suppressed demand for commuting by car.

Additionally, this research shows that there is a body of evidence which demonstrates that the WPL has not negatively impacted on levels of inward investment and that there is some evidence to date that suggests the improved transport system facilitated by the WPL is attractive to potential business investors.

KEY WORDS

Workplace Parking Levy, Evaluation, Theory of Change, Congestion, Inward Investment

PREFACE

An Engineering Doctorate is a PhD level qualification whereby the research must have a practical industrial application. This thesis is the final output from four years of full time research and is produced in partial fulfilment of the requirements of this qualification.

The EngD programme is funded by the Engineering and Physical Sciences Research Council and delivered by a number Centres for Innovative and Collaborative Construction Engineering located at Universities across England, in the case of this research at Loughborough University School of Civil of Civil and Building Engineering.

As the research is based in industry it requires a sponsoring organisation for whom the research is of direct practical use. Nottingham City Council is the sponsor for this EngD and this thesis partially fulfils the Authority's commitment to evaluate the impact of the Workplace Parking Levy scheme and its associated transport improvements.

A further requirement of the EngD qualification is that the research engineer must publish at least three peer reviewed papers including at least one journal paper. The four papers produced to support this thesis are included in appendices A – D. While this thesis can be read and understood as a standalone document it should be read in conjunction with these papers for the fullest understanding of the research. The thesis refers to these papers throughout.

USED ACRONYMS / ABBREVIATIONS

CICE	Centres for Innovative and Collaborative Construction Engineering
DfT	Department for Transport
DVM	Average Delay per Vehicle Mile
EngD	Engineering Doctorate
EPSRC	Engineering and Physical Sciences Research Council
JTVM	Journey Time per Vehicle Mile
LU	Loughborough University
NCC	Nottingham City Council
ONS	Office for National Statistics
PSL	Parking Space Levy
PT	Public Transport
RE	Realistic Evaluation
TDM	Transport Demand Management
ToC	Theory of Change
WPL	Workplace Parking Levy
WPP	Workplace Parking Place

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PAPERS

The following papers, included in the appendices, have been produced in partial fulfilment of the award requirements of the Engineering Doctorate during the course of the research.

PAPER 1 (SEE APPENDIX A)

Dale, S. J., Frost M.W., Ison S. G. and Warren, P., 2014. Workplace Parking Levies: the answer to funding large scale local transport improvements in the UK? *Research in Transportation Economics,* Vol 48, page 410 to 421

PAPER (SEE APPENDIX B)

Dale, S. J., Frost M.W., Ison S. G. and Warren, P., 2015. Evaluating Transport Demand Management Interventions using Theoretical Evaluation. *Transportation Research Board 94th Annual Meeting Compendium of Papers 2015 DVD.* Washington: Transport Research Board.

PAPER 3 (SEE APPENDIX C)

Dale, S. J., Frost M.W., Ison S. G., Nettleship, K., and Warren, P., 2017. An Evaluation of the Economic and Business Investment Impact of an Integrated Package of Public Transport Improvements funded by a Workplace Parking Levy. *Tranpsort Research Part A: Policy and Practice*, Vol 101, July 2017, PP 149-162

PAPER 4 (SEE APPENDIX D)

Dale, S. J., Frost M.W., Ison S. G., Quddus, M. and Warren, P., 2017. Evaluating the impact of a workplace parking levy on local traffic congestion: The case of Nottingham UK**.** *Transport Research Board 96th Annual Meeting Compendium of Papers 2017 DVD.* Washington: Transportation Research Board.

1 INTRODUCTION

1.1 BACKGROUND TO THE RESEARCH

Transport demand management has been an important policy consideration for urban areas worldwide since traffic congestion and its associated environmental degradation first started to emerge in the mid twentieth century (Ison and Rye 2008). To date, the central dilemma as to how to alleviate their impact, while maintaining accessibility and economic growth remains.

Traditional solutions sought to ‘predict and provide’ for future transport demand by providing extra capacity (supply) by expanding highway capacity or to a lesser extent providing mass transit public transport systems (Goodwin 1999). More recently road pricing mechanisms to limit demand for travel by car have been adopted by a number of cities worldwide, either by road user charging, for example London, Stockholm and Santiago (Button and Vega 2008), or less commonly by placing a levy on parking places at the trip destination, for example Perth, Sydney and Melbourne (Legorreta and Newmark 2015).

Literature surrounding the measures that can be deployed to tackle congestion, for example Ison and Rye (2008), Preston (2008) and Aftabuzzaman (2011) suggests that an integrated package of measures which includes some form of congestion charging could be more effective than individual standalone schemes. In the UK the 1998 Transport White Paper “New Deal for Transport: Better for Everyone” set out, amongst other measures, proposals to allow local authorities to introduce either road user charging or workplace parking levy schemes in the UK, provided the revenue raised was hypothecated for transport improvements. The principle of a Workplace Parking Levy (WPL) is that a charge is levied on occupied private non-domestic off street parking places (DETR 1998a), (DETR 1998b). The UK legislative background to WPL can be found in Dale et al (2013) page 340.

In April 2012 Nottingham City Council introduced a WPL, the first in the UK and indeed, in Europe. The Nottingham WPL has a dual role within Nottingham City Council's Local Transport Plan; firstly to act as a transport demand management measure and secondly to raise hypothecated funds for public transport improvements. The WPL and the transport improvements which it part funds are thus a package of measures intended to complement each other to enhance the transport demand management effect. This approach combines the 'stick' of the WPL charge with the 'carrot' of an improved and expanded public transport system.

As the Nottingham WPL is the first scheme of its type in the UK and Europe its effectiveness with respect to achieving the scheme's stated objectives is untested in this geographical and cultural context. While the Australian Parking Space Levy (PSL) schemes are similar to the Nottingham WPL in that they seek to reduce demand for travel by private car by imposing a charge for parking and then use this revenue to pay for transport improvements, the outputs of evaluations carried out on the impact of these schemes cannot be relied upon to predict the impacts of the Nottingham WPL for the following reasons:

1. The design of the Nottingham scheme is different as the level of charge is lower and there are more categories of space that are exempt from the charge.
2. The evaluations carried out on the Australian PSL schemes do not explicitly consider the impact of exogenous contextual change on the indicators used to measure the schemes' impacts, nor do they contain research to provide causal attribution of this change to the PSL scheme.

3. The geographic and cultural contexts of the schemes in Australia are different.

This thesis addresses this knowledge gap and reports on the effectiveness of the Nottingham WPL in achieving the desired impact on traffic congestion and the economy. The findings and conclusions from this thesis will, therefore, be important in informing the business case for future similar schemes in the UK and Europe as well as in addressing concerns amongst businesses and the public regarding a WPL's ability to constrain traffic congestion and deliver economic benefits.

This research has been funded through the Engineering Doctorate (EngD) Scheme funded by the Engineering and Physical Science Research Council. An EngD is an alternative to a PhD for students who want a more industry focused qualification. The research presented in this EngD thesis contributes to the wider evaluation of the Nottingham WPL and its associated transport improvement schemes by focusing on the impacts on traffic congestion and inward investment. Constraining traffic congestion and facilitating inward investment via an improved public transport system have been identified by Nottingham City Council as key objectives for the WPL scheme.

An EngD is based in industry and thus requires an industrial sponsor. The sponsor for this research is Nottingham City Council.

1.2 SPONSORING ORGANISATIONS

1.2.1 NOTTINGHAM CITY COUNCIL

Nottingham City Council is the unitary local authority for the City of Nottingham. It was granted its unitary status in 1998 under the Local Government Review.

The City Council is a democratic organisation and there are a number of decision making tiers:

The Executive Board: this consists of up to ten councilors and includes the Leader of the Council. It is responsible for major decisions about service delivery.

Councilor's "non-executive" committees: these are responsible for keeping an overview of Council business and scrutinising areas of particular interest or concern, holding the Executive Board to account and assisting in the development and review of Council policy.

Full Council: This comprises all 55 Councilors elected to the City Council. One of its functions is to agree the major policies, the "Policy Framework", which governs the way services are provided and provides a direction for the City. Beneath this political decision making structure the Council has a Chief Executive who is the head of the professional organisation answerable to the politicians.

Nottingham City Council has been under Labour Party control since 1991 and there is no indication that this will change in the next few electoral cycles. It has won many awards, including Transport Authority of the Year for its forward thinking transport policies.

Simon Dale, the Research Engineer for this Engineering Doctorate, is a Principal Officer in the Highway Metrics team at Nottingham City Council which is responsible for data collection and analysis across the Authority. Its primary role is to monitor outcomes of the Local Transport Plan (LTP) and major transport schemes, including Nottingham Express Transit (NET) Phase 2 and the WPL. The team collects data for a number of key LTP indicators utilising a pool of survey staff, including data on traffic congestion, transport mode share and bus satisfaction. It also collects data such as traffic counts for scheme appraisal and evaluation.

1.2.2 CENTRE FOR INNOVATIVE AND COLLABORATIVE CONSTRUCTION ENGINEERING

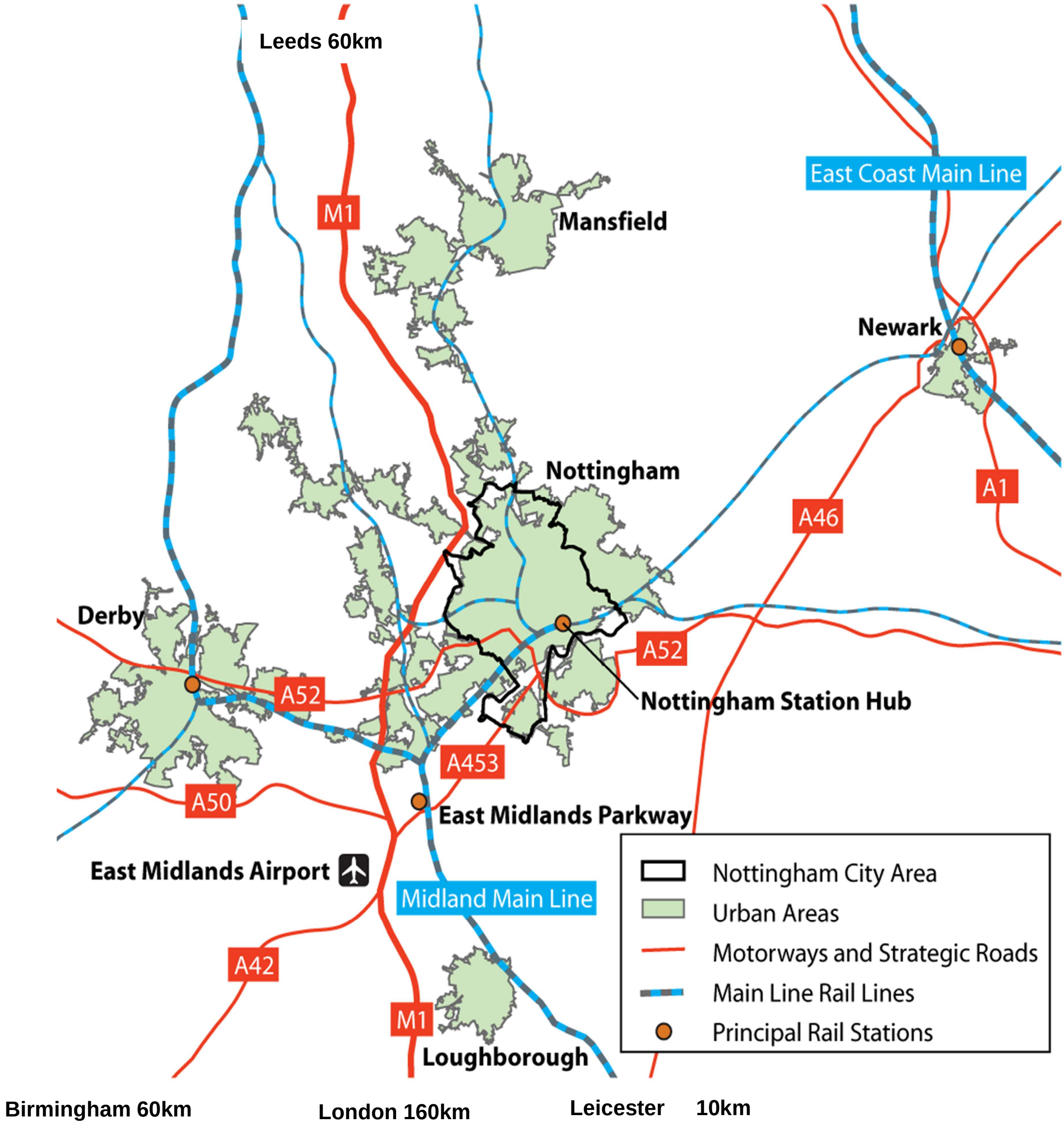
The Centre for Innovative and Collaborative Construction Engineering (CICE) was established in April 1999 at Loughborough University, following an expansion of the Engineering and Physical Sciences Research Council's EngD scheme. It has supported over 130 innovative EngD research projects in partnership with more than 75 different sponsoring companies throughout the built environment sector, including transport and infrastructure.

This research is delivered under the EngD programme.

1.3 CONTEXT OF THE RESEARCH

Nottingham is one of 8 English core cities, situated 180km north of London it is the largest conurbation in the East Midlands with a population of 670,000. Figure 1.1 shows its location and principal transport links. With a smaller population of 313,000, the Nottingham City Council administrative area covers the central area of the city only with the urban suburbs of Beeston, West Bridgford, Hucknall, Gedling and Arnold lying in the surrounding boroughs in the County.

Nottingham has long experienced peak period traffic congestion which it is estimated costs the economy £160 million per year in the AM peak period (NCC 2011). A population growth of around 9% over a 15 year period from 2011 is also expected (NCC 2011). It is thus not surprising that tackling congestion by promoting sustainable transport choices is at the heart of the City Council's transport policy. A central pillar of this approach has been the introduction of a WPL with the dual purpose of acting as a transport demand management tool in its own right, as well as funding large scale public transport improvements.



Source: Nottingham City Council.

Figure 1.1 Nottingham conurbation and its major transport links

The WPL and the transport improvements it part funds are referred to as the WPL Package and it comprises the following:

- WPL – introduced April 2012.

- NET Phase 2 – completed in August 2015, this added two new tramlines from the City Centre to Toton and Clifton, linking to the existing lines to Hucknall and Phoenix Park.
- Ongoing quality enhancements to the Linkbus Services.
- The refurbishment of Nottingham Railway Station (completed June 2014).
- Ongoing WPL funded support to business in the form of travel planning, parking management and workplace cycling infrastructure.

In addition to the WPL funded schemes listed above, the A453 dualling and the Ring Road Major improvement schemes were also completed concurrently in 2015. A total of £750 million has been invested in transport in Nottingham through the WPL Package during the period studied in this thesis.

The Nottingham WPL scheme uses the provisions of the UK Transport Act 2000 and the subsequent Workplace Parking Levy (England) Regulations 2009 to levy a charge on occupied private non-domestic off street parking spaces, i.e. Workplace Parking Places (WPP). A WPP is defined as follows within the local enabling legislation, The City of Nottingham Workplace Parking Levy Order 2008:

a workplace parking place is provided at any premises within the licensing area if a parking place provided at the premises is occupied by a motor vehicle used.—

(a) by a relevant person;

(b) by an employee, agent, supplier or business visitor of a relevant person;

(c) by a pupil or student attending a course of education or training provided by a relevant person

(d) where a body whose affairs are controlled by its members is a relevant person, by a member of the body engaged in the carrying on of any business of the body,

for attending a place at which the relevant person carries on business at or in the vicinity of the premises.

In practice a relevant person is usually an employer who is providing the WPP and d) is a catch all that rarely applies, but is intended to refer to organisations which operate as clubs or societies and thus do not directly have employees.

The scheme operates by requiring employers to apply for a license for each of their premises (where WPP are provided) which states the number of WPP they wish to use and then pay the appropriate levy. The following are exempt from this charge or receive a 100% discount:

- Premises from which frontline health services are provided by or on behalf of the NHS.
- Premises occupied by the emergency services.
- Places occupied by occasional business visitors, customers, disabled blue badge holders and delivery vehicles.
- Employers with 10 or fewer WPP.

The WPL covers only the Nottingham City Council administrative area (the licensing area) and the charge per WPP was £379 in the 2016/17 financial year.

The WPL charge rose above the rate of inflation until March 2015; after which it rose at the rate of inflation. The ‘escalator’ was intended to coincide with the completion of the public transport improvements part funded by the scheme. WPP licensing was introduced in October 2011 and charging commenced six months later on the 1st April 2012.

Despite the WPL being a legally binding levy, its overall success will be dependent on its ability to gain acceptance by the public and the business community, as well as co-existing with, and contributing to, other important policy objectives. Being able to demonstrate success with respect to congestion constraint and economic benefits, while showing that the additional cost of the WPL has had no negative economic impact, is critical to this acceptability in the long term. It is thus important to understand how businesses in Nottingham have reacted to the WPL and its accompanying public transport improvements as this will inform the Business Cases for future schemes. The costs imposed on employers by the WPL are a relatively small percentage of turnover, making it unlikely that this will be a major factor in deciding business location. Research that confirms or refutes this hypothesis will be an important addition to knowledge and could assist in the transferability of the approach to other cities.

It is equally important to evaluate whether the WPL package is successful in achieving its longer term objectives of congestion constraint and facilitating economic growth. Traffic modeling carried out prior to the introduction of the WPL suggested that the standalone impact on congestion of the WPL would be modest and that larger benefits would only be realised once the whole package had been implemented (NCC 2008).

To date Nottingham is the only UK city to introduce a WPL and it was recognised by the City Council in the 2008 Business Case for the Nottingham WPL (NCC 2008) that tracking the scheme's performance would play an important part in its transferability to other cities. In order to assist in delivering this commitment NCC identified the following key objectives for the WPL scheme. These objectives are based on the 2008 Business Case (NCC 2008) and output from the "Examination in Public" (Dodd 2007).

> WPL Objective 1 (WPL_O1): Constrain congestion in the AM and PM peak periods.
>
> WPL Objective 2: (WPL_O2): Increase uptake of workplace travel plans and responsible parking management strategies.
>
> WPL Objective 3 (WPL_O3): Contribute to the implementation of major transport schemes and the Local Transport Plan.

WPL Objective 4 (WPL_O4): Encourage sustainable travel and mode choice.

WPL Objective 5 (WPL_O5): Enhance the attractiveness of Nottingham as a location for business investment.

WPL Objective (WPL_O6): No significant displaced parking problems.

Of these objectives, WPL_O1, WPL_O4 and WPL_O5 relate to longer term impacts and are common to all elements of the WPL Package and the WPL Package as a whole and it is these that this research is concerned with. This point is important as it means that this research is essentially an evaluation of the impact of the WPL Package as the objectives are the same and the impacts are observable across the conurbation. The remaining 3 objectives would, facilitate the progress towards WPL_O1, WPL_O4 and WPL_O5 and are thus addressed as and when relevant within this research. Firstly WPL_O2 will assist in constraining congestion by encouraging mode shift, as well as improving the effectiveness of the WPL as a transport demand management measure by allowing employers to pass on the WPL charge to their employees via parking management. Metrics relating to this objective are thus provided as part of this research. Secondly, WPL_O3 concerns the scheme's ability to deliver a stable revenue stream in order to fund the local contribution to the WPL Package schemes and, as these have now all been delivered, is a matter of public record. Finally, it could be argued that WPL_O6 should not be considered a strategic objective in line with the other 5. Displaced parking is an undesirable outcome which can be effectively dealt with by parking regulation on a case by case basis and is thus outside the scope of this Thesis.

This research is, therefore, intended to reveal to what extent the WPL and the transport improvements which it part funds have achieved the three key objectives set by NCC for the WPL scheme, O1, O4 and O5. The over-arching aim of the project is thus as follows.

1.4 THESIS AIM AND OBJECTIVES

This section presents the aim and objectives for the thesis.

1.4.1 THESIS AIM

The aim of this thesis is to evaluate the impact of the transport interventions comprising the Nottingham WPL Package on levels of traffic congestion, transport mode share and business investment in Nottingham.

1.4.2 THESIS OBJECTIVES

There are seven thesis objectives:

1. Review appropriate evaluation frameworks and methodologies to facilitate the aim of this thesis by examining relevant literature.

2. Examine changes to congestion and mode share across the conurbation by identifying and monitoring relevant time series data.

3. Evaluate changes to employer behavior relevant to the WPL objectives WPL_O1 and WPL_O4.

4. Identify available economic data sets relevant to the WPL objective WPL_O5 and utilise these to monitor of the level of inward investment in Nottingham.

5. Assess to what extent changes to the levels of congestion and mode share are attributable to the WPL Package schemes.

6. Assess to what extent changes to the levels of business investment and the wider economic indicators are attributable to the WPL Package schemes.

7. Provide the conclusions of the research to inform the business case for future similar schemes and inform best practice for assessing the outcomes of such schemes.

Achieving the above thesis objectives is intended to facilitate the execution of the generic research steps required to deliver an evaluation of a complex or innovative transport intervention. These research steps are listed below. In brackets are the relevant Thesis objectives (Based on DfT (2013) and Hills and Junge (2010))

1. Identify an appropriate evaluation framework **(1)**.
2. Monitor the changes to relevant indicators (time series data) relating to the objectives identified for the intervention **(2, 3 and 4)**.
3. Attribute any observed changes in the indicators revealed in step 2 to causal factors including the intervention. This step requires that the evaluator takes into account changes to the context under which an intervention is implemented which could also impact the intervention's objectives, e.g. changes in the national economy increasing demand for transport. **(5 and 6)**.
4. Provide conclusions as to what extent the intervention has achieved its stated objectives **(7).**

To sum up, to be effective an evaluation must monitor change, account for the impact of contextual change exogenous to the intervention and provide attribution of cause and effect (Pawson and Tilley 1997). The academic literature which relates to this general approach to evaluation is detailed in Chapter 2, Section 2.5.

Figure 1.2 presents a research map revealing how these objectives have been addressed by identifying the relevant data, research methods, and thesis outputs. It is arranged as a grid with the columns split by objective and research area (congestion/mode share or inward investment and the economy) and the rows showing the flow from the thesis aims through the objectives to data, methodologies and finally the research outputs. In this chapter the need for brevity prevents a discussion of the research methods used to achieve the above objectives, however, they are fully presented in Chapters 3 & 4.

Figure 1.2 shows how the objectives relate to one another, Objective 1 is relevant to the whole research area, , Objectives 2, 3 and 5 relate to the evaluation of the impacts on congestion and mode share and Objectives 4 and 6 are specifically concerned with the economic impact. Objective 7 draws together both areas of research and the linkages between them.

The data and research methods relevant to achieving each objective are shown in the same column as that objective.

Finally, on the bottom row the project outputs are listed below the objectives which they facilitate. In many cases these outputs are relevant to a number or all objectives.

Figure 1.2 Research map

Aim

Evaluate the impact of the transport interventions comprising the Nottingham WPL Package on levels of traffic congestion, transport mode share and business investment in Nottingham

Objectives

Objective 1 Review appropriate evaluation frameworks and methodologies to facilitate the aim of this thesis by examining relevant literature.

Impact on levels of congestion

Objective 2. Examine changes to congestion and modal share across the conurbation by identifying and monitoring relevant time series data.

Objective 3. Evaluate changes to employer behaviour relevant to the WPL objectives 1 and 4.

Objective 5. Assess to what extent changes to the levels of congestion and mode share are attributable to the WPL Package schemes.

Impact on inward investment and the economy

Objective 6. Identify available economic data sets relevant to the WPL objective 5 and utilize these to monitor of the level of inward investment in Nottingham.

Objective 4. Assess to what extent changes to the levels of business investment and the wider economic indicators are attributable to the WPL Package schemes.

Objective 7. To inform the business case for future similar schemes and provide best practice for assessing the outcomes of future similar schemes.

Datasets required to meet objective

- Traffic Master GPS journey time data
- NCC annual mode share surveys
- NCC and DfT Traffic count data

NCC data from the WPL operations team and the Transport Strategy Team

- Survey of commuters
- Traffic Master GPS Journey time data
- Mode share data from comparator Cities
- DfT data on journey times on locally managed A roads

- ONS Macro-economic data sets
- Enquiries to NCC inward investment team and subsequent investment successes
- Data from commercial estate agents re commercial rental sector

- Case study data concerning major investment and dis-investment decisions.
- ONS macroeconomic Data sets for comparator cities

Methods utilised to achieve objectives

Literature Review

- Develop bespoke analysis applications in MS ACCESS

- Bespoke interview/questionnaire survey of commuters
- Time series model which accounts for the impact of exogenous variables and the introduction of the WPL on congestion.
- Benchmarking against comparator cities

- Benchmarking of macro-economic data against comparator cities
- Analyse examples of investment and dis investment decisions to provide attribution of observed changes to micro and macro – economic indicators
- Triangulation of datasets to arrive at a more robust conclusion.

Research Outputs

Paper 1: Workplace Parking Levies: the answer to funding large scale local transport improvements in the UK?

Paper 2: A methodology to evaluating transport demand management interventions using theoretical evaluation

Paper 4: Evaluating the impact of a workplace parking levy on local traffic congestion: The case of Nottingham UK

Paper 3: An Evaluation of the Economic and Business Investment Impact of an Integrated Package of Public Transport Improvements funded by a WPL

EngD Thesis

1.5 THESIS STRUCTURE

An EngD Thesis follows a standard structure whereby an introduction which provides the background and context of the research is followed by a literature review that provides the reader with an assessment of current knowledge regarding the subject area. This then is followed by a chapter that presents the chosen methodological approach.

The research carried out and the findings of that research are then presented followed by a final chapter which provides a synthesis of the research and overall conclusions. An EngD thesis is shorter than a normal PhD thesis due to the requirement that at least three peer reviewed papers are published as a research output. The four papers produced to support this thesis are included in Appendices A to D and are referred to as applicable throughout the thesis. While the thesis can be read as a standalone document it is recommended that for the fullest understanding of the research the thesis should be read in conjunction with these papers. The papers are detailed in Table 1.1.

This thesis follows the standard structure described above with the addition of a second methodological chapter dedicated to developing the evaluation approach, which is critical given the nature of the intervention being evaluated by this research. This thesis is structured as follows:

Chapter 1 Introduction – this provides the background and context to the research and introduces the bodies who have sponsored the project and the research engineer responsible for delivering it. It provides the overarching aim of the research and the objectives which will need to be met in order to achieve that aim.

Chapter 2 Existing Relevant Research and Knowledge – this literature review explores existing academic knowledge which addresses this area of research and/or details research methods which may be appropriate to the research problem. Specifically this Chapter assesses the following:

- Examples of Parking Space levies and their effectiveness.
- How to define and measure traffic congestion.
- What causes traffic congestion?
- The impact of congestion charging and transport infrastructure improvements on business location and the wider economy and the research methods employed to investigate this.
- Evaluation approaches that could be used in this research.

Chapter 3 Theoretical Evaluation Approaches - this chapter builds on the literature concerning competing evaluation approaches presented in Chapter 2 by detailing the chosen theoretical evaluation approach, Theory of Change (ToC). It provides the reasons for this choice and the practical steps to apply it. The Chapter concludes by detailing the first step of applying this approach by presenting how the WPL was expected to achieve its key objectives and how existing theory and practical experience supports this expectation.

Chapter 4 Research Methodology – this Chapter provides an overview of the practical research methods chosen to deliver the evaluation and thus deliver the Thesis aim and objectives. The Chapter also presents the data that has been used to facilitate the research.

The Chapter also explains how the following interact within the thesis:

- The data used to measure change.
- The research tasks undertaken.
- The three WPL Objectives which are the subject of the evaluation.

- The thesis aim and objectives
- The expectations of change over time generated from the ToC approach.

Chapter 5 Research Undertaken and Findings – this key Chapter details the research undertaken in order to meet the thesis objectives using the evaluation approach presented in Chapter 3 and the methodologies and data discussed in Chapter 4. Additional methodological explanation is also provided where appropriate especially where this is complex or detailed and is presented alongside the analysis in order to aid understanding. The findings of this research are presented in this Chapter. The Chapter structure highlights that there are two distinct areas of research, firstly concerning the impacts on congestion and mode share and secondly the impact of inward investment. These are considered separately within this Chapter but a combined conclusion section recognizes the linkages between the two.

Chapter 6 Conclusions and Recommendations – the findings and their implications are discussed with respect to the degree to which the research aim and objectives have been achieved. Both the strengths and weaknesses of the research and lessons learnt from this thesis are also discussed in this Chapter. The Chapter concludes with a summary of the conclusions and recommendations arising from the research.

Table 1.1 summarises the four key published papers along with the thesis objectives to which they contribute. In addition to the four peer reviewed papers there were also a number of other reports and publications that formed outputs from this research. Table 1.2 itemises these outputs. The two evaluation reports summarised the progress of the overall WPL evaluation project (of which this EngD research forms a component) for the benefit of professional stakeholders.

Table 1.1 Peer reviewed papers

Title	Name of Conference/Journal	Date Submitted	Date of Publication	Relevant Thesis objective	Full Reference
PAPER 1: Workplace Parking Levies: the answer to funding large scale local transport improvements in the UK?	This was selected for publication in a special edition of Research in Transport Economics	26/07/2015	01/06/2014	1	Dale, S. J., Frost M.W., Ison S. G. and Warren, P., 2014, Workplace Parking Levies: the answer to funding large scale local transport improvements in the UK?, *Research in Transportation Economics*, Vol 48, page 410 to 421
PAPER 2: Evaluating Transport Demand Management Interventions using Theoretical Evaluation	Transportation Research Board 94th Annual Meeting	31/07/2014	11/01/2015	1, 2, 3 and 7	Dale, S. J., Frost M.W., Ison S. G. and Warren, P., 2015, Evaluating Transport Demand Management Interventions using Theoretical Evaluation , *Transportation Research Board 94th Annual Meeting Compendium of Papers 2015 DVD.* Washington: Transport Research Board.
PAPER 3:An Evaluation of the Economic and Business Investment Impact of an Integrated Package of Public Transport Improvements funded by a Workplace Parking Levy	Transportation Research Part A: Policy and Practice	14/12/2015	01/07/2015	4, 6 and 7	**Dale, S. J**., Frost M.W., Ison S. G., Nettleship, K., and Warren, P., 2017. An Evaluation of the Economic and Business Investment Impact of an Integrated Package of Public Transport Improvements funded by a Workplace Parking Levy. *Tranpsort Research Part A: Policy and Practice*, Vol 101, July 2017, PP 149-162
PAPER 4:Evaluating the impact of a workplace parking levy on local traffic congestion: The case of Nottingham UK	Transportation Research Board 96th Annual Meeting	31/07/2016	07/01/2017	5	Dale, S. J., Frost M.W., Ison S. G., Quddus, M. and Warren, P., 2017, Evaluating the impact of a workplace parking levy on local traffic congestion: The case of Nottingham UK**,** *Transport Research Board 96th Annual Meeting Compendium of Papers 2017 DVD.* Washington: Transportation Research Board.

Table 1.2 Other outputs

Title	Notes	Date of completion/publication	Relevant thesis objective	Full Reference
Nottingham Workplace Parking Levy Measures and Monitoring: Approach, Baseline and Subsequent Data	The primary audience for this was the UK Department for Transport	28/06/2013	2, 3, 4, 5 and 6	Available on request
Chapter 15 in Transport and Sustainability; Parking; vol 5: Case Study Of The Introduction Of A Workplace Parking Levy In Nottingham	This was a peer reviewed contribution to a book	July 2014	1 and 7	Dale, S. J., Frost M.W., Gooding J., Ison S. G. and Warren, P., 2014, A Case Study Of The Introduction Of A Workplace Parking Levy In Nottingham, In: Ison, S. G. and Mulley, C., ed *Transport and Sustainability; Parking; vol 5;* Ashgate, *ISBN: 978-1-78350-919-5;-Chapter 15*
Nottingham Workplace Parking Levy Evaluation: Second Annual Update Report 2014	The primary audience for this was the UK Department for Transport.	14/04/2016	2, 3, 4, 5 and 6	Available on request

2 LITERATURE REVIEW

2.1 INTRODUCTION

The aim of this Chapter is to review existing literature regarding the key subject areas which are relevant to this research. Firstly, there is a summary of existing parking space levies worldwide and their impact. This highlights the knowledge gap addressed by this thesis. The next section discusses definitions/metrics used to quantify traffic congestion and its causes. This section provides the background knowledge required to inform a research strategy aimed at addressing thesis Objectives 2 and 5 which relate to the monitoring and evaluation of congestion. Section 2.4 considers the factors that influence inward investment decisions in order to understand how transport infrastructure and congestion charging can influence these decisions. This knowledge provides an insight into how to monitor and evaluate the level of inward investment, i.e. facilitate thesis Objectives 4 and 6. Finally, there is a review of relevant approaches to evaluation in order to identify a suitable approach for this research, thus addressing thesis Objective 1.

2.2 PARKING PLACE LEVIES

2.2.1 WORLDWIDE EXAMPLES OF PARKING SPACE LEVYS (PSL)

Legorreta and Newmark (2015) conducted a review of parking space levies worldwide summarising their key characteristics. While they defines PSL's as a "special property tax charged on non-residential off-street parking" a closer examination of the 11 schemes that they identify reveals that only Nottingham, Perth, Sydney, Melbourne and Singapore actually impose a regional levy on each workplace parking place. The other schemes are either national income tax based or are a charge on parking area. In Singapore the levy is so low (US$7.40 per space) that it can be seen as largely symbolic (Legorreta and Newmark, 2015).

This literature review therefore concentrates on the three long standing examples that are closest in typology to the Nottingham scheme, i.e. Perth, Melbourne and Sydney. Paper 1 Section 3 contains a discussion of the differences between these schemes and the Nottingham WPL and an updated summary of this is provided below.

In addition to the Australian schemes, Vancouver also experimented with charging a levy on parking. Unlike the four schemes detailed in this review this levy was based on a charge on parking surface area by charging a fee per square metre. Although this was introduced in 2006 heavy opposition from business prompted a re-think and it was quickly replaced by a tax on transactions for paid for parking (Litman 2013). This example is noteworthy as it demonstrates that opposition from business is an important barrier to successful implementation of a PSL.

Table 2.1 was first presented in Paper 1 and has been updated in the version presented below. It summarises the characteristics of the three Australian PSL schemes and the Nottingham WPL is included for comparison.

Table 2.1 Summary of area wide parking place levy schemes

Location	Area	What's Liable for charge					Introduced	Main Exemptions	Revenue in 2014	Charge per place	Objectives	Uses Of Revenue
		General Description	On Street Parking	Public Car Parks	Un occupied Spaces	Small Business						
Perth Parking Licence Fee	Central Business District (CBD)	All non-residential parking bays that are in use	YES	YES	NO	NO	1999	Disabled spaces, Loading bays, Public service spaces Spaces incidental to primary business activities, Businesses with less than 6 spaces.	A$34m	Long Stay: A$1132, Short Stay: A$1050 (2017)	Cut congestion by effecting modal shift and fund Central Area Transit bus system	Hypothecated for Transport - Central Area Transit bus system and the expansion of the Free Transit Zone
Sydney Parking Space Levy (PSL)	CBD + five other outlying business areas	Off street private non-residential parking, occupied or un-occupied, does not apply to public car parks.	NO	NO	YES	YES	1992	Disabled spaces, Loading bays, Public service spaces, Spaces incidental to primary business activities. Retail, restaurant, hotel parking, is exempt in outlying areas	A$99m	A$2840 CBD and North Sydney, A$2350 in other areas (2017)	Discourage car use Use revenue to fund infrastructure to encourage public transport use.	Hypothecated for Transport Infrastructure: Interchanges, Bus/Rail/Ferry, Park and Ride, Rapid Bus Transit way bus stations, light rail and electronic passenger information systems
Melbourne Congestion Levy	CBD	All public and private long stay non-residential car parking spaces currently in use	NO	YES	NO	YES	2006	Business Visitors, Emergency vehicles, Council and charities, Spaces incidental to primary business activities	A$48.2m	A$1380/A$980 (2017)	Reduce Traffic Congestion via encouraging public transport use by commuter and create more car parking for shoppers and visitors	Not hypothecated - some but not all of the revenue was used for public transport improvements
Nottingham Workplace Parking Levy	City of Nottingham	Occupied private non-residential off street workplace parking	NO	NO	NO	NO	2011	Emergency Services, Frontline NHS services, Employers < 11 spaces, Customers, Disabled spaces Loading bays	£9m	£379 (2017)	Constrain congestion, encourage modal shift to sustainable modes and Fund transport Infrastructure	Hypothecated for Transport - Light rail expansion, Link buses and the redevelopment of Nottingham Station

Sources: NCC (2008), NCC(2012), Enoch (2001), Richardson (2010), Hamer et al (2009), State Revenue Office Victoria (2017), Transport for NSW (2017), Legorreta and Newmark (2015) and DoT (2017)

Differing charging units are one of the key variations between these schemes. Perth, Melbourne and Nottingham only charge for spaces which are in use or occupied while Sydney charges for all spaces. Another distinction is that Perth and Melbourne charge for on street parking while the other schemes charge only for off street parking. Perth and Sydney capture customer parking while in Nottingham customers are exempt and in Melbourne the exclusion of short stay parking will mitigate against customer parking being charged.

Thus, only the Nottingham scheme is a true WPL as it excludes both customer parking *and* public parking.

All four schemes are primarily aimed at targeting traffic congestion, via both the pricing element, as well as investment of the revenue raised back into public transport infrastructure.

The similarities between elements of the Perth and Sydney schemes and the WPL in Nottingham reflect that the two Australian schemes were used as models for the development of WPL in the UK.

Conclusion

The Nottingham WPL Scheme has significant differences to other schemes elsewhere; additionally the geographical and cultural setting of Nottingham is very different to that of the Australian examples with respect to the proximity of competitor cities and a different legislative background. These differences suggest that any assumptions as to the impact of the Nottingham WPL based on existing experience are questionable.

2.2.2 EFFECTIVENESS OF PSL'S

Congestion Constraint and Mode Shift

Researchers (Hamer et al 2009 and Marsden 2006) identified some barriers to carrying out comparisons between area wide parking charge schemes. Such schemes are seldom introduced in isolation as the revenue is usually used to implement a package of TDM measures which can vary from scheme to scheme (Hamer et al 2009). This then causes two problems for researchers

1. It is difficult to isolate the effect of the charging scheme from that of other measures (Hamer et al 2009).
2. The packages can vary significantly from scheme to scheme (Marsden 2006).

Richardson (2010) studied the outcome in Perth; he reports that following introduction, parking supply contracted by 10% before slowly rebounding, but not recovering to pre 1999 levels. This is contrary to the pre 1999 trend of steadily increasing parking supply.

Clearly a reduction in workplace parking supply is not a guarantee that congestion will decrease. However, Richardson (2010) presents figures from the Australian Bureau of Statistics for Perth which shows that there has been a significant shift in mode share. Prior to implementation only 35% of journeys to work were on public transport; however by 2010 this had risen to over 50%, while car mode share had fallen by a similar amount clearly demonstrating a mode shift to public transport. Indeed public transport use grew by 67% in the 10 years from 1999 to 2009. Richardson (2010) reports that the volume of car traffic on routes providing access to central Perth reduced by between 3% and 20% in the three years following implementation of the scheme and that traffic within the city has continued to decline.

While these figures are positive, Richardson (2010) does not present any data to benchmark these against other similar cities. It can be concluded that, while the results of this investigation are encouraging, further benchmarking and corroborative research is required to show causal attribution of the encouraging trends in mode share to the Perth PSL. It is important to note that, over a decade after the introduction of the PSL, Perth is still struggling to overcome traffic congestion due to a booming economy with a large population increase (Martin 2012). Thus the literature suggests that while the Perth Parking Levy has affected both mode shift and an initial drop in traffic levels, these benefits are being obscured by continued economic growth. Hamer et al (2009) carried out a review of the outcomes from the Melbourne CBD parking levy. They conclude that although the total number of trips to the CBD has remained stable, the number and proportion of cars entering the charging area has fallen. However, they conclude that the levy is having only a minor impact on congestion. Young et al (2013) carry out a more recent review of the impacts of the Melbourne scheme and conclude that the impacts appear to be positive in respect of mode shift and a decline in the supply of parking spaces. However they also acknowledge that changing economic and policy factors obscure the extent of the impact of the PSL scheme. Monitoring data for Sydney appears to be sparse (Enoch and Ison 2006). However, according to the New South Wales Ministry of Transport 70% of all trips to Sydney are by car (New South Wales Ministry of Transport 2003). This is used as justification for the Parking Space Levy. Enoch and Ison (2006) argue that, as 85% of all traffic entering Sydney is through traffic and that as 460,000 vehicles travel in the city with only 36,000 chargeable spaces, the impact of the PSL on congestion is likely to be minimal.

The above discussion shows that Perth has seen the most positive results with respect to congestion and mode shift. However, all three Australian schemes lack a comprehensive evaluation in that there is no research which directly links the observed changes in these important indicators to the PSL schemes.

Economic Impact

There is little literature on the economic evaluations of the impact of PSL's

A study carried out by Price Waterhouse Cooper (PwC) on behalf of Nottingham City Council (NCC 2005), prior to the introduction of the WPL, showed that although WPL liability was likely to be less than 1% of their turnover, businesses were highly critical of having to bear this cost. Sixty percent of businesses interviewed said they would relocate some activities away from Nottingham and more than 50% said they would reduce planned investment. 66% felt the levy would not be offset by improvements in public transport; this is despite the academic literature reviewed in Section 2.4 suggesting that a high quality transport system is important in attracting businesses. This then identifies a contradiction between the perception that high quality transport systems are important to business location and the relatively low percentage of turnover being asked to fund this and the strong reaction of businesses to bearing this cost. Some evidence as to how this will play out exists from the parking charging schemes in Australia and the more numerous road user charging schemes, most specifically London. Transport for London (TfL 2008), used the level of VAT registrations and de-registrations as the principal metric for the level of business investment. They compared the net annual change of this in the Central Zone, pre and post implementation of the Congestion Charge, with figures for outer London. Based on this they concluded that there is no evidence that charging has impacted on the level of investment in the central charging area.

In Perth, Australia, the following objective was set out in the Perth Parking Policy 2014; “Ensuring the continued economic and social vitality of central Perth;” (State of Western Australia, 2014). Richardson (2010) reported that concerns expressed that the levy would act contrary to that objective cannot be supported. He evidences this statement by observing that both floor space and employment have enjoyed strong growth. Importantly it would seem that given the longevity of the Australian Schemes, they have been largely accepted by the public and business as a fact of life.

In general, one can conclude that the Australian experience of WPL style schemes has been positive when monitored as a package of complementary demand management measures. Thus, despite the findings of the 2005 study in Nottingham, the inherent expectation behind the Nottingham WPL, based on the Australian experience and the low percentage of turnover of the WPL charge, is that in reality the scheme will not have a negative impact on inward investment.

The above literature review reveals that there is a knowledge gap in two respects:

1. There has been no comprehensive longitudinal evaluation which takes into account attribution of the cause and effect of a WPL and associated public transport improvements impact on congestion or inward investment, either as a package or as a standalone charging scheme.

2. As the Nottingham WPL is the first intervention of its kind in Europe there is no existing evidence that considers the impact of such a scheme in a UK or European context. There are both geographical and cultural differences between Australia and the UK which could cause the impacts of a UK scheme to differ from those observed in Australia.

2.3 TRAFFIC CONGESTION: DEFINITION AND CAUSES

2.3.1 DEFINING TRAFFIC CONGESTION

In order to meet Objectives 2 and 5 it is necessary to understand what is meant by congestion or more precisely traffic congestion. The literature in this section was first provided in Paper 4, Section 2.

The UK Commission for Integrated Transport recommended that a measure of congestion be based on the difference between free flow speed and actual speed (DfT 2000). This indicator was more fully defined in the follow up report "A measure of road traffic congestion in England" (DfT 2000a). This concept has become known as delay. Taylor et al (2000) identified a number of measures and definitions for congestion including the Congestion Index which compares total travel time on a link as a proportion of expected free flow travel time. This can be averaged for all vehicles on a link per time period and can be applied on a segment or corridor level by aggregating the travel times for multiple segments to form full corridors or routes. This approach is useful when comparing levels of congestion across different geographic locations (Wang 2010). However, neither average delay nor the Congestion Index takes into account traffic flow.

The UK Department for Transport (DfT) outlined a methodology to calculate journey time per vehicle mile (JTVM) to monitor congestion on locally managed A roads (DfT 2017). This normalises journey time by link length and flow. US Department of Transport Guidance for measuring effectiveness for highway schemes defines a similar measure which calculates delay per vehicle mile travelled (US DoT 2013) and combines the advantage of a spatially comparable metric and a real world unit of measurement. Delay per Vehicle Mile (DVM), therefore, combines the advantages of both the Congestion Index and JTVM.

Conclusion

Despite the advantages provided by DVM, in this research the primary indicator used is JTVM as it is important to maintain comparability with the DfT congestion indicator. DVM was used in Paper 4 as this comparison with the DfT data was not needed.

2.3.2 CAUSES OF TRAFFIC CONGESTION

In Nottingham, since 2010, congestion levels have increased and similar increases are observed in other UK Core Cities (Dale et al. 2015), however, it should be noted that in Nottingham this is despite a fall in the supply of WPP and other positive changes in employer behaviour. It is therefore important to identify the key factors or 'drivers' which are likely to impact on traffic congestion and may obscure any beneficial impact arising from the introduction of the WPL. These contextual factors can then be taken into account within any potential research methodology. As with the previous Section, the literature in this Section was first reviewed in Paper 4, Section 2.

Tanner (1983) presented research that examined factors that contributed to congestion; he demonstrated the importance of income levels, fuel price and economic output in determining the demand for travel. More recently, and specific to the UK context, Transport for London carried out a detailed review of factors which contribute to traffic speeds in London (TfL 2012). Their work presents a reasoned narrative that points to the importance of household income levels and the effect of reductions in network capacity as road space is re-allocated to public transport and cycling. It also notes that not only overall population change is significant, but that the nature of this change needs to be considered, for example changes in the demographics of the working age population may result in changes to levels of car ownership and the propensity for car use.

The DfT identified three key drivers for the demand for travel in a report detailing their road traffic forecasting (DfT 2013a): (i) population growth, (ii) GDP per capita/disposable income and (iii) the cost of motoring. DfT (2013a) also points out the importance of the availability of alternatives to using the car as well as the cost of those alternatives.

There are also factors which impact directly on congestion by impeding the speed of traffic or by reducing capacity (DfT 2015). The DfT identifies weather conditions as being an important factor, for example, wintery weather slows traffic and can influence mode choice, while increased rainfall is postulated as a causal factor for an increase in journey times in recent years. Jia et al. (2014) examined the impact of rainfall of various intensities on traffic speeds in differing urban situations in Beijing and concluded that the closer to capacity the link and the lower the intensity the rainfall, the less impact on speed. However, they still demonstrated that precipitation levels were a significant factor in reducing speeds in an urban setting.

Conclusion

Any evaluation of the impact of a TDM measures on congestion should consider the impact of the following exogenous variables:

- Macro- economic measures, Gross Value Added (GVA), employment, disposable income
- Population
- Weather
- Network capacity
- Cost of motoring
- Cost of travelling by public transport

2.4 THE INFLUENCE OF CONGESTION CHARGING AND TRANSPORT INFRASTRUCTURE ON INWARD INVESTMENT

WPL is perceived as an additional cost by businesses (Burchell and Ison 2012) and it has been a concern that this will lead to a potentially negative impact on Nottingham especially with reference to Inward Investment (NCC 2005). However, this extra cost needs to be understood in the context of a city's overall offer which includes the transport infrastructure and public transport provision (Smyth and Christodoulou 2010). Nottingham City Council believes that the overall offer will be sufficiently enhanced by public transport improvements the WPL package will deliver that this will offset the deterrent effect on investment of the additional cost of WPL (NCC 2008). It is this position that this research will address. It is, therefore, important that the literature exploring the relationship between transport and business location decisions is reviewed. Additionally, in the same way that congestion is influenced by exogenous factors, the level of inward investment is also subject to many exogenous factors and it is important to understand these in order to inform the research methodology. The literature review in this section is a summary of the extensive literature review contained in Paper 3, Sections 3.2 and 3.3.

By their very nature cities such as Nottingham feature a high degree of agglomeration (Smyth and Christodoulou 2010) and in the broadest terms it is this that forms the basis for attracting business. Agglomeration offers economies of scale and the ability to communicate face to face with customers, suppliers and even competitors. In order for these factors to fulfil their potential it will be necessary for a city to enjoy a relatively high level of accessibility when compared to rival locations that may also enjoy the benefits of agglomeration (Smyth and Christodoulou 2010).

There have essentially been three ways of considering the impact of transport infrastructure, congestion charging and other exogenous factors on inward investment and business location.

1. Discrete Choice Models (DCM) and Count Data Models (CDM) – Bhat (2014) used a CDM technique incorporating neo-classical and institutional determinants to demonstrate that transport infrastructure provision was statistically significant in determining the level of firms locating to different areas of Texas. While these approaches provide consensus that agglomeration economies, transport infrastructure, market size, wages and taxes are significant to business location no such consensus as to the dominant location factors emerge despite numerous examples of this kind of research (Arauzo-Carod et al 2010). Button (2010) suggests that firms adopt 'satisficing policies' whereby provided that the transport infrastructure is seen as sufficient, then other factors, not all of which lead to profit maximisation, will determine the location choice. These include the preferences of existing staff, social amenities and a general image of a city as a place to live and work. If the presence of behavioral factors is accepted then this could explain the heterogeneity seen in the conclusions from empirical studies.

2. Economic Modelling - The two main approaches are microeconomic; Cost Benefit Analysis (CBA) of individual interventions or macroeconomic models which aim to capture the wider economic impacts of transport infrastructure (Lakshmanan 2011). The congestion charging schemes in London and Stockholm have utilised CBA in order to evaluate their economic impact (Leape 2006); TfL 2008; Eliasson 2009). However, none of these studies captured the wider economic benefits of the interventions. Transport for London addressed this by a quasi-experimental approach which compares key indicators between areas of London inside and outside the charging area (TfL 2008). The evaluation

concluded that there has been no detectable negative economic impact from the scheme (TfL 2008).

Macro-economic approaches concentrate on modelling impacts brought about by mainly neo-classical mechanisms; agglomeration, labour productivity gains and general equilibrium effects (Graham 2007), (Combes et al 2008), (Hensher et al 2012). For example, Hensher et al (2012) modelled the expected broader economic benefits of the Sydney Northwest Rail Link project. They identified 18% further economic benefit than that shown by a traditional CBA analysis arising from redistribution of employment activities, together with gains in labour productivity linked to agglomeration effects. Lakshmanan (2011) and Venables (2016) both argue that these macroeconomic approaches ignore forward linkages as the impact continues to 'ripple' through the wider economy as time passes. Venables suggests a more modular approach whereby individual mechanisms are studied empirically. Quddus et al. (2007) provide an example of such a study. They utilised time series analyses to study the impact of the introduction of the London Congestion Charge (LCC) on retail sales in London. They concluded that overall retail sales were not impacted by the LCC despite some localised negative impacts.

3. Direct surveys of employers – Button (2010) argues that, given the presence of behavioural factors that are difficult to quantify (also proposed by Figueiredo et al (2002), the role played by transport can become almost impossible to define by empirical methods. However, a number of studies asking businesses directly what the most important factors for location are have been carried out in the UK. Smyth and Christodoulou (2010) present conclusions by quoting results from a You Gov study for the "Invest Thames Gateway". Over 80% of respondents said they believed that the quality of the transport network was of increasing importance as a factor in business

location decisions. The study identified that an integrated transport system giving access to major cities and international markets was an important determinant along with Government support for infrastructure. While this data outlines in broad terms the value that businesses attach to the quality of the transport network, as well as showing how these factors can contribute to encouraging agglomeration and its inherent advantages, they do not specifically relate to a core city and nor do they quantify how much they are willing to "pay" for such a network. Indeed, when we consider the business by business micro-economic basis for decisions, literature recognises that this may be both location and business specific (Core Cities et al 2006).

A study commissioned by the Core Cities, Passenger Transport Executive Group and Yorkshire Forward (Core Cities et al 2006) examined the competitiveness of Manchester, Birmingham and Leeds by carrying out detailed face to face and telephone interviews with businesses. The results supported Smyth and Christodoulou's (2010) conclusions and the results of the Invest Thames Gateway study, in that they showed that there was a strong view amongst those interviewed that an efficient transport system was a key determinant in business location decisions, but it was perhaps not the most important factor. Smyth et al (2010) and the Core Cities et al (2006) both conclude that an efficient transport system can be considered a prerequisite for business location while it may not be the most important factor.

Conclusion

While data from Perth and London suggests that there is no evidence that congestion charging has produced a negative impact on business investment, applying these conclusions to Nottingham is of limited value as both the nature of the charging schemes and the status and proximity of competitor cities are different. It is possible that Nottingham could be more vulnerable to adverse effects of congestion charging on business as it has the competitor cities of Leicester, Derby, Birmingham and Sheffield close by. Additionally, there is a lack of detailed data available for Nottingham to support the application of the empirical approaches discussed above which examine the causality of neo classical and institutional location determinants (including transport interventions) in business location decisions. Furthermore, such approaches seldom include behavioral determinants which have been shown to be important in business location decisions. While CBA has been used to examine ex-post monetarised benefit of transport interventions, the Nottingham WPL business case stressed the importance of the expected wider economic benefits of the WPL package, thus a CBA would not be appropriate for this research. While macroeconomic approaches seek to include these wider economic benefits they have a limited ability to take into account forward linkages in the economy over time and have limitations with respect to the consideration of contextual factors and causality beyond statistical correlation.

2.5 APPROACHES TO EVALUATION

Prior to the late 1990's evaluative studies relied upon simple monitoring, qualitative approaches such as case studies, or experimental studies. From the mid 1990's theoretical approaches grew out of dissatisfaction with the more traditional methodologies. Experimental and theoretical approaches to evaluation are discussed in the following sections; however, firstly it is important to provide some important definitions of commonly used evaluation terminology:

1. Monitoring – This is the collection and monitoring of time series data which is indicative of the desired change to be achieved by the intervention (DfT 2013).

2. Context – This is the exogenous circumstances against which an intervention is implemented. This context can change over time, e.g. changes to economic factors. (Blamey and Mackenzie 2007).

3. Attribution – This is the term used to describe the causal link between the changes observed by monitoring indicators and the intervention being evaluated (DfT 2013).

4. Evaluation - The wider consideration of context and comparison leading to attributing the medium and long term changes in indicators to the intervention being studied is termed evaluation (Rossi et al 2004); or more succinctly:

   Evaluation = Monitoring + Context + Attribution

2.5.1 The Experimentalist Approach

The classic experimentalist approaches sought to attribute observed change in the population affected by an intervention by comparison to either a randomly selected control group not subject to that programme, or by carefully selecting that control group to be otherwise as similar as possible to that subject to the intervention. The former is termed an experimental approach and the latter a quasi-experimental approach. A quasi experimental approach could be appropriate to an area wide transport intervention in a UK city such that it can be compared to other similar cities.

Rossi et al (2004) stress that the veracity of a quasi-experiment rests on the evaluator's ability to identify all the factors at play in the comparator group which may affect the intended impact, i.e. differences in local context, such as transport policy are critical.

Various academic sources, notably Pawson and Tilley (1997), and Blamey and McKenzie (2007), have criticised the experimentalist approach by citing a failure to represent differing context as the main cause of failure to accurately attribute observed changes in indicators to the programme being monitored. Furthermore Blamey and Mackenzie (2007) point out that while an experimental approach may show that a change has occurred in one group, but not the comparator group, if the reasons for this are not fully understood it may be risky to apply the same intervention elsewhere where the context is different. Theoretical evaluative approaches emerged as a response to the perceived short coming in the experimentalist approach.

2.5.2 THEORETICAL APPROACHES TO EVALUATION

The literature review in this section is a synthesis from those contained in Paper 2 Section 3 and Paper 3 Section 3.4. Theoretical Evaluation approaches have been recommended by the UK DfT in their guidance for the fuller evaluation of major transport schemes in order to provide a more flexible evaluation framework capable of incorporating empirical and qualitative evidence into an evaluation (DfT 2013). These approaches provide a framework for understanding, systematically testing and refining the assumed connections between an intervention and the anticipated impacts. This takes into account contextual changes, as and when they occur, by considering how they will impact on the theory underlying the intervention (Blamey and Mackenzie 2007). Theoretical evaluation approaches also aim to demonstrate the attribution of the observed change of indicators to the intervention in question. This consideration of both context and causal attribution allows these approaches to address the key criticisms of experimental approaches (Blamey and Mackenzie 2007). There are two main approaches, Realistic Evaluation, sometimes also referred to as Realist Evaluation, (RE) (Pawson and Tilley 1997) and Theory of Change (ToC) (Weiss 1995).

Realistic Evaluation

RE embraces the concept that the outcomes to actions will depend on the wider context (Laws 2009). RE can, therefore, be said to have a base formula for exploring this explanatory aim:

Mechanism + Context = Outcome

These 3 elements are explained as follows (Pawson and Tilley 2004):

1. Mechanisms (M): Evaluators need to explore the mechanism that is intended to operate to make the programme effect the intended change. A mechanism is, therefore, a mini theory which says how an intervention will achieve change, e.g. a WPL, where it is passed on it will raise the cost of travelling to work by private car, thus utilising basic economic theory to reduce the percentage of people choosing that mode.
2. Context (C): It's important to explore the context in which it is intended to operate and identify what factors external to the intervention will impact on the intended mechanisms.
3. Outcome Patterns (O): This is the outcomes achieved by the mechanism given the context.

A realist theory, therefore, comprises a series of postulated Context-Mechanism-Outcome theories (CMOs) and the output of the evaluation is refined and tested CMOs. The principle drawback of RE is that the number of mechanisms and contexts for a large intervention may be so numerous that the approach becomes impractical (Pawson and Tilley 2004).

Theory of Change Approach

A ToC describes the causal relationships between the events linked to an intervention which aim to meet a set of stated scheme objectives. In doing so it seeks to take into account context and any likely changes to this that can be foreseen. These events are commonly identified as follows (Blamey and Mackenzie 2007):

- Context/setting – This describes the problem the action will attempt to mitigate and also any relevant contextual factors, thus, it could also be seen as setting the scene.

- Inputs – This describes the nature of the intervention and the resources required to implement it.
- Outputs – This describes what those resources deliver on the ground, e.g. a new tram line.
- Outcomes – This refers to the immediate effect of the intervention in the short and medium term.
- Impacts - This is longer term strategic changes which the intervention has effected or contributed to.

A distinctive aspect of a ToC evaluation is that it relies on this causality being developed based on existing evidence from stakeholders, good practice elsewhere, previous evaluations and academic studies, leading to a consensus on the theory of how change will be effected. Where knowledge gaps are identified bespoke research may be necessary. Modern applications of this approach have recommended logic maps to articulate and understand the theory (Blamey and Mackenzie 2005, DfT 2013 and De Silva 2014).

Literature on how a ToC approach achieves attribution is somewhat general in nature. Connell and Kubisch (1998) while recognizing that there is no guarantee that observed change is due to factors other than the intervention, argue that often, if the observed change is commensurate with the theory, then stakeholders may be willing to accept that it is attributable to that intervention. They identify four points which they believe could be sufficient to demonstrate attribution when adopting a ToC approach, namely that the:

- the theory is plausible;
- the intervention was implemented as expected;
- the magnitude of the outcomes following the above was as predicted by the theory;

- there is an absence of any contextual shift that could account for the above outcomes.

Blamey and Mackenzie (2007) conclude that it may be desirable to include an element of RE within an overall ToC evaluation framework in order to examine the cause of change in more detail.

The nature of the evaluator has been a source of debate in academic literature (for example, Blamey and Mackenzie 2005, and Rossi et al 2004). While it is acknowledged that expert knowledge in the field is desirable, the concept of "goal free" evaluation has been developed whereby an element of the evaluation team is unaware of the interventions objectives and may lack specific knowledge of the field which the intervention concerns (Pawson and Tilley 2004). This approach attempts to remove the risk of preconceptions or bias in respect to the expected outcomes and impacts. However, both the Theoretical Evaluation approaches detailed above rely on efficient interaction between the evaluators and stakeholders. This will require evaluators with good working relations with stakeholders and knowledge of both the sector in general and the important actors involved in the intervention. With this in mind a genuine goal free approach is, in practice, unlikely. It is thus necessary to ensure that other approaches are employed to ensure objectivity such as involving academic partners or employing established and trusted consultants.

Conclusion

Given that the WPL scheme is an area wide intervention, unique in the UK, which aims to achieve change over an extended period of time by funding public transport improvements, it is concluded that a theoretical evaluation approach is required to fully take into account context, establish attribution and fully understand how the observed change has occurred in order to aid transferability of the approach. Given the relative merits of RE and ToC its seems combining the two approaches, as recommended by Blamey and Mackenzie (2007) whereby ToC is complemented by a consideration of a limited number of key mechanisms and contextual factors to add further explanatory detail, is appropriate for this research problem. The approach whereby the evaluation is carried out in partnership with academia, in this case as an Engineering Doctorate with its associated requirement for the publication of peer reviewed papers and final independent examination, should ensure that any unintentional bias associated with the Evaluator's association with the WPL scheme is removed via academic rigour.

The application of this approach is the subject of Chapter 3 of this thesis.

3 APPLICATION OF A THEORY OF CHANGE APPROACH

3.1 INTRODUCTION

In the previous Chapter it was determined that it would be appropriate to utilise a Theory of Change Approach (ToC) as a framework for conducting this research. A ToC approach guides the direction of an evaluation by initially identifying theory which explains how and why an intervention is expected to achieve its desired impacts, which can then be empirically tested by measuring indicators for every expected step on the causal pathway from implementation to impact. In this Chapter the advantages of such an approach are discussed further with specific reference to the WPL. This is followed by a description of the practical research steps which are needed to implement this approach. Finally, a WPL 'Theory of Change' (WPL ToC) is presented and evidenced.

While the decision to base this evaluation on a ToC approach was taken based on the literature review provided in this and the previous Chapter, the DfT recommends the use of a ToC approach for large scale or innovative transport interventions. Additionally, it should also be noted that the DfT further encouraged the use of this approach in direct consultations with the evaluation team.

The objectives that have been identified by the sponsors of the WPL scheme are such that progress towards these can be can be quantified empirically and the data sets that support this approach are largely quantitative. This is because, firstly the relevant secondary data is quantitative and secondly the sensitive nature of the WPL scheme required a light touch when collecting primary data, thus qualitative techniques such as the use of focus groups or detailed interviews with external stakeholders impacted by the scheme were not an option. A further problem with qualitative techniques which seek to interview such stakeholders was that the WPL was such an emotive scheme and it was unlikely that the opinions expressed in any interview would be representative of how the individual or organisation would behave in reality, i.e. there would be a strong emotional response bias. Nevertheless, qualitative data was used to evidence the reasoning behind investment and disinvestment decision making and hence the research in this thesis should be characterised as a mixed method approach, but with a strong bias towards quantitative techniques.

The following Section contains a detailed justification for adopting this evaluation approach together with a discussion of the detail of the methodology used to apply it.

3.2 TOC TERMINOLOGY; 'THEORY' AND 'TRIANGULATION'

At this point the use of the terms 'theory' and 'triangulation' within the ToC approach require further examination.

3.2.1 THE USE OF THE TERM THEORY WITHIN THE ToC APPROACH

There is much ambiguity in the use of the term 'Theory' within literature referring to theoretical evaluation approaches (Blamey and Mackenzie 2007).

The Centre for Theory of Change website provides a definition for both the approach and its output as follows:

"What is Theory of Change? - A Theory of Change is a specific and measurable description of a social change initiative that forms the basis for strategic planning, on-going decision-making and evaluation. The methodology used to create a Theory of Change is also usually referred to as Theory of Change, or the Theory of Change approach or method. So, when you hear "Theory of Change", you may mean either the process or the result". (CTOC 2017)

However, a further examination of relevant literature is required to assess what is meant by the term theory within this evaluation approach. According to Collis & Hussey (2009) a theory may be defined under a Positivist Paradigm as "a set of inter-related variables, definitions and propositions that specifies relationships amongst variables”. They also define a theoretical framework as a collection of theories and models relevant to the research. It could be argued that the initial output from a ToC approach is a theoretical framework as it utilises a collection of existing theories to explain the causality of an intervention achieving its desired impacts.

However, with more interpretist paradigms the definition of a theory is somewhat more flexible. Merriam (1988) and Laughlin (1995) identify lower level theories which are considered context dependent rather being a grand theory which will always operate. Laughlin terms these ‘skeletal theories’ which will always require testing empirically when applied in any given context, while Merriam terms these substantive theories. This concept of a context dependent skeletal/substantive theory could fit with the seminal literature concerning the ToC approach which stresses the importance of context in how intervention will operate. Weiss (1995), for example, identifies two types of relevant theory, implementation theory which is developed prior to implementation to say how implementation will occur and programme theory that states how, when and why the intervention will achieve its stated objectives. She then goes onto state that "I call the combination of programme theory and implementation theory the program’s theories of change”.

Specific to transport evaluations, Hills and Junge (2010) state that “Theory of Change involves a systematic and cumulative study of the links between activities, outcomes and context of an initiative. It involves the specification of an explicit theory of how and why a programme or project might cause or have caused an effect. This theory is then used to guide the evaluation”. Perhaps the most explicit interpretation of this ToC output as a theory is contained in a more recent application of a ToC approach; De Silva et al (2014) state that “a ToC is a theory of how and why an initiative works which can be empirically tested by measuring indicators for every expected step on the hypothesized causal pathway to impact". They go on to present a logic map titled 'SHARE Theory of Change,' SHARE being the programme being evaluated.

From a pragmatic perspective the term WPL ToC will be used within this thesis to describe the output from the application of the ToC approach. Thus, the term WPL ToC refers to the collection of existing theories and real world experience that together explain how and why the WPL is expected to achieve its intended impact. This WPL ToC is articulated in a WPL ToC Map which is a graphical representation of how existing theory facilitates the causal pathway from scheme implementation to longer term impact. The alternative term, logic map is used in some literature, for example Hills and Junge (2010), for such graphical representations of a ToC. Figure 3.1 illustrates the relationship between these terms:

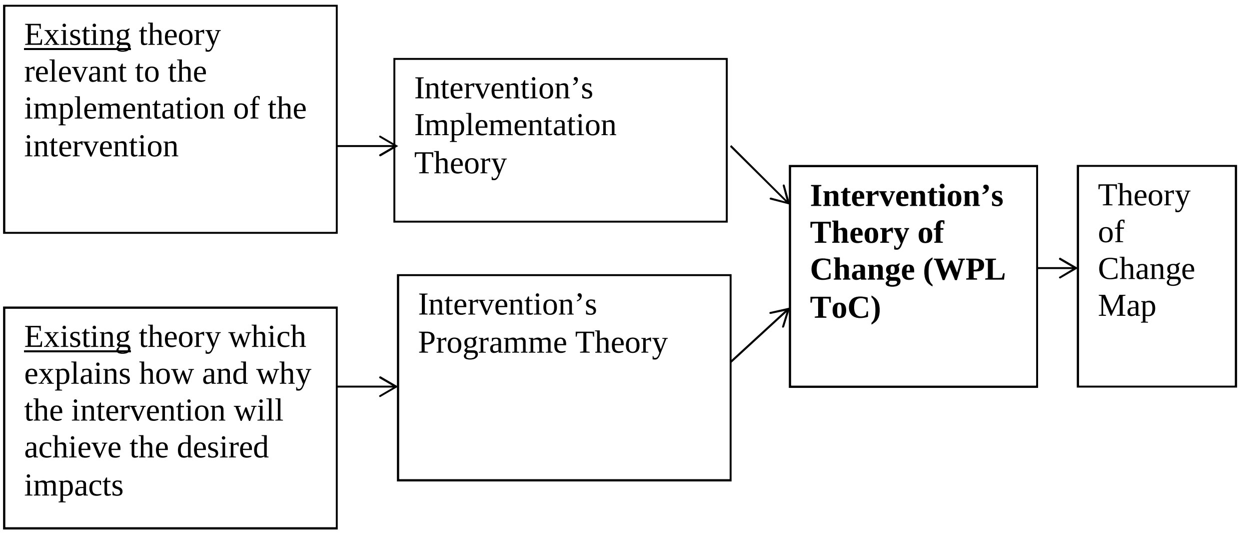


Figure 3.1 Theory of change output

3.2.2 TRIANGULATION AS A RESEARCH METHOD WITHIN THE TOC APPROACH.

The concept of the 'triangulation' of evidence to arrive at a more robust conclusion, while not unique to the ToC approach, is inherent to both a post-positivist paradigm and a theoretical evaluation approach within that paradigm. In the context of social research, triangulation is well defined by Denzin (1989) who identified several different categories including methodological triangulation; the comparison of data collected by utilising different methodologies and data triangulation which combines data from multiple sources.

Methodological triangulation can be further subdivided into ‘within method’ and ‘across method’ triangulation (Casey and Murphy 2009). Within method triangulation is where two different methods are used to derive the same metric and thus cross validate one another, while across method triangulation utilises a variety of indicators generated by both qualitative and quantitative methods.

More recent literature, for example Hills and Junge (2010) and DfT (2013), uses a more generalised definition which combines these above forms of triangulation. The DfT (2013) use the following definition.

“Triangulation, or the integration and mixing of evidence, from different sources is a technique to generate robust conclusions”

This is a pragmatic approach to utilising and interpreting data sets that individually lack statistical rigour and are incomplete or individually inconclusive and the reality is that, outside a strict experimental environment, many datasets do manifest some or all of these imperfections. Thus, this evaluation employs a form of ‘across method’ triangulation whereby largely quantitative data describing different indicators relevant to measuring progress towards the same WPL scheme objective is compared to draw an overall conclusion as to how well that objective has been met. This methodology is especially helpful when evaluating WPL Objective 5 regarding the impact on inward investment.

3.3 WHY BASE THE EVALUATION ON A TOC APPROACH?

A discussion regarding the choice of the ToC approach is contained in Paper 2 Section 5 and is summarised in this Section.

The choice of a ToC based approach for this evaluation was driven by the following considerations with respect to the WPL Package.

Firstly, the WPL is an innovative measure that is untested in a UK or indeed European context, thus it is desirable not merely to report that change has occurred, but to understand why and how, thus rendering information as to how specific context has contributed to that change. The literature review in Chapter 2 shows that this kind of knowledge generation is only possible by adopting a theoretical evaluation approach. Neither before and after monitoring, nor quasi-experimental evaluation approaches provide an understanding of how change is achieved and are not fully able to take into account changing contextual factors over time.

Secondly, a ToC approach is suitable for schemes or packages that are complex and innovative as, while stronger for an existing evidence base concerning impacts, it does not rely on this and is capable of generating conclusions by 'triangulating' evidence from incomplete or sparse monitoring data and comparing postulated outcomes/impacts with actual observed change. This is relevant to large scale transport initiatives, such as the WPL Package, which act across whole conurbations with unique characteristics making traditional experimental comparative approaches difficult to design and implement. Thus, a ToC approach enables a degree of attribution even where no comparator data is available, e.g. bespoke business investment research, as attribution can be achieved by answering the following questions.

- Is the theory plausible?
- Was the intervention implemented as expected?
- Is the magnitude of the observed changes to the indicator as predicted by the theory?

- Is there any contextual shift that could account for the above outcomes and if there was, has this been taken into account? (Connell and Kubisch, 1998)

Despite the above mentioned difficulties with a quasi-experimental approach, the evaluation can still be strengthened by comparing changes to key indicators in Nottingham to changes in other similar UK cities where matching data is available. This provides additional evidence for attribution, while also partially accounting for national and regional contextual factors.

3.4 APPLYING THE TOC APPROACH

The method used for applying the above approach to this research is as follows:

1. Utilise the existing evidence base and theory from similar interventions, academic literature and stakeholder input to propose a WPL ToC. This explains how and why the intervention is expected to work and can be empirically tested by measuring indicators for each step on the hypothesized causal pathway to the intended impact (De Silva et al 2014). This WPL ToC is presented in a logic map which illustrates how the theory will operate over time to achieve the desired outcomes and objectives.

2. Use the existing evidence base and theory from similar interventions, academic literature and stakeholder input to identify the main mechanisms which will operate to facilitate each step on the causal pathway and insert these at the appropriate point in the WPL ToC map. This step thus utilises an element of the Realistic Evaluation approach and strengthens the ToC by providing a more detailed explanation of change. A large scale transport intervention is likely to have an impractical number of mechanisms and thus it is important to only include the mechanisms that are critical to the operation of the ToC.

3. Use the existing evidence base and theory from similar interventions, academic literature and stakeholder input to identify the main exogenous contextual factors under which the

WPL ToC will operate and assess how these may impact on the operation of the mechanisms identified in step 2.

4. Identify the indicators and evidence required to test the WPL ToC.
5. Data collection and analysis.
6. Attribution: Use appropriate quantitative and qualitative methods to test to what extent observed changes in the indicators are caused by the WPL Package elements.
7. If required, refine the WPL ToC in light of the research undertaken.

Paper 2 details how the above approach can be applied to the evaluation of transport interventions and recommends it as good practice for the evaluation of large scale/controversial transport interventions. Such a recommendation facilitates Objective 7 of this research. Paper 2 goes onto apply this approach to the WPL, proposes a WPL Package ToC and examines the evidence to date which validates this. The evaluation approach advocated and associated research contained in Paper 2 is summarised, and where appropriate updated, in the Sections below.

3.5 DEVELOPING THE TOC FOR THE WPL

In this Section the above method is applied to identify the WPL ToC.

3.5.1 PROCESS USED TO IDENTIFY THE THEORY OF CHANGE FOR THE WPL

As outlined in Paper 2 and Section 2.5.2, a ToC approach requires that a ToC for the intervention being evaluated is identified. This is achieved by utilising relevant literature, stakeholder knowledge and, if necessary, bespoke research to explain how and when the intervention will achieve the intended objectives. Figure 3.2 presents the process that was undertaken to identify the WPL ToC:

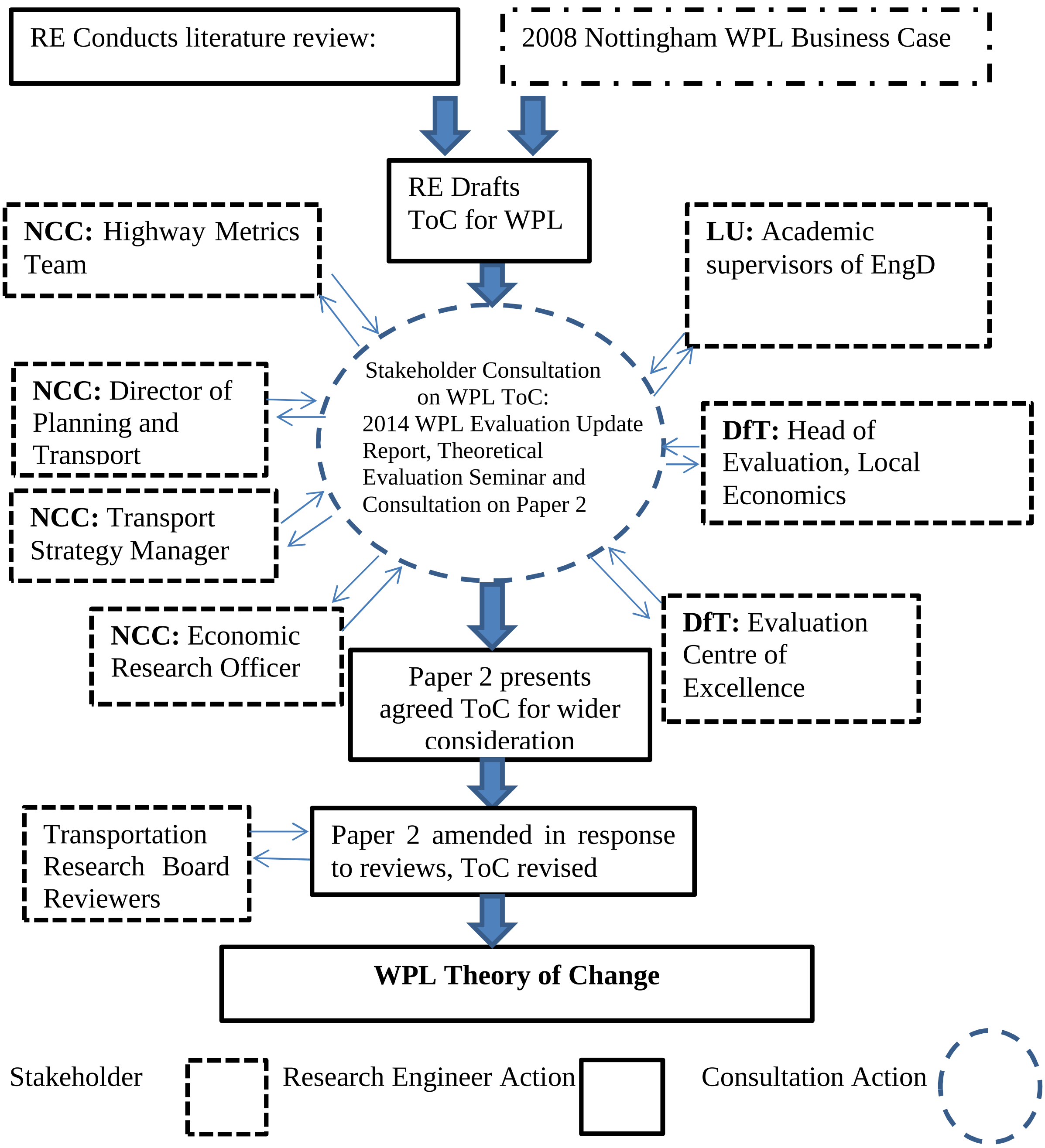


Figure 3.2 Process used to formulate the Theory of Change for the WPL

Figure 3.2 shows how the process of stakeholder engagement was enabled to identify the WPL ToC. It is worth highlighting the importance of the WPL Business Case 2008 (NCC 2008) which provided a good starting point for developing this ToC. The main mediums for stakeholder consultation are identified as the Nottingham Workplace Parking Levy Evaluation: Second Annual Update Report 2014, Paper 2 and a seminar conducted by the RE and attended by NCC and LU stakeholders to explain the principles behind theoretical evaluation. The Nottingham Workplace Parking Levy Evaluation: Second Annual Update Report 2014 is an output from this research but is too large to include as an appendix within this thesis, but is available on request.

Paper 3 contains a ToC for the WPL Package with respect to WPL Objective 5, **'**Enhance the attractiveness of Nottingham as a location for business investment' and then discusses to what extent the available evidence confirms this. As this ToC only concerns WPL Objective 5 it is more detailed than the WPL ToC presented here and can be reviewed in Section 4 of Paper 3, Tables 1 and 2 and Figure 1 along with the accompanying narrative. The WPL Package ToC has been revised as a result of the production of Paper 3, with a number of extra economic mechanisms and contextual factors added.

3.5.2 IDENTIFICATION OF CONTEXTUAL FACTORS AND MECHANISMS FOR ACHIEVING CHANGE

As discussed in Chapter 2, Section 2.5.2 and Paper 2 Section 4, the WPL Package ToC is strengthened if individual mechanisms of change are inserted into the ToC Map at key points to explain why particular linkages occur. Table 3.2 identifies these mechanisms for change. Literature which supports the relevance of these is referenced within this Table. Table 3.1 itemises the exogenous contextual factors which could impact on the efficiency of the mechanisms described in Table 3.2. Table 3.2 then identifies which contexts may impact on which mechanisms. These tables were first presented in Paper 2 as Tables 1 and 2, but they have been updated in this Section and enhanced using material from Paper 3, as discussed at the end of Section 3.5.1.

Table 3.1 Contexts of the WPL Package

Context ref.	Context	Evidence base to support context
C1	Socio-economic characteristics	Nottingham is a medium sized English city with a population of 308,000 (645,000 in the primary urban area). It ranks 20th out of 326 Local Authority areas for deprivation and should, therefore, be considered deprived. 90% of its GVA is accounted for by the service sector.
C2	Relevant Transport Policies	The local transport policy background features extensive bus priority measures, activities to encourage green modes of travel including workplace travel planning, Park and Ride, one existing Tram Line and a general presumption against catering for growth in travel via road improvements.
C3	National Economic Conditions	The WPL package was implemented in a period when the national economy was emerging from recession with associated improving economic growth figures.
C4	Cost of fuel	Standard unleaded fuel prices rose by 30% between January 2010 and a peak in April 2014 before falling back by 15% by Jan 2017. (RAC 2017)
C5	The Nottingham Offer to investors	Key operational costs are lower in Nottingham than other comparable cities in the UK, with office costs at £19 per sq. ft. for Grade A office space (compared to £35-40 in Birmingham and Manchester, £30 in Leeds, £25 in Milton Keynes and £25 in Cardiff) and salary costs on average 10% lower than the national average (Lambert Smith Hampton 2014). These are the main costs that a business will focus on when deciding on a new location and are key in terms of what Nottingham has to offer as a location.

Context ref.	Context	Evidence base to support context
C6	Existing Congestion Problem	Nottingham City Council estimates, based on an independent study by WS Atkins, that congestion in the AM peak period costs the City's economy £160m pa (NCC 2011), this will manifest itself as a cost to business in lost time, increased transport costs, difficulties in access for qualified workforce and difficulty in accessing suppliers/customers.
C7	Presumption of Growth	Population projected to grow by 9% 2011-2026 (NCC 2011)
C8	Short term disruption to network by construction phase of WPL Package.	Journey Time per Vehicle mile in the AM peak period on radial routes into the City affected by these road works rose by 31% between 2010/11 and 2013/14 while on those isolated from them it rose by 5.4%, less growth than in three out of four of the comparator Cities in the same period..
C9	National and local political situation	Nottingham City Council is very stable, it's been controlled by the Labour Group for over two decades and there was no expectation that this would change during the WPL consultation, implementation and evaluation period. This gave decision makers the confidence to implement the WPL. Successive national administrations have stated that the decision to implement a WPL is a matter for local administrations.
C10	Supply of Public and on Street Parking	There are approximately 10,000 public paid for public off street parking places in Nottingham City and 2400 paid for on street bays.

Context ref.	Context	Evidence base to support context
C11	Availability of Commercial Premises	Currently there is a chronic shortage of large high quality commercial premises in Nottingham, while rental values are not high enough to stimulate new build.

Table 3.2 Mechanisms activated by the WPL Package

Mechanism Ref.	Mechanism	Evidence base to support mechanism	Relevant Contextual Factors
M1	**WPL funds improved public transport (PT) options.**	The parking space schemes in the Australian deliver stable hypothecated revenue for transport (NCC 2008). The Nottingham WPL scheme has raised £7 million in the first year of operation (Dale et al 2014).	C1 C2 C3 C4
M2	**Improved PT options result in increased capacity and shorter journey times**, encouraging new trips generated by growth to choose PT rather than the car.	In Nottingham the introduction of the tram increased PT trips from 68,000 in 2003/4 to 74,000 in 2005/6. (NCC 2006).	
M3	**Improved PT options result in better connectivity, image and convenience when using PT**, encouraging modal switch from the car to PT.		
M4	**WPL funds business support measures** to encourage workplace travel plans, car park management and cycle infrastructure improvements which encourage employees to switch from car to PT, cycling or walking.	Studies show that Travel Planning is effective in encouraging mode shift (Cairns et al 2004). Passing the cost of the WPL on to employees via parking charges may address the concern that the WPL is an additional cost to business and there is evidence that this is taking place (Dale et al 2014).	

Mechanism Ref.	Mechanism	Evidence base to support mechanism	Relevant Contextual Factors
M5	**Direct increase in cost in commuting to work by car due to Workplace Parking Charges.** Some employers choose to pass on the cost of the provision of these places to their employees, thus effectively increasing the cost of commuting to work by car. According to basic economic theory this should decrease the demand for this mode of travel.	Evidence from long standing parking space levy schemes in Australia suggests that they can contribute towards modal shift (Hamer et al 2009 and Richardson 2010). The London Congestion Charge prompted an initial drop in congestion, although it did later rebound, possibly due to external economic factors (TfL 2008). A report on the economic and business impact of the WPL produced by Price Waterhouse Cooper on behalf of Nottingham City Council (NCC 2005) predicted that a significant number of employers would choose to pass the charge onto their employees.	C1 C2 C3 C4
M6	**Indirect increase in cost of commuting to work by car.** WPL causes a contraction in the supply of workplace parking resulting in an additional cost to commuting by car as paid for non-workplace parking is used, thus decreasing the demand for this mode of travel.	There is evidence that the introduction of the Nottingham WPL has prompted a contraction in the supply of workplace parking places. (Dale et al 2014).	C1 C2 C3, C4 C10
M7	**Decrease the supply of Workplace Parking**. The WPL prompts employers to 'ration' the workplace parking places (WPP) they provide to employees causing a contraction in the supply of WPP in places where there is no alternative supply so other modes will need to be utilised.		C3 C10

Mechanism Ref.	Mechanism	Evidence base to support mechanism	Relevant Contextual Factors
M8	**Enhanced effect of WPL package.** The combined effect of the WPL Package: the WPL, NET Phase 2, the refurbishment of Nottingham Station and provision of Linkbus services act as a combined package to greater effect than the individual schemes to encourage mode shift.	It is generally accepted that to be most effective Transport Demand Management measures need to be provided in an integrated package (Ison and Rye 2008 and Meek et al 2008).	NA
M9	**Congestion Constraint.** The improved PT quality and capacity combines with the increase in the cost of commuting by car to prompt modal shift away from the car and thus reduces or constrains traffic congestion.	Evidence from long standing parking space levy schemes in Australia, which also use revenues generated to improve PT, suggest that they can contribute towards congestion constraint (Ison & Rye 2008 and Richardson 2010). The London Congestion charge prompted an initial drop in congestion although it did later rebound possibly due to external economic factors (TfL 2008).	C3 C4 C7 C8
M10	**Transport demand management effect of the WPL package reduces cost of congestion** to businesses making Nottingham more attractive as a business location.	A study by the Core Cities Group showed that the availability of an efficient transport system is a prerequisite for business location; however it is not the most important factor (Core Cities 2006). Nottingham City Council estimates, based on an independent study by WS Atkins that AM peak period congestion costs the City's economy £160 million pa (NCC 2011), this will manifest as a cost to business in lost	

Mechanism Ref.	Mechanism	Evidence base to support mechanism	Relevant Contextual Factors
M11	**Increased PT capacity and efficiency makes Nottingham more attractive as a business location due to workforce mobility.**	time, increased transport costs, difficulties in access for qualified workforce, etc. The 2005 study, carried out by PwC on behalf of Nottingham City Council (NCC 2005), showed that employers recognised that congestion represented a cost to them.	C5
M12	**Employers choose to pass on the cost of the WPL** to their employees via parking management thus mitigating the WPL as a cost to business.	A study carried out on behalf of Nottingham City Council predicted that a significant number of employers would pass on the cost of the WPL to their employees (NCC 2005)	C3, C5
M13	**Increase in cost of operating a business in Nottingham.** The WPL charge is absorbed by employers thus placing an additional cost burden on local businesses which risks a reduction in inward investment.	Studies carried out before and after the implementation of WPL show that businesses cite this as a key mechanism (NCC 2005 and Burchell and Ison 2012), although the 2005 study concluded that it was debateable as to whether they would act on this as the WPL charge formed less than 1% of turnover for most.	C5 C11
M14	**Suppressed demand for travel by private car.** As congestion decreases, demand supressed by the capacity of the network is released, thus no real congestion benefit is derived.	This is the well documented effect of induced traffic in response to increased road capacity (Goodwin 1996),	C1, C3 C4, C7

Mechanism Ref.	Mechanism	Evidence base to support mechanism	Relevant Contextual Factors
M15	**Agglomeration economies.** Increased urban density made possible through a reduction in travel times or in the cost of travel leads to positive gains from agglomeration due to increased productivity.	These are neo classical economic effects which underpin the wider economic benefits from transport improvements. Literature, for example Graham (2007), Combes et al (2008) and Hensher et al (2012), supports the wider economic impacts of transport improvements by modelling impacts brought about by agglomeration (Graham 2007), labour productivity gains (Coombes et al 2008) and general equilibrium effects (Hensher et al 2012). Hensher et al (2012) predict the expected broader economic benefits of the Sydney Northwest Rail Link project from redistribution of employment activities, together with gains in labour productivity linked to agglomeration effects, to be an 18% further economic benefit than that shown by a traditional CBA analysis.	C3 C5 C6 C9 C11
M16	**Labour force effects.** Improved accessibility leads to an increase in quantity and quality of labour and associated productivity improvements. This will also potentially lead to an increase in wage levels and disposable income as the existing labour pool seeks to use the new transport options to maximise their earnings and save on travel costs.		
M17	**General equilibrium effects.** Increased productivity, time and cost savings associated with increased PT capacity and shorter journey times cause a general economic improvement as a new equilibrium of increased economic activity is achieved. This change may be initiated by M15 and M16.		

While Table 3.2 describes each mechanism, it is important to understand how the contextual factors itemised in Table 3.1 are likely to impact on these mechanisms. The way the contextual factors interact with the mechanisms is highly interconnected, i.e. most of the contextual factors have some impact on the effectiveness of multiple mechanisms. However, the discussion below highlights the most important links.

The revenue raised by the WPL (M1) is dependent on the number of commuters opting to switch mode away from the car due to an increase in costs/reduction in WPP supply (M5, M6 and M7). All four of these mechanisms will, therefore, be impacted by socioeconomic factors (C1) and the National economic situation (C3), these two contextual factors will determine to what extent employers and employees are prepared to bear the cost of the WPL. The availability of PT alternatives (C2) is also a factor affecting these mechanisms.

The mode switch to PT options due to Mechanisms 2, 3 and 4 will be influenced by socio-economic factors (C1) as these will affect the propensity for use of different modes. It is likely that the more deprived the area the greater the propensity to use PT. Economic conditions (C3), including fuel prices (C4), will also play a part in the perceived attraction of different modal choices. In general historic trends from Nottingham show that the less favourable the economic conditions and the higher the cost of fuel, the greater the propensity for the use of PT.

As M8 is a secondary mechanism, recognising the combined effects of M1 to M7, the contextual factors affecting this mechanism are the same as the individual mechanisms.

Congestion constraint arising from the improved PT quality and capacity combined with the increase in cost of commuting by car (M9) will be influenced by temporary reductions in network capacity arising from roadwork activity (C8) along with factors that affect the demand for travel by car such as C3, the National economic situation with respect to rising employment and C7, an increase in population. Clearly, an increase in demand for travel or a reduction in effective network capacity will increase congestion and offset benefits from the WPL Package. Suppressed demand for travel by car, M14, will also interact with this mechanism to reduce its effectiveness.

Mechanisms 10 through to 13, which describe how the benefits of reduced congestion and less car use due to improved PT options encourage inward investment, will be heavily influenced by the 'Nottingham Offer' to businesses and its competitiveness with other locations (C5). The more competitive the overall offer to investors inclusive of the WPL cost, the more effective these mechanisms will be in moving towards the desired objective of attracting investment to Nottingham.

M14, suppressed demand for travel by car offsetting mode switch will be influenced by economic contextual factors C1, C3, C4, C6 and C7. Put simply, the higher the disposable income together with available network capacity, the greater the propensity to release this suppressed demand.

The neo classical economic mechanisms M15 to M17 relate to economic growth stimulated by improved journey times and accessibility derived from transport improvements brought about by M2 and to a lesser extent by M9 congestion constraint and are thus impacted by the same contextual factors as these two mechanisms.

3.5.3 WPL THEORY OF CHANGE MAP

Figure 3.3 presents the WPL ToC Map. This is the output from the process illustrated in Figure 3.2. This was first presented in Paper 2, Figure 1, but has been updated in this section and enhanced using material from Paper 3 as discussed at the end of Section 3.5.1. This WPL

ToC map is chronological in nature and identifies the stages and linkages flowing from the initial context to the inputs, outputs, outcomes and eventual longer term impacts. It also shows which outcomes and impacts contribute towards the following WPL Objectives. These are discussed previously in Section 1.3:

WPL_O1 - Constrain congestion in the AM and PM peak periods.

WPL_O4 - Encourage sustainable travel and mode choice.

WPL_O5 - Enhance the attractiveness of Nottingham as a location for business investment.

The mechanisms of change from Tables 3.2 are integrated into the WPL ToC map. The mechanisms that have been identified try to balance the need for them to be defined and discrete with recognition, that if they were broken down into the smallest units, there could be double or triple the number. Thus, individual mechanisms occur at more than one place within the map. Contextual factors that are relevant at the scheme's inception are identified within the background and context box in Figure 3.3. The exogenous contextual factors which have changed over the evaluation period (2010-16) and could impact on the efficiency of the mechanisms, are not specifically included in Figure 3.3, but are represented in Table 3.2 and discussed in the previous Section.

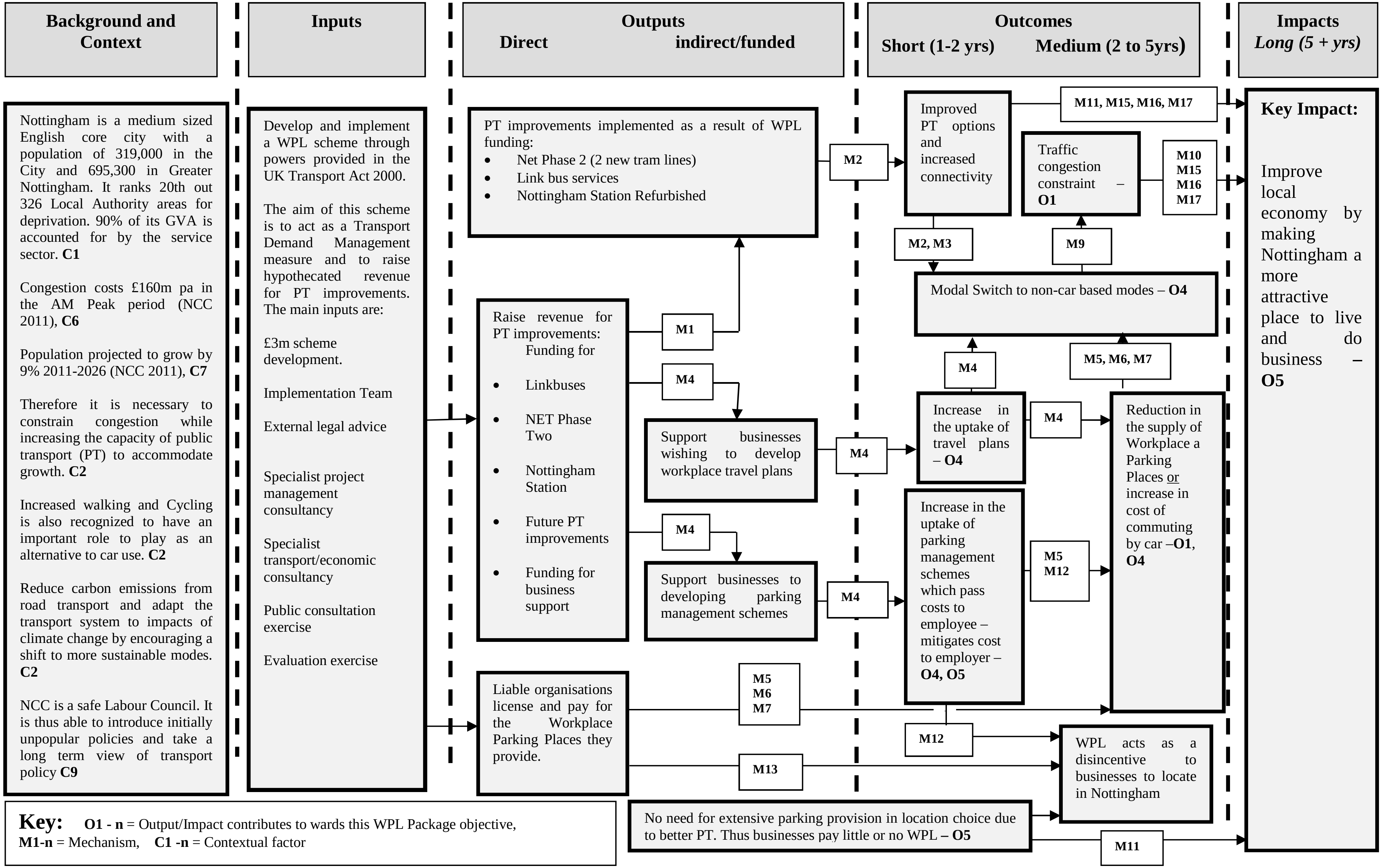


Figure 3.3 WPL Theory of Change map

3.5.4 CHOOSING COMPARATOR CITIES FOR BENCHMARKING INDICATORS

In Section 3.3 the desirability of including an element of quasi-experimental evaluation within the overall ToC Approach framework is discussed. To facilitate this it is necessary to identify comparator cities to Nottingham to provide a non-random control group. It is important that the cities chosen are as similar as possible to Nottingham. Based on size, geography, demographics, economic structure and transport characteristics, Newcastle, Liverpool, Sheffield and Leicester were selected. The detailed justification for choosing these is presented in Appendix E. The following indicators are available for all 5 cities:

- Journey Time per Vehicle Mile on locally manged A roads in the AM Peak Period
- Public Transport patronage
- GVA
- Number of jobs located within the City
- Net Business births and deaths

The above indicators are fully specified in Table 4.1 in Chapter 4.

3.6 SUMMARY

In this Chapter a WPL ToC is proposed based on the existing evidence base from similar interventions, academic literature and stakeholder input. This WPL ToC has been strengthened by itemising and including external contextual factors and individual mechanisms based on existing theory which will lead to change. This inclusion of mechanisms facilitates an understanding of how each step along the causal pathway from implementation to impacts is achieved, as well as informing the research required to test their operation. To support this approach a quasi-experimental methodology has been outlined whereby change in Nottingham is benchmarked against comparator cities.

The next step in the evaluation process is to identify the available indicators that can facilitate the proposed research and provide metrics against which progress towards the three WPL Scheme objectives and the WPL ToC can be tested. The next Chapter outlines the methodologies used to test the WPL ToC and thus evaluate the impact of the WPL and its associated transport improvements on traffic congestion and inward investment.

As the WPL ToC map identifies not just the starting point and desired end point on the causal pathway, as would be the case in an evaluation which relies on an experimental or before and after approach, but all the steps along the route, it enables the monitoring to be tailored to verifying the postulated outcomes and impacts at each stage as well as testing if the mechanisms that facilitate this are active. Additionally the monitoring must also test the extent of contextual change which the WPL ToC suggests may act on these mechanisms to impact their effectiveness. The subsequent Chapter identifies indicators and methodologies capable of achieving this.

4 RESEARCH METHODOLOGIES

4.1 INTRODUCTION

In the previous Chapter the ToC approach is shown to be appropriate for evaluating the Nottingham WPL with respect to its three key scheme objectives. A WPL ToC has been presented in Section 3.5 which shows how the WPL is expected to achieve these scheme objectives and according to the ToC approach, the next step is to test the extent to which these objectives have been met and thus test the WPL ToC. This Chapter identifies the data requirements and provides an overview of the methodologies required to achieve this and is, therefore, split into three sections.

4.2 Indicators of change - Identifies the indicators and evidence available to facilitate Thesis Objectives 2, 3, 4, 5 and 6 and which can be used to test the extent to which the WPL scheme objectives have been met and the WPL ToC.

4.3 Data collection methods - The methods required to assemble the datasets identified in 4.2.

4.4 Methods for attribution - Appropriate quantitative and qualitative methods to test to what extent observed changes in the indicators are caused by the WPL Package elements. These methods must also take into account the impact of the exogenous contextual factors identified in Table 3.1 in the previous Chapter. These methodologies are key to achieving Thesis Objectives 5 and 6.

4.2 INDICATORS OF CHANGE

Paper 1, Table 1 and Section 6 identifies an initial monitoring framework, however this has undergone significant development since the paper was submitted due to practical experience. Table 4.1 summarises the indicators that are available and maps these against both the objectives of this thesis and the WPL Objectives set by NCC. The choice of these indicators was informed by the literature presented in Chapter 2. They were also determined by the WPL ToC and to this end the table identifies which Outcome, Impact and Mechanism is tested by each indicator. Thus, the WPL ToC directs the evaluation by identifying what research is required to evaluate the outcomes and impacts of the WPL on each step of the causal pathway from implementation to longer term impact. This is particularly useful in this evaluation as it may be some time after this thesis is submitted before the full economic benefit is realised.

Table 4.1 also identifies which data sources include data for the four comparator Cities identified in Section 3.5.4. This is important for attribution of cause and effect via the quasi-experimental component of the evaluation as discussed in the previous Chapter. Indicators which evidence contextual change are not included in this table, but are addressed in Chapters 5 and 6 as and when they are relevant.

The base year for the indicators is 2010, the year before the commencement of WPL licencing. However, where available, data for 2009 has been provided for economic indicators as it is possible that potential investors could have been influenced prior to the scheme's implementation.

Table 4.1 Summary of indicators

Nottingham WPL Objective	Thesis objective	Tested WPL ToC Outcome/Impact	Tested WPL ToC Mechanism	Performance Indicators	Description of base data	Source	Comparator data available?
WPL Objective 1: Constrain congestion in the AM and PM peak periods	2 and 5	Constrain traffic congestion	M9, M10, M8	Journey Time per Vehicle Mile	AM peak period journey time (decimal mins), on NCC congestion monitoring network.	Primary Data	No
	2 and 3	Increase in the uptake of travel plans	M4	Percentage of employees covered by a travel plan	Percentage of employees covered by a travel plan at start of financial year	NCC	No
	2 and 3	Increase in the uptake of parking management schemes which pass costs to employee – mitigates cost to employer	M12, M13	Number of places and number of employers covered by workplace parking management schemes	Number of WPPs and employers covered by workplace parking management schemes	NCC	No
	2, 3 and 5	Reduction in the supply of Workplace Parking Places <u>or</u> increase in cost of commuting by car AND WPL acts as a disincentive to businesses to locate in Nottingham AND no need for extensive parking provision in location choice due to better PT. Thus businesses pay little or no WPL	M5, M6, M7	Number of Liable Workplace Parking Places	Total number of WPPs for which the charge is paid	Primary Data	NA

Nottingham WPL Objective	Thesis objective	Tested WPL ToC Outcome/Impact	Tested WPL ToC Mechanism	Performance Indicators	Description of base data	Source	Comparator data available?
1: Constrain congestion in the AM and PM peak periods	5	Constrain traffic congestion	M9, M10, M8	Journey time per vehicle mile on locally managed A roads in the AM Peak period	AM peak period journey time (decimal mins), on A roads for which NCC is the highway authority, this data reflects both inbound and outbound travel to the City	DfT	Yes
WPL Objective 4: Encourage sustainable travel and mode choice	2	Modal Switch to non-car based modes	M2, M3, M5, M6, M7, M8	Mode share of public transport at Inner Area Traffic Cordon	Percentage of travel by public transport on main radial routes +tram/rail	NCC	No
	2 and 5		M2, M3, M5, M6, M7, M8	Local bus and light rail passenger journeys	Millions of passengers on trams and buses in City and Greater Nottingham	NCC	Yes
	2 and 5		M2, M3, M5, M6, M7, M8	Cycling trips	Cycle counts at strategic points in City (Index 2010 = 100)	NCC	Yes
WPL Objective 5: Enhance the attractiveness of Nottingham as a location for business investment	4 and 6	Improve local economy by making Nottingham a more attractive place to live and do business **-**	None, indicative of overall economic performance but does not evidence causality	Employee numbers	Number of jobs in the City	Business Register and Employment Survey	Yes
	4 and 6			Gross Value Added (GVA) for the Nottingham City Area	£ Million	Office for National Statistics (ONS)	Yes

Nottingham WPL Objective	Thesis objective	Tested WPL ToC Outcome/Impact	Tested WPL ToC Mechanism	Performance Indicators	Description of base data	Source	Comparator data available?
	4 and 6			Business investment enquiries and subsequent successes	Number of business investment enquiries to NCC Inward Investment team and subsequent successes	Invest in Nottingham	No
	4 and 6			Volume of deals done on rental of commercial properties	Square ft. of floor space/ No. of deals	Commercial Estate Agents	No
	6		M11, M15, M16 and M17	Examples of investment and dis-investment decisions	Qualitative data	Primary Data	No

4.3 METHODOLOGIES FOR DATA COLLECTION TO ASSEMBLE INDICATORS

In this section the methodologies required to collect the data identified in Table 4.1 is detailed.

4.3.1 METHODOLOGIES FOR DATA COLLECTION: CONGESTION INDICATORS

Vehicle Journey Time and Vehicle Delay

This data source was initially presented in Paper 1, Section 6.2 and is central to Paper 4 and is thus described in Section 3 of that paper. Journey Time per Vehicle Mile (JTVM) is collated across sixteen radial routes inbound into Nottingham and in both directions on the main orbital route the A6514 (the Nottingham Ring Road) in the AM Peak period (07:00-10:00) for cars and light goods vehicles. The total length of the network used in this study is 68.2 miles.

This metric is calculated using average journey time generated from the Trafficmaster (TM) satellite navigation system, fitted to many fleet and private vehicles in the UK. This data source is also used by the DfT to generate national journey time statistics in preference to other similar data sources.

Figure 4.1 shows the congestion monitoring network used for this research. In addition to the above data, the DfT provide figures based on TM data for Locally Managed A Roads in the AM peak period by Local Authority. It should be noted that this data has two key differences from the NCC TM analysis:

1. It is two way whereas the NCC data is inbound only, except for the A6514 Nottingham Ring Road.
2. The network is different as it includes all A roads whereas the NCC network includes some B and unclassified roads, but excludes some A roads which are orbital routes.

It is suggested that this will result in the following:

1. The DfT dataset will run slower as some of the orbital A roads not included in the NCC dataset have very low speeds e.g. the A6008 Inner Ring Road.

2. The magnitude of change is likely to be less in the DfT dataset as the inbound radial routes which are at or near capacity in the AM peak period and only require a small increase in traffic to result in a large increase in journey time, will be offset by the inclusion of outbound radials which are not at capacity in the AM peak.

Despite these differences this data should broadly reveal the same trends and can be used to benchmark the Nottingham data.

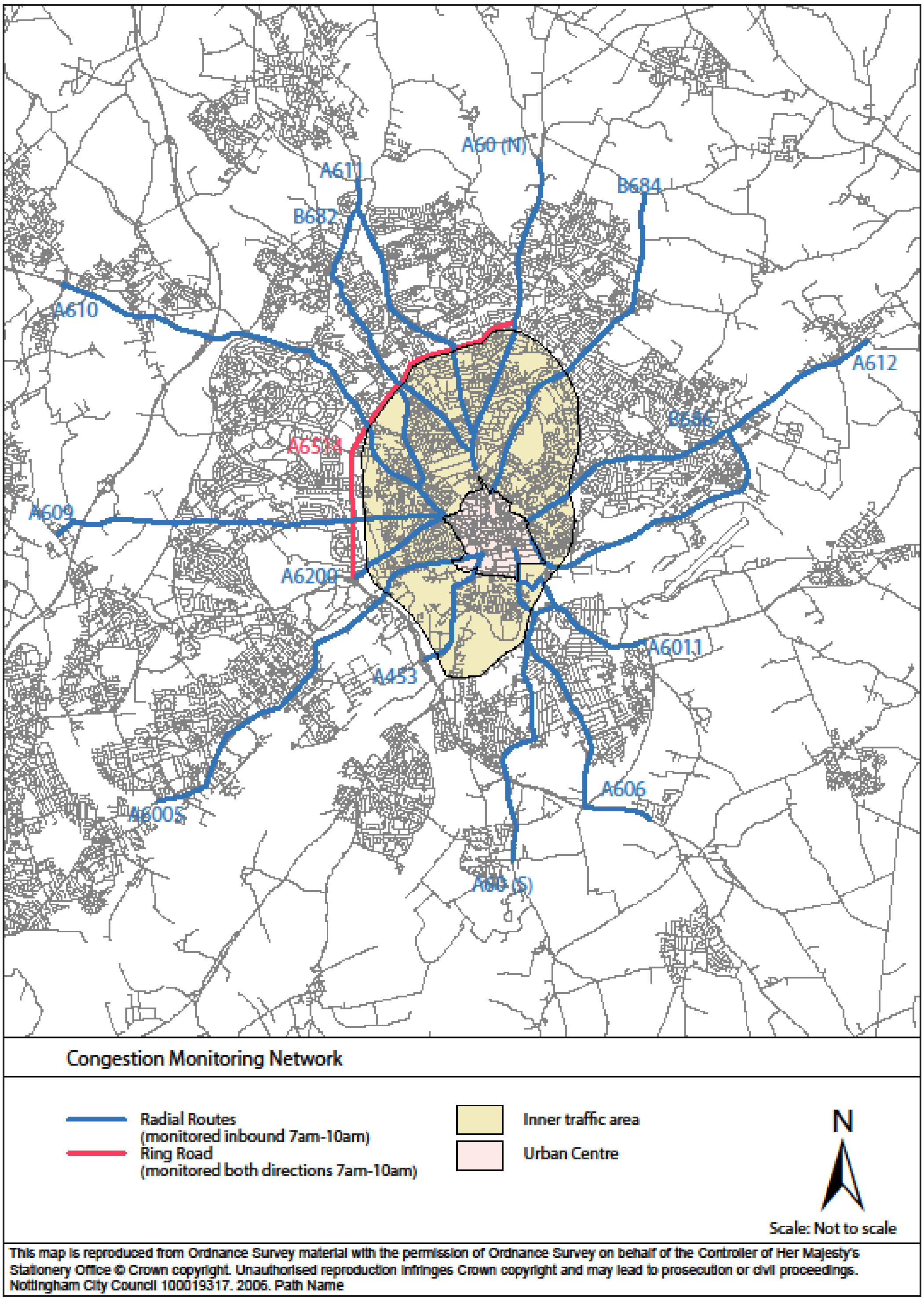


Figure 4.1 Greater Nottingham Congestion Monitoring Network

Given WPL objective 1, “Constrain Congestion in the AM and PM Peak periods”, there is an assumption within this research that both peaks are similar in terms of overall congestion levels and respond to drivers of congestion in the same way. To substantiate this assumption the average total journey times to traverse the congestion monitoring network (See Figure 4.1) in the AM peak period (7am to 10am) and the PM Peak Period (4pm-7pm) were calculated and were found to be 248 minutes and 245 minutes respectively in 2015/16, a difference of just 1.2%. Furthermore, an examination of data presented in Table 4.2 which shows the factors used to convert the AM and PM peak hour flows to a 16 hour weekday flow (calculated from the City’s permanent automatic traffic counters) reveals that the relationship between the two peaks remains relatively stable over the study period.

Table 4.2 Factors used to convert weekday peak hour flows to 16 hour school term time weekday average flows

Year	AM	PM
2011	11.73	11.80
2012	11.96	11.11
2013	11.85	12.28
2014	12.39	12.46
2015	12.83	12.38

Source: Nottingham City Council

These two metrics suggest that both the scale and trend in the AM and PM peaks are similar. The AM peak period was chosen to be consistent with the historic practice of both the DfT and NCC to monitor in this period rather than in the PM peak period or both. Thus, data supplied by both NCC and the DfT which is used in this Thesis for triangulation and benchmarking refers to the AM Peak only. The DfT (2016) notes that the AM peak is chosen to monitor congestion indicators as it is the period when demand is at its highest.

4.3.2 METHODOLOGIES FOR DATA COLLECTION: MODE SHARE INDICATORS

The percentage share of people travelling by motorised modes of travel is monitored at twelve sites arranged in a cordon on the main radial routes just inside the Inner Traffic Area of the conurbation. This is a manual survey conducted in Spring and Autumn in the AM peak period (7am-10am) for inbound traffic. A classified traffic count is augmented with bus, tram and multiple occupancy car surveys, together with a count of passengers exiting Nottingham Railway Station. The total people movements by mode can then be calculated and thus the percentage of travel by each mode. Clearly, a shift away from the car and towards public transport supports the premise that WPL is either directly or indirectly, encouraging sustainable travel and mode choice. These surveys only include motorised modes as active modes such as cycling and walking tend to use more diffuse routes through the cordon. The level of cycling is monitored at strategic points across the cycle network in Greater Nottingham. Continuous cycle count data is obtained from automatic counters while monthly one day cycle counts are carried out at the five River Trent crossings. Data is combined for all sites to produce City/Greater Nottingham figures. These mode share and cycle metrics are complimented by total patronage data for bus and tram modes. This data is the total number of passengers boarding each mode by quarter over the whole day. At the end of each quarter the largest public transport operators (NCT, Trent Barton and Tramlink) supply a detailed return of their passenger numbers. These get apportioned between the City, County and other Authorities on the basis of past surveys. A top up amount for smaller operators is added at the end of each financial year. This data collection is organised and analysed by NCC as part of its annual monitoring programme.

4.3.3 METHOD FOR MONITORING INWARD INVESTMENT.

One of the major concerns about the WPL scheme raised in the media is that it will drive employers away from Nottingham. The term inward investment in this evaluation refers not just to new investors, but also the effect of the WPL package on the indigenous business population as they make decisions to invest, de-invest or relocate. The indicators chosen to monitor this can be subdivided as follows:

- Macro-economic indicators - Datasets relating to the general economic health of the City.
- Local inward investment indicators – Indicators relating directly to individual investment decisions, even if this data is aggregated.

Papers 1 and 3 utilise the datasets below and thus the methodologies for the collection and analysis are presented within these papers. Paper 1, Section 6.3 provides an overview while Paper 3, Sections 4.1 and 5.1 discusses the macro economic datasets and Sections 4.2 and 5.2 of that paper discuss the local inward investment indicators.

4.3.3.1 Methodologies for data collection: Macro-economic indicators

The number of jobs (employees) in Nottingham - This metric is supplied by the Office for National Statistics (ONS). It is collected by the Business Register and Employment Survey. The data shows a snapshot in September of a particular year, so it will exclude the majority of seasonal jobs. This data source may also include a degree of over estimation when analysed by area due to national business HQs in Nottingham registering all their national jobs in Nottingham. However, this could be equally true in the other Cities, thus the official ONS figures are now accepted in this evaluation.

Economic output - Gross Value Added (GVA) is a measure of economic output which provides the total value of goods and services produced in an area. GVA is related to the more commonly used GDP as follows:

GVA + Taxes on products - Subsidies on products = Gross Domestic Product (GDP)

As taxes are not collated at a local level, GVA is the normal indicator for tracking regional economic output. The annual time series for GVA at local authority level is supplied by the ONS.

4.3.3.2 Methodologies for data collection: Local inward investment indicators

These indicators are intended to track the level of investment and de-investment in Nottingham. Up to the end of 2014, Nottingham City Council maintained an Inward Investment Team dedicated to working with employers interested in investing in Nottingham. This team supplied the data for this part of the WPL evaluation. From 2015 onwards this function was re-organised and the Inward Investment Team was replaced by Invest In Nottingham, an arms-length organisation controlled by NCC. Unfortunately, this change resulted in a disruption to the supply of this data and this has made the economic evaluation of the WPL more difficult.

The level of inward investment enquiries - The Inward Investment Team maintained a record of the level of enquiries which they received, the number of those which ended with successful inward investment and the additional employment that was generated. It is considered that tracking this data year on year will be indicative of the level of investment in the City. However, it should be noted that this is not a complete record of inward investment and applies only to cases known to the NCC Inward Investment Team.

The volume of deals done on commercial property in Nottingham - This data was supplied by commercial estate agents via the Nottingham Office Review (Lambert Smith Hampton, 2014) and expresses the number of deals done and the floor space concerned in each deal, thus enabling an annual figure to be calculated. It is considered that this metric is indicative of levels of inward investment.

4.4 METHODS FOR ATTRIBUTING CHANGES TO INDICATORS TO THE WPL PACKAGE

As discussed in Chapter 2 an evaluation requires an assessment of to what extent the change observed in the indicators can be attributed to the intervention which is being evaluated. In this Section the methodology for achieving this attribution is discussed.

For the indicators related to congestion there are three principal methods which have been used to achieve attribution:

1. Benchmarking indicators against the 4 Comparator Cities; Leicester, Sheffield, Newcastle and Liverpool. This is only possible for indicators where comparable data is available. The detailed methodology and results are provided in Chapter 5, Section 5.2.7.1.

2. Time series modelling which takes into account exogenous external contextual variables and tests the correlation between variables representing the introduction of the WPL and the levels of congestion. This is fully described in Paper 4 and Chapter 5, Section 5.2.7.2.

3. A survey of commuters which asked those who have switched mode away from the car why they have done so. Clearly, each case where this has been due to reasons linked to the WPL package provides attribution of cause and effect. The detailed methodology and results are provided in Chapter 5, Section 5.2.7.3.

For indicators which track the economic and inward investment performance, attribution is tested firstly by benchmarking the macro-economic indicators against the Comparator Cities (This research is described in Section 5.3.3.1) and secondly by examining individual investment and dis-investment decisions (see Section 5.3.3.2). This data explores the reasoning behind important investment or de-investment decisions that have been managed by the City Council's Inward Investment Team. It gives an understanding of the causal factors which influence these decisions, including the role played by improving public transport options and the WPL. While the number of the examples recorded will not be suitable to track trends in business investment or disinvestment they do provide evidence as to what factors have caused the patterns observed in the other local inward investment indicators. This data source is discussed in Paper 3, Section 5.2.

Officers within the Nottingham City Council's Inward Investment Team were provided with a pro-forma for capturing examples of investment decisions and this is included in Appendix F. There are a number of issues concerning this data which require consideration:

1. The examples have been compiled based on the accounts of Nottingham City Council officers responsible for handling each relevant 'account'. These officers were responsible for negotiating and assisting each investor or dis-investor.
2. It is necessary to anonymise the examples for reasons of confidentiality.
3. The examples supplied represent major investment decisions and de-investment decisions, as well as all cases where WPL is cited as a factor in the decision.
4. It is recognised that this indicator does not present a complete dataset, but it seeks to provide relevant examples to demonstrate attribution.

4.5 CONCLUSION

In this Chapter an overview of the data and methodologies used for this EngD research is provided. This supports the monitoring of change to indicators relevant to the three key WPL objectives and the WPL ToC. These methods will enable Thesis Objectives 2, 3 and 4 to be met. Methods to achieve attribution of changes to these indicators to causal factors, including the WPL Package, have been specified thus facilitating Thesis Objectives 5 and 6.

The research undertaken utilising this methodology is detailed in Chapter 5 together with findings which address Thesis Objectives 2,3,4,5 and 6. Where necessary additional methodological detail is provided in chapter 5 so as to integrate methodology and findings where the research method is complex and the two indivisible, the time series analysis being an example of this approach. This research also serves to test the WPL ToC to see if the desired Outcomes and Impacts have been realised as expected.

5 THE RESEARCH UNDERTAKEN AND KEY FINDINGS

5.1 INTRODUCTION

Chapter 5 details the research carried out over the course of the four year EngD. Firstly, the research in this Chapter evidences and discusses changes to the indicators chosen in Chapter 4 to measure the impact of the WPL and its associated public transport (PT) improvements on congestion mode share and inward investment. Secondly, it assesses to what extent those changes can be attributed to the WPL and its associated public transport improvements. This Chapter is split into 2 main Sections; Section 5.2 describes the research and findings concerning the impact on congestion and mode share, while Section 5.3 concerns the impact on inward investment. There is then a final Section, 5.4, which summarises the research and findings for both congestion, mode share and inward investment and the linkages between these outcomes and impacts. The research presented in this Chapter can thus be used to assess if the observed changes to the chosen indictors are as would be expected, given the WPL ToC presented in Chapter 3, once any relevant exogenous, contextual change has been taken into account. Throughout this Chapter references are made, where appropriate, to Papers, 3 and 4 which contain key research relevant to the thesis objectives.

5.2 IMPACT OF WPL ON CONGESTION AND MODE SHARE: RESEARCH AND FINDINGS

In this Section the research carried out to provide and analyse time series data which measures congestion and mode share is presented and this is followed by an account of the research carried out to determine to what extent these changes are attributable to the WPL and its associated PT improvements. This Section, therefore, facilitates Thesis Objectives 2, 3, and 5 and enables an assessment as to what extent the WPL has met its objectives with respect to congestion constraint and mode shift (WPL_O1 and WPL_O4).

The individual indicators, how they map against the WPL Objectives, the objectives for this thesis and the data collection methodologies are presented in Chapter 4, Section 4.2, 4.3 and Table 4.1. However, Journey time per Vehicle Mile, Delay per Vehicle Mile and Liable Workplace Parking Places metrics required additional analysis to produce a time series. The research undertaken to achieve this is described below in Sections 5.2.1 and 5.2.2 and Paper 4.

5.2.1 RESEARCH UNDERTAKEN TO PROVIDE TIME SERIES DATA FOR JOURNEY TIME PER VEHICLE MILE (JTVM) AND DELAY PER VEHICLE MILE (DVM)

As discussed in Chapter 2 Section 2.3.1 the chosen metrics to monitor congestion are JTVM and DVM. Chapter 4, Section 4.3.1 explains the overall methodology for collecting this data. In this Section the additional analysis required to generate these time series is described. This research is also detailed in Paper 4, Section 3.

From 2010 onwards Trafficmaster GPS journey time data, from a satellite navigation system widely used in vehicles in the UK, has been supplied to Local Authorities by the UK Department for Transport (DfT).

For this study congestion is measured inbound on the main radial routes into Nottingham and on the main orbital route (A6514 Ring Road) in both directions in the AM peak period (7am-10am). Figure 4.1 shows the congestion monitoring network. Night time reference journey times needed to generate DVM are averaged across the period 02:00-05:00. Multiple years are required due to data sparsity issues.

This dataset renders an average journey time for each link on the UK Ordnance Survey Integrated Transport Network in each 15 minute period by date.

The following formula was used to calculate JTVM and DVM from the raw Trafficmaster data for a given time period:

$$AJT = (\sum_{1-n}^{l} \mathrm{JT})/\mathrm{n}$$

$$ANJT = (\sum_{1-n}^{l} \mathrm{NJT})/\mathrm{n}$$

$$JTvM = \sum_{1-n}^{s} (((\mathrm{AJT}/60) * \mathrm{FL})/(\mathrm{SL}/1609.3 * \mathrm{FL})) * (\mathrm{SL}/\mathrm{NwL})$$

$$DVM = \sum_{1-n}^{s} ((((\mathrm{AJT} - \mathrm{ANJT})/60) * \mathrm{FL})/(\mathrm{SL}/1609.3 * \mathrm{FL})) * (\mathrm{SL}/\mathrm{NwL})$$

JTVM = Average Journey Time per Vehicle Mile
DVM = Average Delay per Vehicle Mile
AJT = Trafficmaster average journey time for individual time period on each date
NJT = Night time Trafficmaster average journey time for individual time period on each date
AJT = Average AM Peak Period Journey Time in seconds
ANJT = Average Night time Journey Time in seconds
S = segment
l = ITN link
FL = total flow in the AM peak period
SL = Length of Segment
NwL = Total Network Length

Each value rendered for each 15 minute period is treated as 1 observation, regardless of the actual number of vehicles from which the figure was derived. This is because the observations within each period will not be independent of one another where the link is close to capacity.

Bespoke MS ACCESS applications were developed to output these two metrics based on guidance from the DfT (DfT 2009).

5.2.2 RESEARCH UNDERTAKEN TO PROVIDE TIME SERIES DATA FOR THE NUMBER OF LIABLE WORKPLACE PARKING PLACES (LWPP)

This is an important metric as it highlights changes to employer behaviour and is indicative of key mechanisms of change M5, M6 and M7 which explain why the quantity of WPP provided should decrease and thus enable a standalone impact from the WPL on congestion. There is no one time series which spans the before and after period, although data is available from the 2010 Off Street Parking Audit (OSPA) which was a complete survey of LWPP prior to implementation, and WPL and monthly licencing data from the commencement of the scheme. These allow a time series to be synthesised.

Unfortunately, the OSPA surveys prior to the commencement of WPL licencing, do not provide complete data for total WPP which includes exempt employers, thus the quantity of LWPP is used as a continuous variable. LWPP are defined as those parking places which are liable to the full WPL charge and are not exempt or subject to a 100% discount. The research that was undertaken to assemble a time series for this metric is fully described in Paper 4, Section 3.

5.2.3 OBSERVED CHANGES TO CONGESTION INDICATORS

In this Section the findings with regards to Thesis Objectives 2, and 3 are presented. These aim to monitor changes to relevant time series which can be used to test the WPL ToC with respect to the anticipated impact on congestion and mode share. An assessment has been provided as to what extent they have moved in the direction expected given the WPL ToC and the WPL Objectives.

Table 5.1 shows three time series which evidence how congestion, as measured by JTVM, has changed between 2010/11 and 2015/16. The three corridors in which the two new tramlines (NET Phase 2) have been constructed are presented alongside data for the whole congestion monitoring network. The full dataset is provided in Appendix G.

Table 5.1 Summary of principal annual time series for congestion in Greater Nottingham

Route	From	To	Trafficmaster Data					
			2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
A453 (Full corridor)	Barton in Fabis	City Centre	4.24	3.90	4.69	5.33	5.33	2.40
A6005	Nottingham Rd Chilwell	City Centre	3.42	3.29	3.62	4.76	3.78	3.35
A52W (Full corridor)	M1 Junction 25	City centre	3.39	3.15	3.67	4.30	3.79	2.94
All routes on congestion monitoring network	**NA**	**NA**	**3.38**	**3.28**	**3.45**	**3.76**	**3.78**	**3.69**

Source: Nottingham City Council, Trafficmaster

Across all routes, an initial drop in congestion in 2011/12 was followed by a year on year increase in the following three years until a slight fall in 2015/16.

The tram corridors have seen a steeper rise in congestion than the wider congestion monitoring network since 2011/12, as one would expect with peak period lane closures associated with the construction works for NET Phase 2, the Ring Road Major Scheme and the A453 improvement. However, these works concluded in 2014/15 and in 2015/16 there was a fall in JTVM.

While the three years of increasing congestion would appear to be contrary to the WPL ToC, the WPL package was implemented within a period of economic growth and disruption to the network due to the above works, so considering these two contextual factors, it is not entirely unexpected. The literature presented in Chapter 2 shows that these two contextual factors would normally increase traffic congestion and could have obscured any impact of the introduction of the WPL. The importance of this context is tested in Paper 4 and is discussed in Section 5.2.7.2 of this Chapter.

5.2.4 Observed Changes to Modal Share Indicators

The WPL ToC Map (Chapter 3 Figure 3.3) suggests that any congestion constraint is enabled, at least in part, by a mode shift away from the private car towards more sustainable modes, due to enhanced PT options and a reduction in the supply of WPP (M2, M3, M5, M6 and M7). The methodology for obtaining mode share data is described in Chapter 4 Section 4.3.2.

Table 5.2 presents the matching datasets for mode share and person movements in Greater Nottingham. This is monitored at 14 sites arranged in a cordon on the main radial routes just inside the Inner Traffic Area (ITA) of the conurbation.

Table 5.2 AM inbound peak period modal share data for the ITA cordon

Metric	Route	2010	2011	2012	2013	2014	2015
% Public Transport Mode Share of motorised traffic at the ITA Cordon (Excludes LGVs/HGVs)	A453 Clifton Lane	35.9	33.0	26.3	19.2	25.4	25.5
	A6005 Abbey Bridge	15.1	16.8	12.3	10.8	9.2	45.3
	B682 Vernon Road.	68.3	66.5	66.9	65.3	77.9	70.6
	All routes weighted average	**35.4**	**36.5**	**35.9**	**34.5**	**35.8**	**37.0**
	Weighted average inc. rail trips	**37.9**	**38.8**	**38.4**	**37.0**	**38.6**	**40.6**
Persons	Rail passengers exiting Nottingham Station	2732	2431	2589	2584	2829	3968
	Total people movements all motorised modes	68372	69361	67439	67834	64879	70368

The modal share data for 2016 was still being validated at the time of submission.

The PT mode share time series can be summarised as follows

1. A rise from 2010 to 2011.

2. A period of levelling off between 2011 and 2014. Within this period, 2013 saw a sudden drop of 1.4% which was reversed in 2014. It is not known whether this is data anomaly or due to a real world cause.

3. In Autumn 2015, the proportion of people travelling by PT crossing the Inner Traffic Area cordon, jumped by 2%, driven by both a growth in travellers using Nottingham Station (as evidenced in Table 5.2) and the opening of the two additional tram lines. Thus the PT mode share is now over 40% for the first time. Table 4.6 shows that, in 2015/16, following the opening of these two new tram lines, public transport patronage increased by almost 1.5 million passengers compared to 2014/15.

4. In general the three corridors containing the tram lines show a decline in 2013 due to a change in integrated ticketing arrangements and the disruption due to the roadworks followed by an increase in subsequent years. Overall the A453 corridor hasn't seen a rise in mode share of PT over the study period as the dualing of this link has seen an increase in cars which has offset the additional PT patronage due to the new tram line. The A6005 has seen a large increase in 2016 due to the new tramline. The B682 with its existing tram line has also seen a large rise in 2014 but falls back in 2015, but is still higher than prior to 2014.

The total people movements across the ITA cordon range between 67,400 and 69,400 2010 to 2013. However, 2014 shows a 4.4% fall in the number of people crossing the cordon, but there is no evidence to suggest a cause for this. However, this then rebounds to over 70,000 in 2015 driven by an increase in people exiting Nottingham Station and extra tram patronage on the two new tram lines. Table 5.3 presents the annual total Public Transport (PT) patronage data for Greater Nottingham.

Table 5.3: Public transport patronage in Greater Nottingham

Year	Passengers (millions)
2010/11	75.90
2011/12	76.21
2012/13	74.13
2013/14	74.95
2014/15	75.58
2015/16	77.03

Source: Nottingham City Council

The annual total PT patronage for Greater Nottingham demonstrates a trend generally consistent with the mode share time series. However, 2012/13 saw a fall in PT patronage which coincides with the period following changes made to Nottingham City Transport's Easy Rider City Card travel card and integrated day ticketing arrangements in December 2011, neither of which included tram travel beyond the start of 2012. This effectively increased the cost of travel on the tram.

There is thus little conclusive evidence that the introduction of WPL has impacted the mode share of PT on the ITA cordon prior to the opening of NET Phase 2. However, the 2015/16 data shows a significant increase with historic high levels of PT mode share and patronage and this directly coincides with the opening of NET Phase 2 which is part funded by the WPL.

The mode share data for the ITA cordon does not include cyclists. The level of cycling in Nottingham is expressed as an index with 2010 being 100. This is based on counts across the cycle network. There has been a 34% increase in cycle trips in Nottingham in the study period. When this index is applied to the 3.5% cycling mode share suggested by the UK 2011 Census, an increase from 3.0% to 4.1% in mode share is indicated. Although this may reflect the boom status of cycling as a sport it is nevertheless an encouraging trend and also corresponds with the introduction of the WPL.

The increase in cycling from 2010 and in PT mode share following the opening of NET Phase 2 would be expected given the WPL ToC.

5.2.5 IDENTIFY CHANGES TO EMPLOYER BEHAVIOUR RELEVANT TO THE OBJECTIVES OF THE WPL PACKAGE

Objective 3 of this Thesis identifies the need to record changes to employer behavior relevant to the WPL Objectives 1 and 4, i.e. congestion and mode share. Three important behavioural changes amongst City employers have occurred as a result of the introduction of the WPL which will contribute to the objective of constraining congestion in the peak periods. These changes are evidenced and discussed below.

Supply of Liable Workplace Parking Places (LWPP) - In Section 5.2.2 the construction of a timeline for LWPP was discussed and this is presented in Figure 5.1.

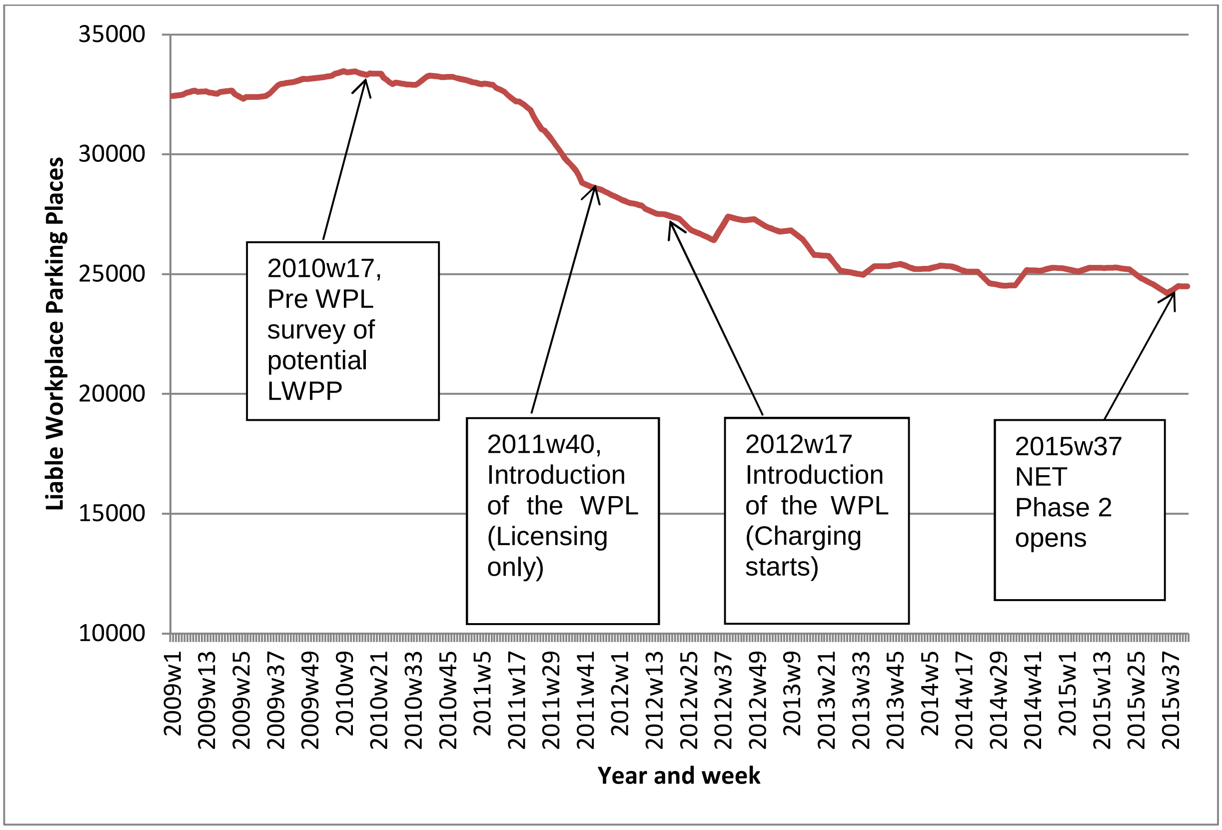


Figure 5.1 The supply of liable workplace parking places

LWPP shows an initial fall of 17.5% prior to the introduction of the WPL and a subsequent more gradual fall to around 75% of its 2010 levels. This demonstrates that employers have reduced their supply of LWPP in reaction to the WPL, either as a response to a decline in demand from their employees due to increased cost, or in order to reduce their liability. This is in accordance with the WPL ToC as it is indicative that Mechanisms M5, M6 and M7 (See Table 3.2), which all rely on a reduction in LWPP supply, are operational and thus should contribute to congestion constraint. M12, whereby the cost of the WPL is passed on to employees, will follow on from this to offset the cost to business, M13.

Workplace Travel Planning - This has increased by 18% since the introduction of the WPL. Although this is a modest increase, it should contribute, when combined with other elements of the WPL package, to congestion constraint via mechanism M4 which refers to mode switch due to workplace travel planning activities.

The number of LWPP covered parking management schemes which pass on the cost of the WPL to employees - Table 5.4 shows that the number of places covered by parking management schemes has increased in the period 2013 to 2016.

Table 5.4 LWPP covered parking management schemes which pass on the cost of the WPL to employees

	2013 WPPs in liable employers	**2016 WPPs in liable employers**
All	26449	24895
Parking Management	10281	13342
% of all WPPs	38.9%	53.6%

There is no data for the 2010 baseline, however the City Council's Travel Planning Team estimates that less than 1% of all WPPs in Nottingham were covered by parking management schemes at that time. Despite the lack of before data, there can be little doubt that the introduction of WPL has acted as an incentive to introduce formal parking management schemes, whereby the cost of WPL is passed onto employees. Notable examples of this are the University of Nottingham, Boots and Nottingham City Council, three of the City's biggest employers, all of whom have introduced schemes since the introduction of the WPL. This change in behaviour is important with respect to the operation of the WPL ToC, as firstly it will enhance the TDM effect of the WPL as a standalone scheme (M5) and secondly, employers examining Nottingham's "package" as a place to locate will be able to see that the cost of WPL, M13, can be offset, thus assisting with WPL Objective 5 via M12.

5.2.6 Summary of Changes to Congestion and Mode Share Indicators

While a consideration of context and attribution is essential and is addressed in the next two Sections, the following conclusions can be drawn from the above monitoring.

- An initial drop in congestion in 2011/12 was followed by a year on year increase in the following three years until a slight fall in 2015/16. This is not what would be expected given the WPL ToC, however, data on contextual factors is required before any conclusion can be drawn.
- JTVM has increased more on routes impacted by roadworks associated with construction of transport improvements, suggesting that this disruption may be obscuring any beneficial effect on JTVM of the introduction of the WPL.
- Mode share of public transport showed little growth prior to 2015 when NET Phase 2 was completed. However, it did increase to over 40% for the first time in 2015 driven by additional tram users on the two new tramlines and an increase in the use of heavy rail. An increase in the PT mode share is the outcome expected within the WPL ToC and is a pre requisite for achieving the longer term impact of congestion constraint.
- An increase in the uptake of workplace travel planning and parking management schemes which pass on the cost of the WPL to employees, combined with a 25% reduction in the supply of WPP, should contribute to congestion constraint.

5.2.7 Attribution and Context: Research to Identify the Impact of the WPL and Associated PT improvements on levels of Congestion and Mode Share

This Section builds on the monitoring described in Sections 5.2.3 and 5.2.4 to provide a more detailed consideration of contextual factors which will impact on the mechanisms of change identified in Chapter 3 Table 3.2 and to show to what extent changes to congestion and mode share indicators can be attributed to the components of the WPL package. This facilitates Objective 5 of this thesis. There are three research actions that were undertaken to achieve this:

1. Where data is available indicators were benchmarked against the four comparator Cities.
2. A statistical analysis was carried out on the impact of the introduction of the WPL as a standalone measure. This work is detailed in Paper 4.
3. 2000 Nottingham commuters were surveyed in late 2016 to ask if they had changed their normal main mode of travel to work since 2010 and, if so, why.

These three strands can then be combined to render a conclusion regarding the impact of the WPL Package on congestion and mode share.

5.2.7.1 Benchmarking indicators from Nottingham against Comparator Cities to account for context and attribution

The DfT publishes data on JTVM on locally managed A Roads, thus Nottingham can be benchmarked against the Comparator Cities. This dataset differs from the Trafficmaster metric developed specifically for this research as the networks are not the same and the DfT data applies to both in and outbound traffic, however, the overall trends should be similar. Figure 5.2 presents the results from the bespoke analysis of the Trafficmaster data against the DfT time series. The DfT time series was discontinued after 2015 as part of a review of DfT congestion indicators. The replacement indicator which is delay is not yet available at a local authority level.

It should be noted that it is not valid to compare the absolute values of JTVM in each City as the morphology of the road network is different in each City with significant variations in the types of route and relative proportions of high and low speed routes. Nottingham City has very few high speed routes on the A road network.

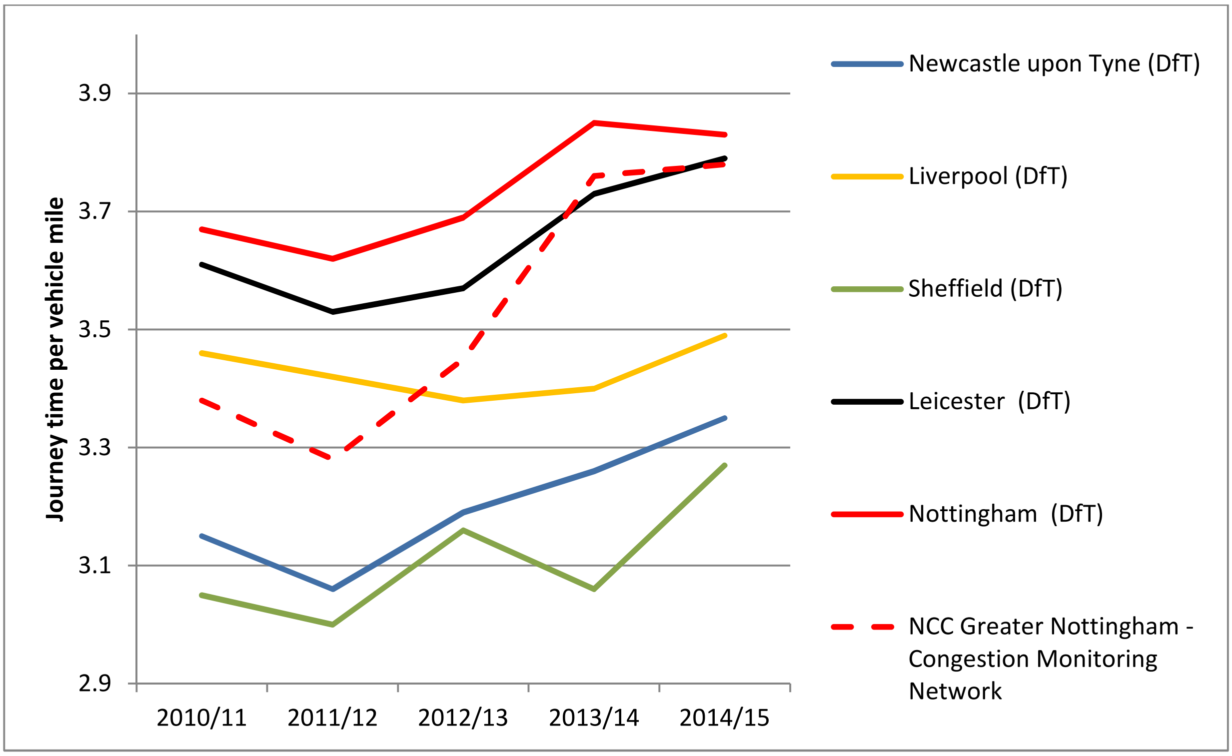


Figure 5.2 Journey Time per Vehicle Mile in Nottingham and Comparator Cities 07:00–10:00

Source: DfT Table cgn206b Journey Time per Vehicle Mile on Locally Managed A Roads in the AM Peak Period

Given the disruption caused by the construction works, it is encouraging that Nottingham performed similarly to other Comparable Cities during the period up to 2014/15.

More recently, as these roadworks were progressively lifted as the schemes neared completion, there have been some positive shifts in this indicator. Between July 2014 and July 2015, Nottingham was the only Core City in England to observe a reduction in JTVM on Locally Managed A Roads in the AM Peak Period. This fall occurs in the period where the above mentioned construction works ended. This fall in the level of congestion means that the overall rise in congestion since 2010 has been less than that observed in Leicester, Sheffield and Newcastle. Liverpool took a policy decision and suspended their bus lanes in October 2013 and has a general policy presumption of providing capacity enhancements to the road network (See Appendix H) and this may explain the low growth in JTVM compared to the other Cities.

The bespoke Trafficmaster analysis for this Thesis shows the same trend as the DfT time series, but the magnitude of change is greater. It would seem reasonable to assume that the presence of outbound links in the DfT dataset has a diluting effect on the overall indicator as peak period congestion tends to be tidal.

There are two important contextual considerations, however, regarding the 2011-15 period. Firstly, the key PT intervention of the WPL package, NET Phase 2, was only opened in August 2015, thus mechanisms M2 together with M3, the improved PT options encouraging mode switch and M8, the combined effect of the whole WPL package, have only had the opportunity to effect change as suggested by the WPL ToC since that date. Secondly, the construction phase of NET Phase 2, the dualing of the A453 link road to the M1 and the Ring Road Improvement scheme were all taking place simultaneously between mid 2012 and 2014 and caused significant traffic congestion on routes in the South, West and North side of the City (C8). This is evidenced by Figure 5.3.

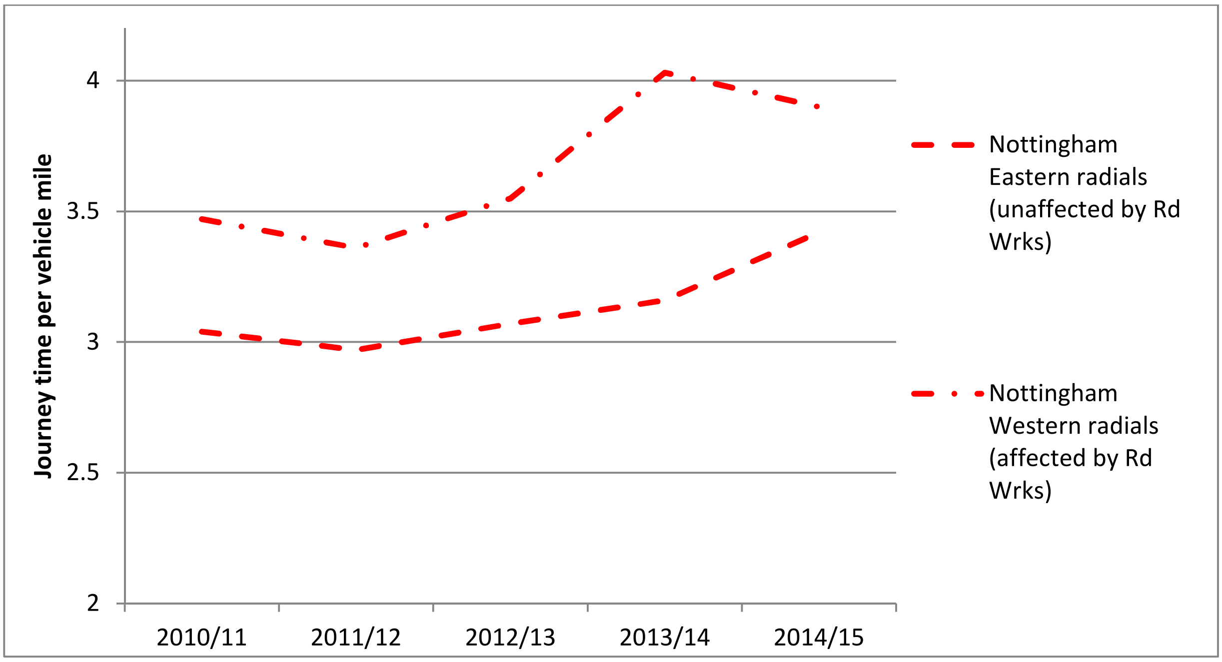


Figure 5.3 Journey Time per Vehicle Mile in Nottingham on routes affected/unaffected by construction works 07:00–10:00

Source: Nottingham City Council

It is concluded that the disruption caused by the construction phases of NET Phase 2, the Ring Road improvement scheme and the dualing of the A453, since their commencement in the summer of 2012, distorts the overall journey time per vehicle mile figure for Nottingham between mid 2012 and mid 2014. The eastern radials in Nottingham, which are isolated from the impacts of these works, can be used to show a more realistic pattern of change for this metric and demonstrate a similar change in that period to that in Sheffield, Leicester and Newcastle.

It is acknowledged that roadworks due to capital investment will be ongoing in some of the other Comparator Cities, however, as evidenced in contextual information regarding TDM interventions in the Comparator Cities in Appendix H, this is not on the same scale as in Nottingham which, if the dualing of the A453 is included, invested in close to £1 billion of transport improvements in the study period.

It is concluded that the changes to JTVM in Nottingham broadly correspond to expectations given the WPL ToC, once these changes are benchmarked against the Comparator Cities and important exogenous contextual factors are taken into account (see Table 3.1). These contextual factors are the improving national economic situation (C3) and the disruption due to roadworks (C8) both of which provide upward pressure on congestion. This conclusion is supported in the research outlined in Section 5.2.7.2 later in this Chapter.

Data for the Comparator Cities with respect to mode share is available, however, the methods of collection differ considerably and it was considered that meaningful benchmarking was not possible. However comparable bus patronage data is available and this is presented in Figure 5.4.

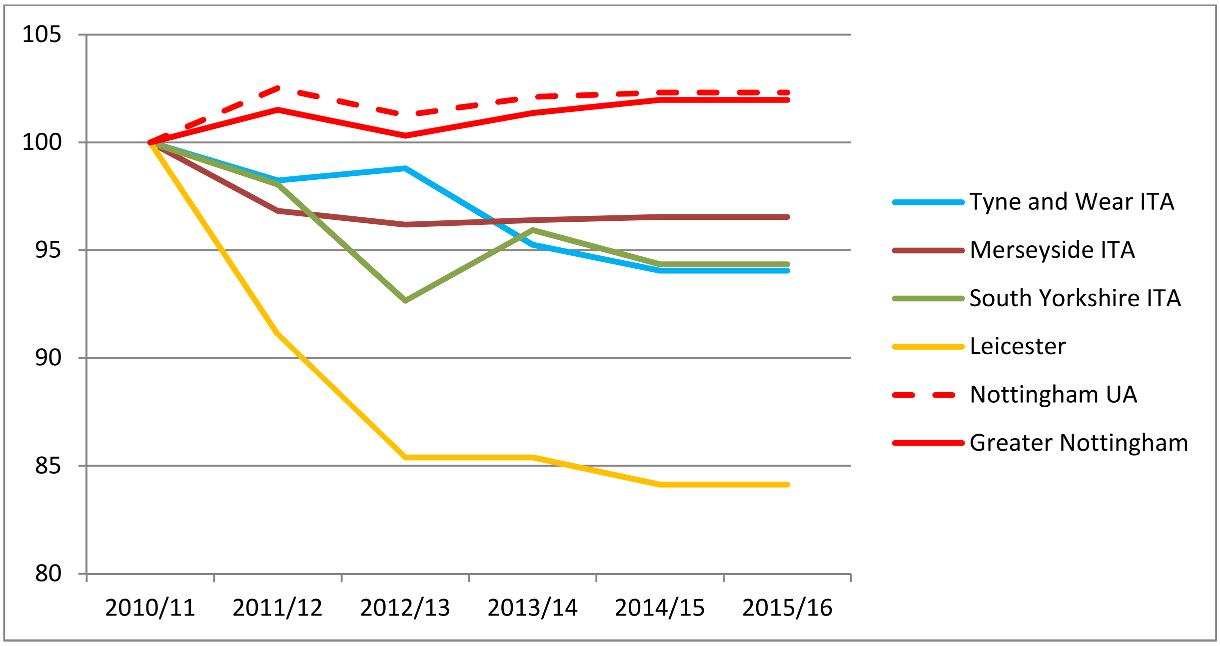


Figure 5.4 Bus patronage in Nottingham and Comparator Cities (indexed to 2010/11)

Source: DfT Public Service Vehicle Survey Bus Statistics

Figure 5.4 shows that Nottingham has seen a small rise in bus patronage since the 2010/11 base year, while other Comparator Cities have seen patronage fall.

Given the context of changes to the tram ticketing arrangements discussed in Section 5.2.4 and a background of declining bus patronage figures in other Comparator Cities, this dataset is positive with regards to the congestion constraint objective and would be expected according to the WPL ToC.

The level of cycling activity is expressed as an index with 2010 being 100, the baseline year. The results for Nottingham and its Comparator Cities are shown in Table 5.5

Table 5.5: Cycling trips – Nottingham City and Comparator Cities (Index 2010 =100)

Area/Yr	Data Notes	2010	2011	2012	2013	2014	2015
Nottingham City*	Cycle Counters network	100	115	115	124	133	134
Sheffield*	12hr Cordon Counts Calendar Year	100	103	91	88	NA	NA
Newcastle**	Cycle Counters network	100	115	127	NA	NA	NA
Leicester**	12hr Cordon Counts Calendar Year	100	128	144	108	125	145
Mersey Travel ITA*	Combined cordon and counter network., quoted in LTP	100	NA	116	134	NA	NA

Source Data: * Provided by LA as shown, ** Provided by LA – indexed by NCC

From the data available, Nottingham shows a strong growth in cycling compared with Sheffield.

While Merseyside ITA (Liverpool) and Newcastle have shown a higher growth in cycling than Nottingham this has come from a lower level of existing cycle usage than in Nottingham as evidenced by the 2011 Census Travel to Work data in Table 5.6. Leicester has outperformed all the other four Cities with respect to growth in cycle trips by combining the largest increase with a relatively high base mode share in 2011.

Table 5.6 Mode share of travel to work by bike: Nottingham and Comparator Cities

Area/Yr	% Travel to work by bike
Nottingham	3.5
Sheffield	1.7
Newcastle	2.7
Leicester	3.6
Liverpool	2.0

Source ONS: 2011Census Data

Given the context discussed above the rise in cycle usage in Nottingham is in accordance with the WPL ToC

5.2.7.2 Time series modelling to attribute changes in Delay per Vehicle Mile to the implementation of the WPL

Additional evidence concerning attribution is provided by research detailed in Paper 4 which uses a time series model to determine the impact of the WPL on congestion as a standalone intervention. Importantly, the technique enables the impact of the exogenous variables that can impact on congestion, as identified in the literature review in Paper 4, Section 2, to be taken into account. This research thus accounts for relevant contextual factors and provides a statistical link between the WPL and a reduction in congestion which demonstrates attribution of cause and effect.

Paper 4, Section 2, also details the various model types that could have been chosen and their strengths and weaknesses. A Prais-Winsten regression model (Prais and Winsten 1954) was chosen as it is the most parsimonious model form capable of correcting for autocorrelation.

This approach requires a dependent variable, an independent intervention variable and relevant independent exogenous variables to be specified. The morphology of these variables and data quality determines both the final form of the model and the quality of the output, therefore, a full understanding of these is required. This is fully discussed in Paper 4, Section 3. Additionally, the research undertaken to assemble the dependent variable and intervention variable is also described in Section 5.2.1 and 5.2.2 of this Thesis. The basis for choosing the independent exogenous variable is also fully discussed in Paper 4, Section 2.

Table 5.7 summarises these variables

Table 5.7 Variables included in Prais-Winsten Regression Model

Variable	Type of variable	Type of variable	Reference
Delay per Vehicle Mile (DVM)	Dependent	Congestion indicator	Paper 4 Section 3 Thesis 5.2.1
Liable Workplace Parking Places (LWPP)	Independent	Continuous intervention variable representing the introduction of the WPL	Paper 4 Section 3 Thesis 5.2.2
Monthly total rainfall	Independent	Exogenous explanatory variable	Paper 4 Section 3
Working Age Population minus Total Benefit Claimants	Independent	Exogenous explanatory variable	Paper 4 Section 3
Index of road work activity	Independent	Exogenous explanatory variable	Paper 4 Section 3
Fuel price	Independent	Exogenous explanatory variable	Paper 4 Section 3
Season	Independent	Exogenous explanatory variable	Paper 4 Section 3
Public Transport patronage	Independent	Exogenous explanatory variable	Paper 4 Section 3

In order to specify the model it was important to consider the potential relationship between these variables in order to arrive at a testable hypothesis. These potential relationships are discussed in Paper 4, Section 3. Figure 5.5 shows the dependent and independent intervention variables plotted against one another with the introduction of the WPL noted.

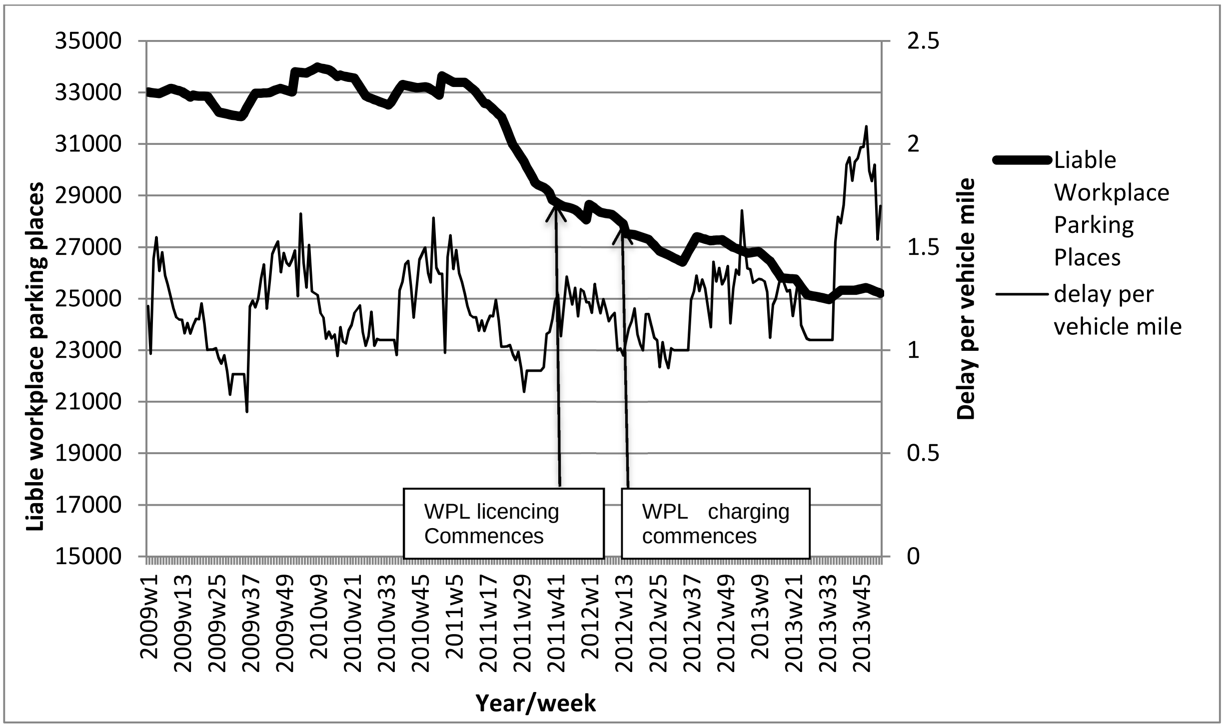


Figure 5.5 Delay per vehicle mile and workplace working places

The following hypothesis was tested by this research based on the data in Figure 5.5:

The fall in LWPP from 2010 to early 2012 has contributed to the observed reduction in DVM from late 2010 to mid 2012.

A Prais-Winsten regression model with AR(1) disturbance was employed as shown below:

$$yt = \alpha + \beta_k Xt + \gamma lnLWPP_t + \theta_m Dt + \varepsilon t$$

where, yt is the value of DVM, the dependent variable, for period *t* (in this case week t), X is a k vector of continuous explanatory variables some of which are logged, $LWPP$ is the continuous intervention variable that is expected to influence *DVM*, *D* is an m x 1 vector of categorical/dummy explanatory variables, ε is white noise. β, γ and θ are appropriately sized vectors of parameters to be estimated.

In this model, the errors are assumed to follow a first-order autoregressive AR(1) disturbance as shown below:

$$\varepsilon t = \rho\varepsilon_{t-1} + e_t$$

Where ρ $(-1<|\rho|<1)$ is the autocorrelation coefficient, and e_t is independent and identically distributed with zero mean and a constant variance σ2.

The results are fully presented and discussed in Section 5 of Paper 4. Overall the model diagnostic statistics proved it was fit for purpose:

- The model goodness-of fit, the adjusted R^2, is 0.62 which is very good for this type of model.
- An *F*-value of 42.9 with probability close to 0 shows that, overall, the model applied can statistically significantly predict the dependent variable.
- The Durbin-Watson *d*-statistic of 2.04 demonstrates that the model has successfully compensated for serial correlation present in the data by applying the Prais-Winsten transformation.

Having established the model is a good fit to the data, an examination of the regression coefficients can be undertaken. These are presented in Paper 4, Section 5, Table 2. The model output shows that LWPP has a statistically significant impact on DVM. The *t*-statistics and *p*-values for LWPP show that there is less than a 5% chance that the co-efficient predicted has occurred by chance, i.e. the variable is statistically significant at the 95% confidence level.

The co-efficient is positive, thus a decrease in the quantity of LWPP would have resulted in a reduction in congestion if all other variables were kept constant. The elasticity for DVM with respect to LWPP[1] is calculated as 0.55.

The following exogenous independent variables are also statistically significant with respect to having an impact on delay:

- Road Works Index - as the level of road work activity increases, DVM increases.
- Average Minimum Temperature- as temperature decreases, DVM increases.
- Bus patronage- as bus patronage increases, DVM also increases.
- Working age population minus out of work benefit claimants (WAP-OWB) - as this metric increases, DVM increases.
- Fuel Price - as fuel price increases, DVM decreases.
- Additionally, the season is shown to be relevant with autumn and winter shown as significant with respect to delay.

A detailed discussion of these results is presented in Section 6 of Paper 4, including some important limitations of the research. These limitations can be summarised as follows:

- It was necessary to interpolate weekly values for a number of the variables, including the continuous intervention variable LWPP. It was not possible to derive weekly values for Gross Value Added (GVA). The working age population minus the number of those claiming out of work benefits (WAP-OWB) is thus used as a more directly relevant macro-economic indicator.

[1] The elasticity of DVM with respect to LWPP is calculated by using the term: $\frac{\hat{\gamma}}{\bar{y}}$

- Finally, it is recognised that, in utilising the WAP-OWB to represent the economic driver for demand for travel, the assumption is that, over the 5 year study period, the demographics of the WAP remain sufficiently similar so as not to change the overall propensity to choose any given mode of travel.

Paper 4 draws the following important conclusions from the above research:

The results of this research confirm the hypothesis;

The fall in LWPP from 2010 to early 2012 has contributed to the observed reduction in DVM from late 2010 to mid 2012.

This demonstrates that M9, congestion constraint is active. This represents a time saving for the last quarter of 2013 of just under 15 seconds per vehicle mile, or 1,146 days across the network in 2013.

Of the independent variables included, the number of people of working age who are not claiming out of work benefit and the levels of roadwork activity are shown to have the most impact on DVM. While LWPP (i.e. the introduction of the WPL) is perhaps less influential than these variables, it does, nevertheless, still have an important impact and thus contributes to congestion restraint. These results show that, while the WPL contributed to the reduction in DVM observed in 2011, further ongoing beneficial impact has been obscured by external explanatory variables, particularly the high levels of roadwork activity from 2012 onwards and economic growth, i.e. WAP-OWB. This is the first time that such an analysis has shown a statistical correlation between a parking based transport demand management measure and traffic congestion constraint.

5.2.7.3 The Commuter Survey

While it may be possible to make some assumptions concerning the likely causes of mode shift based on the WPL ToC the most direct method to establish causal attribution is simply to conduct a survey to ask commuters if they have switched mode and why. With this in mind a need for such a survey was agreed amongst stakeholders. This research is therefore the third method for considering the attribution of change in the indicators selected to monitor congestion levels and mode shift. It aims to attribute to what extent observed mode shift is due to the WPL package by sampling commuters on each mode of travel and asking if they have switched mode since 2010 and if so why. The research compliments that detailed above in Section 5.2.7.2 as mode shift is, according to the WPL ToC, a pre requisite for congestion constraint in a period of economic growth. It also expands the consideration of attribution beyond the WPL as a standalone scheme to include the other WPL Package elements and is thus an integral part of achieving Thesis Objective 5.

Survey design

The method of delivery for this survey was a mixture of direct interview or self-completion questionnaires (either completed online or returned by post).

The Survey sample

While it is recognised that some form of random (probability) sampling of commuters is desirable (Iacobucci and Churchill 2010), this is not possible due to the following constraints;

1. No sampling frame available - lack of any dataset of the population to form a sampling frame.

2. Not all businesses will co-operate with workplace based surveys of car users.

3. It is considered that an expert ‘judgment approach’ (Chisnall 1997) is a more sensible way of selecting a representative sample of bus services in particular, but also participatory businesses.

Thus, the sample is a non-probability sample based on a population defined as commuters within the Nottingham City area travelling in the AM and/or PM peak periods. This is stratified by mode of travel with a sample being taken from commuters using the following modes:

1. Car
2. Bus
3. Rail
4. NET Line 1
5. NET Lines 2 & 3
6. Cycle

The method by which each stratum is surveyed will, for practical reasons, need to be tailored to that mode. Having a mix of direct interview and self completion methods for gathering this data is unavoidable and it is recognised that there will be some response bias where self completion is adopted. However, self completion was mainly used for car users via online workplace questionnaires and should not affect the veracity of the broad findings for this mode. The issue of bias is considered on a mode by mode basis within the account of the data collection methodology presented below.

The final sample size for commuters on each mode is given in Table 5.8.

Table 5.8 Sample Size for the Commuter Survey

Travel mode	**Survey Method**	**Sample**
Bus	Interview	496
Rail	Interview	311
Car	E Mail/ Interview	584
NET Line 1	Interview	290
NET Lines 2&3	Interview	719
Cycle	Interview/Paper self-completion	168

The methodology for each mode was as follows:

Data Collection Methodology

Car – As a roadside interview survey could not be justified due to cost and the traffic disruption generated, it was decided that surveying car users at the workplace was the best method to obtain the required data for this mode. In an ideal situation one would randomly select businesses within strata based on location and business characteristics. However, approaching businesses randomly and asking for assistance in such an endeavour, without a prior contact with Nottingham City Council, was not feasible. Thus businesses from three business parks already engaged in a European funded project to deliver workplace travel planning were used and infilled with cases elsewhere in the City where the employers are known to either the City Council's WPL team or the Travel Planning Team. Although some direct interviews were conducted on the business parks the employers surveyed elsewhere used an online questionnaire to minimise disruption to the working day.

This sampling regime was necessitated by practical and funding considerations and there is an assumption that the bias due to a) the presence of Workplace Travel Planning activities and b) geographical location has a sufficiently small impact on the propensity for commuters to switch to the car that it does not compromise the broad conclusions concerning car users generated by this research. It is likely that the reasons for an individual to switch to the car from some other mode are such that the travel planning is unlikely to be a factor in that decision. The geographic locations of the three business parks would seem to be reasonably representative with NG2 being located close to the City Centre, the Science Park is just outside the Inner Traffic Area Cordon and Nottingham Business Park lies on the north west edge of the City. The latter is relatively poorly served by public transport while the NG2 Park lies both on the new tram line and within walking distance of City Centre transport hubs. The Science Park is located to the west of the City Centre adjacent to Nottingham University and is also well served by bus and tram links. In addition to these three business parks, all businesses for which the Workplace Travel Planning team have contact details were asked to participate in the survey, however, only six agreed.

Bus/Tram/Rail – Commuters on these modes were surveyed by direct interview at selected bus and tram stops and at Nottingham Railway Station. Survey staff were briefed to approach commuters at random to avoid case selection bias. The bus stops and services were chosen to gather data primarily from Linkbus passengers, however, some non-Linkbus services were included so that all sectors of the City were represented. Tram stops were selected in consultation with the NET Phase 2 evaluation team to be representative for each corridor.

Cycle –While cyclists were asked to engage in face to face interviews, if they declined because they did not have time, they were given a self completion questionnaire. Unfortunately, some response bias will thus be unavoidable, but should be diluted when combined with the interview generated data. The survey locations were chosen based on practical considerations such as safety and at natural stopping points and so that all major cycle corridors into the City Centre were covered.

Questionnaire Design

As discussed previously, the method by which each stratum was surveyed, for practical reasons, was tailored to that mode and thus a bespoke questionnaire for each mode was used. These are presented in Appendix I.

The questionnaire design was screened to try to minimise bias due to the wording of individual questions and question sequence effects, both problems commonly associated with questionnaire design (Chisnall 1997).

A key design consideration was how to formulate the question which asked why respondents had changed mode. This is question 14 in the questionnaire for bus, cycle, rail and the workplace (car), question 15 for Net Line 1 and question 12 for NET Lines 2 and 3.

There were two principle elements that were considered in the design of this question:

The Dimension: **–** this is a term used to describe a set or 'battery' of attitudes chosen to represent issues requiring research (Brace 2010). A battery of 16 appropriate statements giving potential reasons as to why individuals choose to switch mode were arrived at by cross referencing established dimensions from other NCC travel surveys together with consulting with internal stakeholders.

These were as follows:

1. Change of workplace
2. Change of home address
3. Employer removed access to parking at work
4. Increase in cost of parking at work
5. Improved bus service
6. Deterioration in bus service
7. New tram line opened
8. Improvement in quality of cycle lanes/storage/facilities
9. Deterioration in quality of cycle lanes/storage/facilities
10. Improvement in rail service
11. Deterioration in rail service
12. Wanted to do more exercise
13. Change in family circumstances/health issues
14. Shorter journey time
15. More reliable option
16. Other – please specify

Some of these statements were mode specific, thus not all were included in each questionnaire. The statements provided the opportunity for respondents to select each element of the WPL Package. 3 and 4 relate to the WPL impact while 5 relates to the enhanced Linkbus services. 7 relates to NET Phase 2. 8 accounts for the effects of WPL funded workplace travel planning and related cycle infra-structure grants and finally, 10 relates to the improvements to Nottingham Railway Station. To avoid question bias negative options, 6, 9 and 11 were also provided.

The Scale – this is the nature of the measurement used to assign a value to the respondent's response to each attitude statement in the dimension. (Iacobucci and Churchill 2010). A semantic scale of 1 to 5 (with 5 being very important and 1 being of little or no importance), was adopted for this survey. This form of scale was preferred over the Likert Scale (Chisnall 1997) as it avoids ambiguous and, in this case, ill-fitting wording inherent in a Likert Scale. While a Constant Sum Scale (Brace 2010) was attractive it was considered overly complex for respondents given the number of statements in the dimension.

Data Analysis

Unfortunately, due to the requirement to allow at least one year after the opening of NET Phase 2 to pass before conducting this research, the data only became available in January 2017, well into the writing up of this Thesis. Hence, only a summary of the initial analysis is presented, but this data will be further evaluated in follow up work.

The 16 statements contained in the dimension described above can be grouped into broader categories to indicate causality for the following:

- The WPL scheme
- The WPL Package transport improvements
- The WPL Package as a whole

Additionally other non WPL related categories can also be identified

Table 5.9 below summarises how the statements are grouped to indicate causality. They are colour coded for clarity and to relate them to the charts in Figure 5.6

Table 5.9 Groupings of statements into categories attributing reasons for mode switch

	Possible responses to question for reason for mode swap	Grouping of reasons into categories which attribute cause of swap (colour coded for charts in Figure 5.6)	
		Non Car Modes	Car
1	Change of workplace	Other	O&D change
2	Change home address	Other	O&D change
3	Employer removed access to parking at work	WPL	Other
4	Increase in cost of parking at work	WPL	Other
5	Improved bus service	WPL funded schemes	Other
6	Deterioration in bus service	Other	Deterioration in PT or cycle facilities
7	New Tram Line opened	WPL funded schemes	Other
8	Improvement in quality of cycle lanes/storage/facilities	WPL funded schemes	Other
9	Deterioration in quality of cycle lanes/storage/facilities	Other	Deterioration in PT or cycle facilities
10	Improvement in rail service	WPL funded schemes	Other
11	Deterioration in rail service	Other	Deterioration in PT or cycle facilities
12	Wanted to do more exercise	Other	Other
13	Change in family circumstances/Health Issues	Other	Changes in life situation
14	Shorter journey time	Shorter journey time/more convenient	Shorter journey time/more convenient
15	More reliable option	Shorter journey time/more convenient	Shorter journey time/more convenient
16	Other	Other/allocated to one of the above	Other/allocated to one of the above

The data has been analysed by identifying commuters on each non car mode who have switched to that mode from travelling to work by car after the 1st January 2010. The results from the question asking the respondents to rank the importance of the reasons for this choice were then analysed to reveal to what extent the WPL Package influenced that choice.

A sample of car users was also surveyed using the same methodology and this data is also included in the analyses.

This analysis produced two metrics.

1. The number and percentage of respondents scoring 4 or 5 for at least one statement indicating the WPL and/or WPL Package PT schemes as a reason for mode swap - This analysis utilises the categories presented in Table 5.9, although for this metric the 'shorter journey time/more reliable' category has been included within the WPL funded scheme category, provided a change in origin and/or destination (O&D) hadn't been indicated as an important cause for the change of mode. This metric is presented for the WPL as a standalone scheme, WPL funded schemes, and the WPL Package as a whole. In order to allow for the differing sample sizes, a weighted average across all five modes is then calculated to give an estimate of the percentage of commuters travelling on sustainable modes who have swapped away from the car, at least in part, due to the WPL Package, i.e. they have scored at least one reason for swapping which relates to the WPL Package as 4 or 5. This analysis for non car modes is presented in Table 5.10, while Table 5.11 presents the data for commuters using the car.

2. The percentage of the total score for the categories presented in Table 5.9 attributing causality for mode change to car and non-car modes. For example; if the sum of all scores for all the statements indicated as of relevance by bus commuters came to 100 and there were 4 bus commuters scoring 'increase in cost of parking at work' 5 and 3 scoring 'increase in cost of parking at work' 4, then the category referring to the WPL would have a total score of 32 out of 100 or 32%. The category 'Other' was attributed a score of 4. This analysis is presented in Figure 5.6.

Table 5.10 Number and percentage of respondents scoring 4 or 5 for at least one reason applicable to the WPL package

Mode	Total Sample	Sample swapping away from car	WPL (Statements 3 & 4)		WPL Funded Schemes (Statements 5,7,8,10,14 and 15)		WPL Package (WPL+WPL Funded Schemes)		% Respondents swapped to or from car	Mode Split based on annual monitoring divided by 100*	Weighted average scoring 4 or 5 due to WPL scheme across all modes*	Weighted average scoring 4 or 5 due to WPL Package across all modes*
			No. scoring 5 or 4	% No. 5 or 4	No. scoring 5 or 4	% No. 5 or 4	No. scoring 5 or 4	% scoring 4 or 5				
Cycle	168	45	7	4.2	15	8.9	22	13.1	26.8	0.04		
Bus	496	80	27	5.4	12	2.4	36	7.3	16.1	0.63		
Tram 1	290	51	8	2.8	14	4.8	21	7.2	17.6	0.13	NA	
Tram 2&3	719	212	2	0.3	164	22.8	165	22.9	29.5	0.07		
Train	311	65	11	3.5	12	3.9	22	7.1	20.9	0.13		
All	1984	453	55	2.8	217	10.9	266	13.4	22.8		**4.4**	**8.6**

* The weighted averages are based on mode split in 2015 for people crossing the Inner Traffic Area Cordon inbound in the AM Peak period, cycle count data and people alighting at Nottingham Station – (see section 5.1.1.3 for further details on mode split monitoring)

Table 5.11 Number and percentage of respondents swapping to the car since 01/01/2010

Mode	Total Sample	Sample swapping to car	% Respondents swapping to the car
Car NCC	379	98	25.9
Car Non NCC	205	48	23.4
Car All	584	146	25.0

Table 5.10 reveals that, of those commuters surveyed, 22.8% have swapped to bus, tram, train or bike from car. Across these modes, a weighted average of 8.6% of respondents have stated that at least one reason facilitated by the WPL package is important in making that decision. 4.4% have stated that at least one reason related to the WPL as a standalone scheme is important in making that decision. Of the WPL package elements the two new tramlines are, not surprisingly, the most successful in attracting commuters away from the car with 29.5% of users surveyed saying they previously used the car. These findings demonstrate that, while not the dominant reason for commuters swapping away from car, the WPL and its associated transport improvements are playing an important role in such decisions.

However, Table 5.11 reveals that a quarter of those car users surveyed have switched to the car since 2010. The sample of car users contained a disproportionate number of responses from Nottingham City Council (NCC) employees, thus Table 5.11 shows the results for NCC and Non NCC respondents separately. It is noted that the results are similar for both sub samples.

This data suggests that there is strong suppressed demand for commuting by car (M14) which is released, either as the disposable income of individuals increases, or as and when road space becomes available due to the WPL package prompting individuals to switch away from commuting by car. This is strong evidence that mechanism M14 is active and potentially obscuring the congestion constraint benefits of the WPL Package.

Figure 5.6 presents the percentage of the total score for the categories presented in Table 5.9 and generally supports the above conclusion that the WPL Package is playing an important part in effecting mode shift away from the car, but that it is not the only or dominant causality in the majority of decisions.

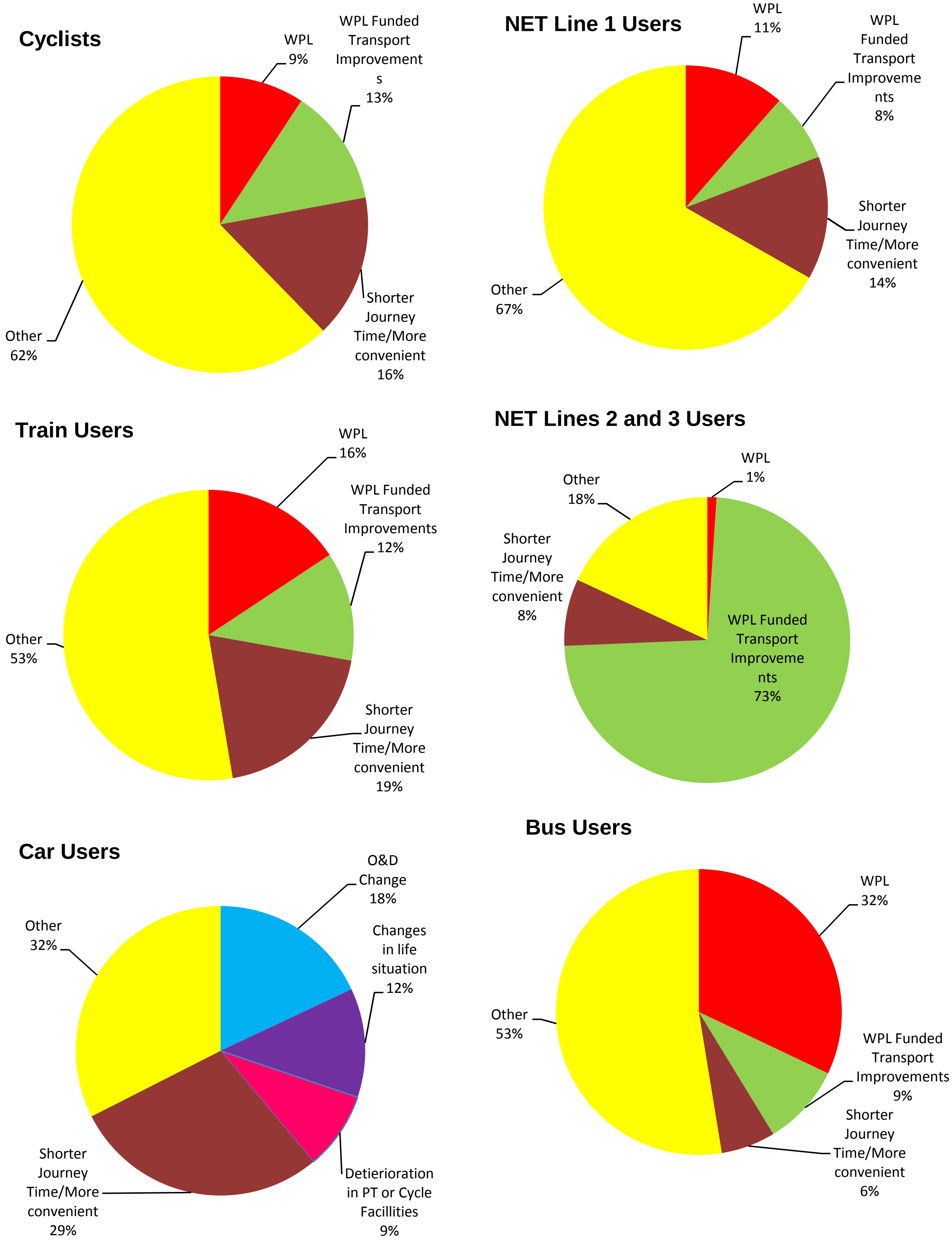


Figure 5.6 Score for the groupings of reasons for mode switch

The charts for cycle, train and bus users all follow a similar pattern with the grouping ‘Other’ scoring at over 50%, while WPL Package related groupings occupy between one third and one half of the total score. The role played by the WPL as a standalone scheme is substantially more important amongst bus users than for train or cycle users.

The chart for NET Line 1 is similar to that of train users, however, for NET Lines 2 and 3 which only opened in 2015, WPL funded transport improvements account for 73% of the score. This is not surprising given that, by definition, users must have previously used another mode.

It is interesting to note that scores for the car are dominated by Other and Shorter journey time/more convenient, this seems to reflect the broad attraction of that mode compared to other options.

The following important conclusions can be drawn from this research:

1. 8.6% of those currently using sustainable modes have indicated that the WPL Package has played an important part in their decision to swap away from the car.

2. The data suggests that this causality is split roughly 50/50 between the PT/cycle improvements and the WPL itself with a weighted average of 4.4% of commuters on sustainable modes switching from the car in part due to, either an increase in the cost of parking at work, or the removal of parking at work. The sample sizes are such that a scheme by scheme analysis is not viable.

3. This research provides attribution of cause and effect between observed changes in the indicators relating to congestion and mode shift presented in Section 5.2.6 and the WPL Package.

4. Additionally, this research provides evidence that suppressed demand for commuting by car, mechanism M14, is operating and is obscuring the congestion constraint benefits of the WPL Package.
5. These findings cross validate the findings presented in Section 5.2.7.2 which show that a fall in LWPP will result in a reduction in DVM, all other factors being equal.
6. A more detailed analysis of this data set is required.

5.2.7.4 Summary of Attribution and Context for Congestion and Mode Share

The three research actions here provide good evidence that the WPL Package is having an impact on the WPL objective of constraining traffic congestion in the peak periods and effecting mode switch away from the car.

Firstly, the benchmarking of JTVM in Nottingham against four Comparator Cities shows that, despite considerable disruption between 2012 and 2014 due to the construction of the major transport improvements, Nottingham has shown a lower rate of growth than three out of the four Comparator Cities in the study period. This is driven by a slowing of the rate of growth of JTVM in Nottingham since 2014, while growth continued at a steady pace in the other Cities. This coincides with an increase in PT mode share since the opening of NET Phase 2. Nottingham is also the only City of the five that has shown a growth in public transport patronage in the study period indicating that M2, an increase in PT capacity, is active.

Secondly, the time series modelling undertaken and presented in Paper 4 has demonstrated that the WPL has had an impact on traffic congestion and contributed to an initial fall in DVM in 2011/12. This research also demonstrates that any further benefits have been obscured by road work activity linked to the construction of transport improvements and by a growth in the working age population who are in employment.

Finally, a survey of commuters has demonstrated that 8.6% of those currently using sustainable modes have indicated that the WPL Package has played an important part in their decision to swap away from the car since 2010. This provides attribution for changes observed to mode shift and thus congestion to the WPL Package.

Thus, it is concluded that the changes to indicators relating to congestion and mode share are moving in the direction suggested by the WPL ToC, once the exogenous contextual factors are taken into account. The evidence presented in this Section demonstrates that these changes can reasonably be attributed at least in part to the WPL Package. Arguably, to fully confirm that the WPL ToC is operating as expected, it would be desirable to see a larger magnitude of change. One possible reason for this could be suppressed demand for travel by car, M14, which would be an important area for further research. Evidence presented in Section 5.2.7.3 supports the operation of this mechanism. This is discussed more fully in Chapter 6.

5.3 IMPACT OF WPL ON INWARD INVESTMENT: RESEARCH AND FINDINGS

In this Section the research carried out to provide and analyse time series data which measures inward investment and wider economic impacts is detailed and this is followed by an account of the research carried out to determine to what extent these changes are attributable to the WPL and its associated PT improvements. This Section, therefore, facilitates the Thesis Objectives 4 and 6 and draws on research in Paper 3.

5.3.1 DATA SETS TO FACILITATE AN ASSESSMENT OF THE LEVEL OF INWARD INVESTMENT IN NOTTINGHAM

This Section discusses the time series data available which facilitate Objective 4 of this thesis and provides an assessment as to what extent they have moved in the direction predicted by the WPL ToC and thus the progress towards WPL Objective 5, enhance the attractiveness of Nottingham as a location for business investment.

The basket of indicators available can be split into high level macro-economic indicators available from the Office for National Statistics (ONS) and local inward investment specific indicators.

5.3.1.1 Macro-economic Indicators

Table 5.12 Number of employees and GVA in Nottingham

City	Number of employees based in City administrational area							%Change 2010-15
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015 (Prov-isional)**	
Jobs based in Nottingham	188,500	193,900	194,000	202,000	205,000	207,600	215,300	11.0
GVA for Nottingham (x 1,000,000)	7,546	7,786	7,922	8,011	7,942	8,512	8,816	13.2

Source: Nottingham City Council from the ONS Dec 2016

The two macro-economic time series presented in Table 5.12 show contradictory trends, with the number of jobs showing strong growth throughout the study period, while there is a marked slowing of growth in GVA in 2012 and a fall in 2013. Despite strong growth in GVA before and after this period this is not what would be expected given the WPL ToC. This is discussed further in Section 5.3.3.1.

5.3.1.2 Local Inward Investment indicators

There are two time series which have been used as indicators to gauge the level of inward investment in Nottingham.

Enquiries to the Inward Investment Team and subsequent successes - Nottingham City Council had an internal team (up to 2015) dedicated to working with employers interested in investing in Nottingham. Table 5.13 shows the level of enquiries to NCC's Inward Investment Team and subsequent successes which realised actual investment. This is not a complete record of inward investment and applies only to cases known to the team.

Table 5.13 Enquiries to the Inward Investment Team and subsequent successes

Year	Enquiries	No. of successes	% Successes	Jobs created
2008/09	91	3	3.3	360
2009/10	156	5	3.2	85
2010/11	110	2	1.8	85
2011/12	146	5	3.4	65
2012/13	175	9	5.1	1100
2013/14	176	18	10.2	304
2014/15	189	9	4.7	303

Source: Nottingham City Council

There is no evidence to suggest that the level of either inward investment enquiries or successes has fallen since the introduction of the WPL in 2011/12. Indeed, while one must be cautious in the absence of any counter factual data or meaningful benchmarking, it appears that 2012/13, 2013/14 and 2014/15 were the best years since the credit crunch and subsequent recession in 2008/9 for attracting inward investment. Unfortunately, it was not possible to obtain reliable data from 2015/16 onwards due to an internal re-organisation within NCC.

New commercial property rentals in Nottingham – As discussed in Chapter 4, Section 4.3.3.2 and Paper 3, Section 4.2, a healthy commercial property sector is symptomatic of a buoyant inward investment. Thus, the volume of new rentals for commercial property in Nottingham has been chosen as an indicator for inward investment. This data was supplied by commercial estate agents and shows the number of new rental agreements and the floor space concerned in each deal, thus enabling an annual figure to be calculated. Table 5.14 shows this data.

Table 5.14 New commercial property rentals in Nottingham

Floor space Sq. Ft	Year	Number of new rentals
251768	2011	42
241900	2012	43
190789	2013	50
NA	2014	NA
469364	2015	51
391271	2016	77

Source: Nottingham Office Review

The data shows that the numbers of new rentals were similar in 2011 and 2012, but rose in 2013, 2015 and 2016. The total floor space declined between 2011 and 2013, but rose sharply in 2015. The increase in the number of rentals reflects activity in the market by small and medium sized enterprises. A growing important contextual factor for this indicator is a scarcity in the supply of large properties (C11) and this drove down the floor space metric in 2012 and 2013 before rebounding strongly in 2015. These local investment indicators suggest that the additional cost of the WPL (M13) is not impacting on the level of inward investment.

5.3.2 SUMMARY OF DATA DESCRIPTION AND MONITORING FOR INWARD INVESTMENT

The two principle macro-economic indicators for wider economic benefit, jobs and GVA (Table 5.12) are contradictory and thus require further analysis. The time series for jobs supports the economic growth anticipated within the WPL ToC, while the decline in GVA in the years immediately following the introduction of the WPL is contrary to the WPL ToC. GVA shows strong growth before and after 2012/13 which suggests this anomaly may be caused by a one off economic shock, rather than on going policies such as the WPL. This issue is addressed in more detail in Section 5.3.3.1. The time series for these two important macro-economic indicators are thus inconclusive with respect to confirming or refuting the operation of mechanisms M11, whereby enhanced PT is attractive to investors, or conversely M13, whereby investment is inhibited due the cost of the WPL. The neo classical economic mechanisms, M15 to M17 would result in an increase in GVA and employment in Nottingham if they were operating as expected and thus these results are also ambiguous with respect to this. These mechanisms are more long term in nature and as economic data is not yet available for the period after NET Phase 2 was opened in August 2015, one would not expect to see them operational at this time.

There is no evidence from the local inward investment indicators that the cost of the WPL is inhibiting inward investment as these indicators show a strong growth in the years after the introduction of the WPL. This suggests that M13 within the WPL ToC is not active to an extent whereby it is significantly hindering progress towards WPL Objective 5.

5.3.3 Attribution and Context: Research to identify the impact of the WPL on levels of Inward Investment and the Wider Economy

In this Section, benchmarking and examples of investment decisions are utilised to understand if positive changes to the indicators relating to inward investment levels and employment noted in Section 5.3.1 can be attributed at least in part to the WPL Package.

This research is described in Paper 3 and has been updated in Section 5.3.1 of this Chapter. In this Section the relevant indicators are, where possible, benchmarked against data for the Comparator Cities to attempt to take account of national contextual factors and, in part, to provide attribution of the observed changes to the WPL Package. Paper 3 also presents a number of examples of investment and dis-investment decisions, including an assessment of factors which drove those decisions. This dataset provides further attribution of cause and effect of the WPL Package. Paper 3 then draws together all the above evidence and triangulates it to form a balance of probability conclusion regarding the impact of the WPL Package on levels of inward investment and the wider economy. In this Section the research contained in this Paper is updated and the conclusions are summarised.

5.3.3.1 Benchmarking of Macro-economic Indicators

In Section 5.3.1.1 the time series for the two principle macro-economic indicators, jobs located in Nottingham and GVA are presented. In this Section this data is benchmarked against the Comparator Cities.

Figure 5.7 presents the time series for the number of jobs in Nottingham and the Comparator Cities. The number of jobs in Nottingham increased by 11% between September 2010 and September 2015, which compares favourably with the situation in all four Comparator Cities.

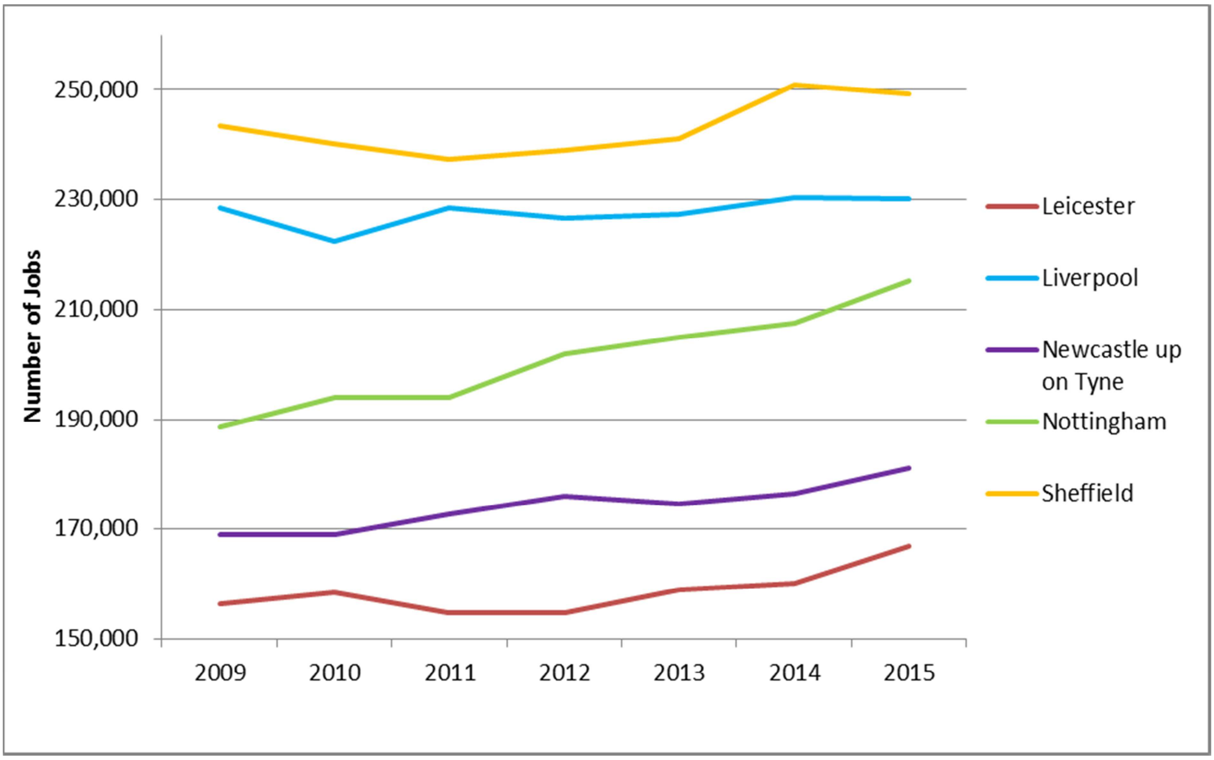


Figure 5.7 Numbers of jobs located in Nottingham and Comparator Cities

Source: Nottingham City Council (NCC) from the Office for National Statistics (ONS) 2016

In addition to the jobs data presented above, Paper 3, Section 5.1, Table 4 shows that the employment rate data broadly agrees with the jobs data, with Nottingham seeing the highest rate of growth amongst the Comparator Cities since 2010/11.

Table 5.15 Gross Value Added (income approach) at current basic prices comparator cities and England (x 1,000,000)

City	2009	2010	2011	2012	2013	2014	2015 (provisional)	% Change 2010-2015	% Change 2013-2015
Tyneside	15,044	15,379	16,239	16,649	16,866	17,388	18,224	18.5	8.1
Liverpool	10,837	10,435	10,019	9,961	10,093	10,613	10,907	4.5	8.1
Sheffield	10,160	10,254	10,382	10,740	10,862	11,038	11,300	10.2	4.0
Nottingham	7,546	7,786	7,922	8,011	7,942	8,512	8,816	13.2	11.0
Leicester	5,923	6,030	6,217	6,573	6,725	7,113	7,473	23.9	11.1

Source: ONS 2017

Table 5.15 shows there was a slowing in GVA growth in Nottingham in 2012, followed by a decline in 2013. However, Leicester, Tyneside and Sheffield show continuous growth throughout the period. Nottingham shows growth of 13.2% between 2010 and 2015 which is better than Liverpool and Sheffield, but worse than Leicester and Newcastle. However, since 2013, growth in Nottingham has exceeded that in all other Comparator Cities, except Leicester which is only 0.1% higher.

This poor performance in growth in 2012 and 2013 is not what would have been expected given the WPL ToC and, therefore the causality behind the poor GVA performance in 2012 and 2013 requires further consideration. Table 5.16 presents the two Macro-economic indicators alongside other relevant data to aid this discussion.

Table 5.16 Summary of macro-economic indicators for Nottingham

Year	GVA	Jobs	Jobs exc. recruitment	Public Sector Jobs
2009	7,546	190,700	170,700	64,000
2010	7,786	193,900	174,400	67,000
2011	7,922	194,000	169,800	62,300
2012	8,011	202,000	168,700	61,900
2013	7,942	205,000	168,200	62,300
2014	8,512	211,900	173,200	62,800
2015	8,816	215,300	178,000	62,800

Source: ONS 2017

While the metric of jobs based in Nottingham is retained in this thesis as it is a key standard macro-economic indicator, there is some concern that Nottingham City has a disproportionate growth in national jobs linked to employment agencies and thus some of those jobs are not necessarily based in Nottingham. Indeed the jobs time series with these jobs removed does more closely coincide with the GVA data and shows a decline in jobs between 2011 and 2013 as illustrated by Figure 5.8. This decline in jobs also coincides both in timing and scale with a reduction in public sector jobs.

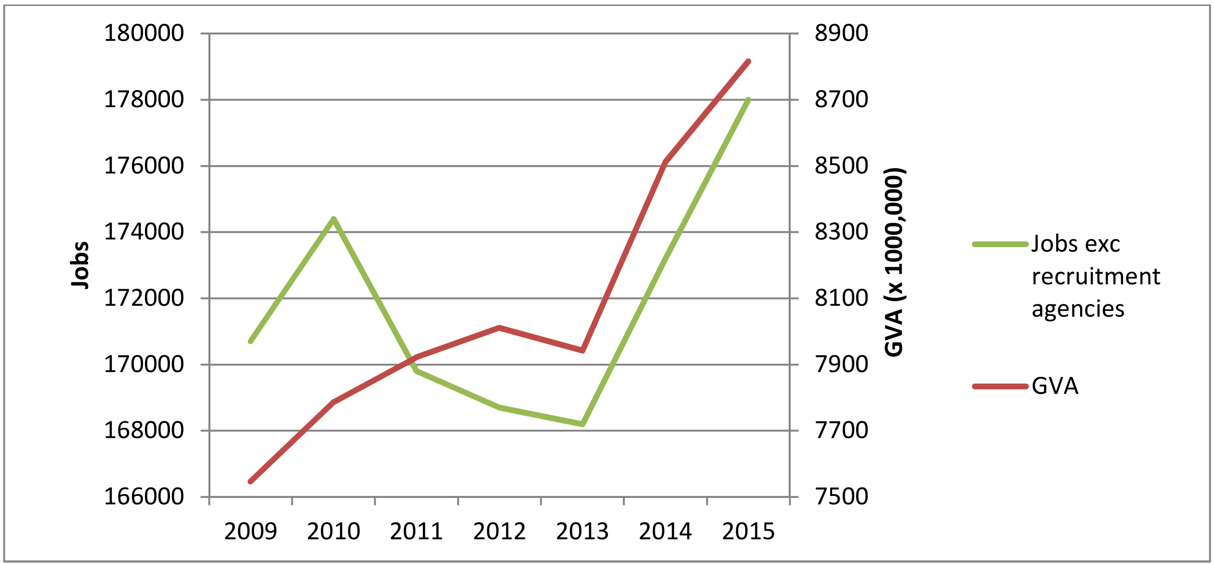


Figure 5.8 GVA and jobs based in Nottingham time series Source: ONS 2017

A closer examination of where the reduction in GVA fell (Table 5.17) shows that the reduction is almost all attributable to a reduction in profits in 2012 and then in remuneration of employees in 2013.

Table 5.17 Nottingham City GVA by category 2010 to 2015

Category	2009	2010	2011	2012	2013	2014	2015
Compensation of Employees	5,007	5,259	5,242	5,474	5,352	5,558	5,800
Mixed Income	193	187	197	228	231	252	258
Rent	576	554	599	616	594	621	603
Non-market Capital	235	233	248	254	245	257	270
Holding Gains	6	-46	-40	-16	-18	0	-1
Gross Trading Profits	1,398	1,446	1,531	1,304	1,393	1,668	1,719
Gross Trading Surplus	23	26	24	25	20	29	29
Taxes	132	147	134	142	140	145	155
Subsidies on Production	-25	-20	-14	-15	-15	-17	-18

Source: ONS 2017

The decline in public sector jobs appears to have impacted Nottingham harder than the other Comparator Cities as shown in Table 5.18.

Table 5.18 Public sector jobs in Nottingham and Comparator Cities

Area	2009	2010	2011	2012	2013	2014	2015	% change 2010-12
Leicester	55,400	56,700	57,100	57,100	58,000	60,000	62,800	0.71
Nottingham	64,000	67,100	62,400	61,900	62,400	62,800	62,800	-7.75
Liverpool	94,000	88,200	87,300	86,200	84,100	82,600	84,300	-2.27
Sheffield	81,200	80,100	80,100	84,600	84,400	87,100	85,000	5.62
Newcastle upon	64,000	64,800	65,900	68,200	70,700	69,700	68,800	5.25

Source: ONS 2017

Given the above discussion it is possible to arrive at the following hypothesis

Hypothesis: A large drop in public sector employment in 2011 resulted in a reduction in profits in 2012 and this resulted in a decline in employee compensation in 2013. In 2014 this shock had worked its way through the system and growth resumed in line with the Comparator Cities.

The time series data supporting this hypothesis is summarised in Table 5.19 below.

Table 5.19 Summary of hypothesised linkages between jobs and GVA; cause and effect

Time Series		2009	2010	2011	2012	2013	2014	2015
Jobs	All (exc. RA)	170,700	174,400	169800	168,700	168,200	173,200	178,000
	Public Sector	64,000	67,100	62,400	61,900	62,400	62,800	62,800
GVA	All	7,546	7,786	7,922	8,011	7,942	8,512	8,816
	Gross Trading	1398	1,446	1,531	1,304	1,393	1,668	1,719
	Compensation of Employees	5007	5,259	5,242	5,474	5,352	5,558	5,800

Source: ONS 2017

It is recognised that testing this hypothesis empirically may not be possible and is outside the scope of this thesis.

It is relevant to note that the other City to experience poor growth in GVA is Liverpool which also experienced a high level of public sector job losses. Liverpool had the highest reduction a year earlier than Nottingham and its GVA also started to decline a year earlier. This evidence from a Comparator City tends to strengthen the link between a decline in GVA and public sector job cuts.

There are three main conclusions to the above discussion.

1. The causality of the Nottingham's poor GVA performance in 2012/13 remains unproven and requires further research. It is recognised that it may not be possible to assign a cause for this with any degree of certainty.

2. Notwithstanding the above, there is no evidence to alter the conclusion contained in Section 5.3.1.1, i.e. that it is unlikely that the WPL is the cause as GVA shows strong growth before and after 2012/13 relative to the comparator Cities which suggests this anomaly may be caused by a one off economic shock rather than on going policies such as the WPL.
3. Given the evidence presented above, it is possible to conclude that the most likely cause is an economic shock caused by a disproportionate reduction in public sector employment resulting from the Coalition Government's austerity policies in response to the 2008 financial crisis, however, further research would be required to confirm this hypothesis.

A time series showing the percentage change in the balance of businesses VAT registered in each calendar year is presented in Paper 3, Section 5.1, Table 6. This provides a supplementary indicator that can be benchmarked against the Comparator Cities. Business Births and Deaths may not be a direct indicator for the WPL due to the propensity for the data to be skewed towards small businesses which do not pay the WPL; however, it may be indicative of the extent to which Nottingham is attracting businesses due to the transport improvements the WPL package provides. The analysis of this data in Paper 3 suggests that Nottingham City is "rebounding" more slowly than the surrounding areas and most of the Comparator Cities, following a significant slump in 2009 when the whole of the UK was in recession. However, this conflicts with the data for employment which shows Nottingham recovering, if anything, faster than the other Comparator Cities. Additionally, it is noted that Nottingham City shows a relatively strong performance in 2012 and 2013 compared with Greater Nottingham, suggesting growth has been concentrated in the City area.

In summary, Nottingham shows a relatively strong performance in terms of job creation when referenced to the Comparator Cities, while the situation concerning economic output is more ambiguous.

5.3.3.2 Inward Investment Examples

While the above benchmarking hints at attribution by demonstrating differential change between Nottingham and the Comparator Cities, the main mechanism for the attribution of the movements in the inward investment indicators discussed in Section 5.3.1.2 is based on the examination of examples of inward investment decisions in Nottingham (see Section 4.4 and Paper 3, Sections 4.2 and 5.2). Table 5.20 presents six examples of employers who have either, moved into the City, or who are existing indigenous employers who have chosen to consolidate to premises within Nottingham rather than relocating elsewhere. Table 5.21 presents five examples of employers who have moved out of Nottingham. It should be stressed that this is the sum of all relevant examples known to NCC up to January 2015. These examples represent all the large employers (more than 200 jobs affected) that are known to Nottingham City Council who have moved in or out of the City between 2010 and 2015, regardless of the relevance of either improved public transport provision or the WPL. Smaller employers were only included if improved public transport provision and/or the WPL was a factor in the decision.

Table 5.20 Summary of examples of major inward investments

Type	Improved PT a factor	Size of employer	Stated reasons for decision	Notes
New business to the City	Major	Medium	Close to suppliers, access to workforce, PT connectivity	Moved to Nottingham despite other options elsewhere in Nottinghamshire, the UK, and Europe. Good PT access to site was an important requirement, thus car parking and the WPL became a minor consideration
New business to the City	Not at all	Large	Close to suppliers, close to customers	Access to workforce and customers were key locational factors. WPL was a factor, but was mitigated by discussion with NCC via workplace travel planning support
Consolidation of indigenous business	Major	Large	Access to workforce, PT connectivity	Consolidated multiple Nottingham sites into City Centre location, access for workforce by PT critical
New business to the City	Minor	Medium	Availability of suitable property, PT connectivity	Company based on Business Park outside the City. The lease expired due to redevelopment of their site. They identified a premises located in the City which offered them proximity to transport links, a suitable premises and some parking. They have bought the building.
New business to the City	Major	Large	Access to workforce, PT connectivity	Expansion project opening a satellite office outside London.
Consolidation of existing indigenous business	Major	Large	Access to workforce, PT connectivity	Expansion project as company consolidates a number of properties into a large City building, ease of access for staff, ease of operation with single site in City.

Employer Size Key defined by number of jobs affected; 1-99 = Small, 100 – 199 = Medium, Large = 200+

Table 5.21 Summary of examples of major decisions to relocate away from Nottingham (disinvestment)

WPL factor	Employment implications	Stated reasons for decision	Notes
Not at all	Large	External pull factors	Down-sizing and moving all manufacturing out of UK
Not at all	Medium	External pull factors	Consolidating multiple East Midlands' sites into one site. Business was car based so access to national and regional road network paramount, as was a central location
Minor	Small	External pull factors WPL	Consolidating into one site, current site not fit for purpose, WPL cited as a factor, half of staff were not Nottinghamshire based
Minor	Medium	External pull factors WPL	Company growth triggered seeking alternative premises. WPL was mentioned as a factor for the relocation outside of the City. However, greater weighting was given to the need for suitable premises that could provide office and warehousing for products and such a site was difficult to locate in Nottingham.
Not at all	Medium	External pull factors	Relocation to office in another City with some redundancies. Triggered by Nottingham office lease renewal and move to more flexible working arrangements.

Employer Size Key defined by number of jobs affected; 1-99 = Small, 100 – 199 = Medium, Large = 200+

In four out of the six investments, public transport connectivity was a major factor attracting these employers to locate in Nottingham. Three of these are located in the City Centre while the other is located in a business park within which a tram stop is now located as part of NET Phase 2. In one case, the WPL was a discussion point between Nottingham City Council and the employer, however, this issue was overcome by supporting the employer to minimise their liability for the WPL charge via reducing the demand for parking by providing workplace travel planning for staff. A further example indicates that public transport connectivity was a minor factor. These examples suggest that increased workforce mobility (M11) and possibly a reduction in the cost of congestion relative to other locations (M10) are active in some location decisions.

Of the five cases where businesses have moved out of Nottingham, two cited the WPL as a contributory factor and in both cases this was considered as a minor factor. The principal drivers for both of these relocations were related to the suitability of the premises. In one case the lease expired on their current site which was no longer fit for purpose and combined with moving nearer to the majority of their workforce and consolidating their business into one site. The other business where the WPL was a minor factor moved out as a result of the growth of their business requiring larger premises which were found just outside Nottingham. The largest employer to leave was undergoing an international restructure related to a declining worldwide market and chose to move all its manufacturing away from the UK.

The above data supports the WPL ToC as it indicates that, while the cost of the WPL is an extra cost to some businesses, it is such a small percentage of turnover that it plays a very small part in location decisions. Outweighing this, it appears that businesses consider access to an efficient public transport network as an important factor when considering a potential location. Whilst cost is a significant factor when choosing a new location or considering remaining and re-investing in a location, the above evidence suggests that the additional cost of the WPL does not present a barrier for a business. This provides evidence to attribute the WPL package to the positive changes in employment and inward investment indicators. However, the research presented in Paper 3, Section 5.2 suggests that there are undoubtedly other exogenous contextual factors that are also responsible for these changes including C3, C5, and C11. In particular, C5 the Nottingham Offer, which includes lower property and labour costs (the two largest operational costs for a business) when compared with cities such as Bristol, Milton Keynes and larger cities such as Leeds and Manchester, ensures that Nottingham remains competitive. C11, the shortage of large, high quality commercial premises remains an important factor in inhibiting inward investment.

5.3.4 Summary

Table 5.22 below summarises the movement of the indicators and compares this to what would be expected if the WPL ToC was operating as suggested in the WPL ToC map (Chapter 3, Figure 3.3). The magnitude of each change is described as large, small or none. Any attempt to provide a numerical figure would be spurious as there is not enough existing data from similar interventions to accurately predict this. A similar approach is taken for differential change to the Comparator Cities for the macro-economic indicators. This allows all the research described above to be triangulated to provide a balanced probability of conclusion.

This research is discussed in further detail in Sections 6 and 7 of Paper 3 and detailed conclusions from this research are provided. These are summarised below:

- There is a good body of evidence that indicates that the WPL is not having a negative impact on inward investment. This is supported by examples of investment decisions that suggest that the WPL plays a very small role in business location decisions.
- The strong growth in employment combined with a positive movement in the inward investment specific indicators suggests that Nottingham is relatively attractive to potential investors. There is positive evidence from six inward investments that the public transport improvement components of the WPL package are playing a role in this.

Table 5.22 Indicator trajectory and magnitude: expected based on WPL ToC and actual

KEY

⬆⬇ = Indicator increases/decreases at a greater rate than comparator City average <u>or</u> shows a disproportionate increase/decrease. than the time series trend

⇧⇩ = Indicator increases/decreases, but neither at a faster rate than the comparator Cities nor at a rate has that demonstrated a departure from the time series trend.

Indicator	Change in indicator 2010/11 to 2013/14		Movement Relative to City Comparator Average from 2010	Comment
	Predicted	Actual		
Jobs located in Nottingham	⬆	⬆	Greater	Job creation and economic output is directly associated with a buoyant inward investment market. The WPL ToC suggests a strong growth in these indicators could be expected as the WPL package combines with **C3**, an improving national economic situation.
Economic Output	⬆	⇧	Less, growth in GVA in slowed in 2012, before falling in 2013. Despite strong growth before and after that period this pegged back growth in the study period to less than that in Leicester and Newcastle	
Business Births and Deaths	⇧	⇧	Less	Only weakly linked to level of inward investment as data is dominated by smaller business start-ups and failures.
Commercial property market activity	⇧	⇧	No comparable data available	The WPL ToC, suggests an increase, however, there is a finite amount of premises (C11) so the magnitude could be limited.
Inward Investment Enquiries and Successes	⬆	⬆	No comparable data available	The WPL ToC predicts a large increase as the impact of the WPL package combines with C3, an improving national economic situation.
Case study data	Employers being attracted to Nottingham due to good PT connectivity. Few, if any, de-investors cite WPL as a significant factor	As expected; 4 investors cite PT as major factor and 1 as a minor. 2 de-investors cite WPL as minor factor	No comparable data available	The WPL ToC suggests that this should show evidence that the WPL is either, not a factor in dis-investment decisions, or a very minor one, while there should be a number of instances where businesses cite good public transport connectivity as a major reason for their location decision.

Overall, while not yet conclusive, the evidence suggests that, on the balance of probability, the WPL package is making good progress towards its economic objective with the majority of chosen indicators moving in the direction and magnitude that would be expected according to the WPL Package ToC. An internal re-organisation of NCC's inward investment team in 2016, whereby it was replaced by an arms-length agency, Invest in Nottingham, has resulted in difficulties in obtaining a continuation of the local inward investment datasets and this has made the evaluation of the economic impacts of the WPL more difficult.

5.4 SUMMARY OF RESEARCH UNDERTAKEN

The research outlined in this Chapter enables conclusions to be drawn as to what extent the WPL has met its stated objectives with respect to congestion constraint and economic impact. The research aims to test to what extent the WPL ToC outlined in Chapter 3 has operated as anticipated to achieve those objectives.

In this Chapter the local time series that have been identified as indicators to measure the intervention's success have been presented. Analysis of these local indicators (see Section 5.2.6 and 5.3.2), prior to a detailed consideration of context and attribution, presents an ambiguous picture with respect to confirming the WPL ToC; a reduction in LWPP and an increase in parking management schemes which pass on the cost of the WPL and of travel planning, suggest employers are modifying their behaviour in a manner which should contribute to congestion constraint. However, higher level indicators for mode share and congestion appear to be slow to respond to these stimuli. The macro-economic indicators also appear contradictory with respect to confirming the WPL ToC, while the indicators of inward investment show a strong growth in line with expectation given the WPL ToC.

In order to make sense of these indicators additional research seeks to place this monitoring against the context of exogenous, ongoing change and to assess to what extent the changes observed in the indicators can be attributed to the WPL and its associated transport improvements.

Firstly, where possible, the indicators are benchmarked against data from the four Comparator Cities. (See Sections 5.2.7.1 and 5.3.3.1 and Paper 3) This research demonstrates that the majority of indicators are moving in the direction expected according to the WPL ToC, once the contextual factors are taken into account, with Nottingham performing relatively strongly with respect to congestion constraint, mode shift and job creation. However, these observations do not provide evidence of cause and effect. With respect to congestion, this is provided by a time series modelling approach which demonstrates that a fall in the provision of LWPP is statistically linked to a reduction in DVM (see Section 5.2.7.2 and Paper 4). This research also demonstrates that contextual factors, i.e. roadwork activity and a rise in the working age population, are statistically significant and are obscuring the congestion reduction linked to the WPL from 2012 onwards.

Further research, whereby a sample of 2000 commuters were asked if they had switched mode since 2010 and, if so, why, demonstrated 8.6% of those currently using sustainable modes have indicated that the WPL Package has played an important part in their decision to swap away from the car (see Section 5.2.7.3). This research also provided a strong indication that there is significant suppressed demand for travel by car which may be counteracting the Transport Demand Management effect of the WPL Package.

Finally, research to assess the economic and investment impact of the WPL has been presented by updating the research presented in Paper 3. Relevant macro-economic indicators are benchmarked against data for comparable UK cities and considered alongside local time series data which track the levels of inward investment in Nottingham (see Section 5.3.1). This data is supported by a dataset of investment and disinvestment decisions in Nottingham since 2010 which provides the reasoning behind those decisions (see Section 5.3.3.2 and Paper 3, Section 5.2).

While no single dataset can be used to answer the research questions relating to the intervention's economic impact, when all these indicators are triangulated against one another a balance of probability conclusion is obtained. This shows that there is strong evidence that the WPL is having no significant negative impact on inward investment. Additionally, evidence suggests that the public transport improvement components of the WPL package are playing a role in attracting investment to Nottingham.

6 CONCLUSION AND DISCUSSION

In this Chapter the findings of the research detailed in Chapter 5 are discussed in order to draw overall conclusions. The impact of this research on the sponsoring organisation and wider industry is then discussed followed by a critical review of the research conducted. This Chapter concludes with recommendations for further research and finally a summary of the unique contribution to knowledge from this thesis.

The aim of this thesis is to evaluate the impact of the transport interventions comprising the Nottingham WPL Package on levels of traffic congestion, transport mode share and business investment in Nottingham. Chapter 5 details the research undertaken to achieve the thesis aim and the objectives. The research tasks which were identified to meet Thesis Objectives 1 to 6 have all been completed while objective 7 is met by the production of this chapter.

6.1 CONCLUSIONS

The thesis aim is linked to three key objectives which were identified for the WPL scheme, but which equally apply to the WPL Package as a whole. Therefore, in this Section the research findings from the previous Chapter are summarised in order to show to what extent the WPL Package has met those objectives. This is then followed by a discussion as to what extent the research has confirmed the WPL ToC.

6.1.1 WPL OBJECTIVE 1: CONSTRAIN CONGESTION IN THE AM AND PM PEAK PERIODS

The research outlined in Chapter 5 demonstrates a measurable impact of the WPL as a standalone scheme on congestion and that the WPL Package has also contributed to congestion constraint. The key evidence to support this is:

- Employers have reduced the number of LWPP which they provide and larger employers have introduced parking management schemes which pass on the cost of the WPL to their employees.
- Evidence is provided by the time series model research detailed in Paper 4 which shows that the elasticity of DVM with respect to LWPP is 0.55. This results in a time saving of around 15 seconds per vehicle mile (or 1146 days) in 2013 due to the fall in LWPP caused by the introduction of WPL scheme. This research also revealed that an increase in employment in Nottingham, linked with economic growth, is continuing to reduce the effectiveness of these beneficial impacts. It is also suggested that suppressed demand for travel by car and a potential reduction in long term effective road capacity are also contextual factors which could result in an increase in congestion.
- Benchmarking against the comparator cities shows that Nottingham has seen a slower growth in JTVM than three out of four of the cities between 2010 and 2016.

A survey of 2000 commuters carried out at the end of the study period has provided evidence that commuters have switched away from commuting by car in favour of more sustainable modes as a result of the WPL Package. This study shows that all four main elements of the WPL Package have played a role in this. However, this research also reveals that there have also been significant numbers of commuters who have switched back to the car since 2010. This demonstrates that there is substantial suppressed demand for commuting by car which is counteracting the transport demand management effect of the WPL and its associated public transport capacity improvements. This presents somewhat of a puzzle; given it has been shown that the number of Liable Workplace Parking Places has fallen, it is unclear where the car trips generated by suppressed demand are parking. This underlines the need for further research on this subject to inform future policy.

These findings, especially the initial fall and subsequent increase in Delay per Vehicle Mile reported in Figure 5.5 Section 5.2.7.2, are consistent with the experience in Perth and Melbourne reported in the Literature Review in Section 2.2.2 of this Thesis. The PSL schemes in both Cities were initially linked with a fall in congestion/traffic levels and an improvement of non car mode share. However, literature (Martin 2012 and Young et al 2015) shows that this is increasingly offset by changes to exogenous factors, mainly economic and population growth. Transport for London (TfL 2008) noted that the initial reduction in congestion as a result of the original London Congestion Charging Scheme (LCG) had also been reversed. TfL attributed this mainly to a reduction in effective network capacity due to the re-allocation of road space to cycling and public transport (TfL 2008). There is no data to suggest that effective network capacity in Nottingham has been significantly reduced during the study period. TfL (2008) go onto point out that this does not mean that the LCG is not having an ongoing congestion constraining impact and conclude that levels of congestion would be higher without it. This conclusion is consistent with the findings of the time series model for Nottingham presented in Section 5.2.7.2.

Key Conclusion: The WPL, NET Phase 2 and the refurbishment of Nottingham Station have contributed to congestion constraint in Nottingham. There has been strong progress towards this objective. However, congestion constraint has been tempered by the presence of confounding contextual factors, i.e. population growth, an increase in the number of jobs located in the City, suppressed demand for commuting by car and in the short term by disruption due to road works. Overall the change observed with regards to congestion is as would be expected, given the WPL ToC, once exogenous contextual changes have been taken into account.

6.1.2 WPL OBJECTIVE 4: ENCOURAGE SUSTAINABLE TRAVEL AND MODE CHOICE

Despite a rise in bus patronage throughout the study period there was little evidence of mode shift towards public transport (PT) prior to the opening of NET Phase 2, the most significant of the public transport improvements part funded by the WPL. Following the opening of these two new tram lines there has been a jump in PT patronage accompanied by a rise in the mode share of PT due to more people arriving by rail and patronage on the two new tramlines. Cycling has shown a growth in numbers throughout the evaluation period.

A survey of 2000 commuters shows that all sustainable modes have attracted individuals to switch away from commuting by car. The survey shows that around 8.5% of all commuters on these modes have switched away from the car, at least in part because of the WPL Package; about half of these people cited the increase in the cost of parking at work or the removal of workplace parking as an important reason for their switch.

However, the survey also demonstrates that a quarter of all car users have switched to this mode in the study period, with convenience and a quicker journey time being important reasons for this switch. This demonstrates that there is significant suppressed demand for commuting by car. It is concluded that this limits the ability of the WPL to actually reduce congestion as when road space is consequently released by the WPL itself, or the measures it part funds, further car trips are generated.

Key Conclusion: While a significant shift in mode share towards PT has only been observed after the opening of NET Phase 2, the survey of 2000 commuters suggests that mode switch due to the WPL and its associated transport improvements has been ongoing throughout the study period. While progress has been made towards this objective, both the magnitude and speed of change is less than would be suggested by the WPL ToC. There is strong evidence that this is due to suppressed demand for commuting by car. However, the WPL package has led to a significant increase in overall transport capacity which will cater for the anticipated future economic and population growth. Evaluation of the impacts of PSL schemes in Australia, Perth (Richardson 2010) and Melbourne (Hamer et al 2009), show a greater mode switch away from the car than demonstrated in Nottingham. This perhaps reflects the higher level of charge per space. However, Hamer suggests that this change in Melbourne may not be due to the PSL itself, but rather a result of other factors.

6.1.3 WPL Objective 5: Enhance the attractiveness of Nottingham as a location for business investment

The data and analysis presented in the previous Chapter, Section 5.3.4, demonstrates to what extent the economic indicators are moving in the direction and magnitude that would be expected according to the WPL ToC and thus, if the Nottingham WPL Package is making progress in achieving the intended economic impacts.

The number of jobs based in Nottingham has seen strong and sustained growth and shows that Nottingham has fared better than average when compared to the comparator Cities. While performance on economic output is ambiguous, evidence suggests that this is very unlikely to be linked to the WPL. It is concluded that there is no observable negative effect on overall macro-economic performance associated with the introduction of the WPL.

The level of commercial property market activity and the number of inward investment enquires and subsequent successes have shown strong growth in 2012/13 and 2013/14. The inward investment examples collated so far demonstrate that the WPL is a relatively minor consideration when businesses make investment decisions, while the availability of good connectivity to PT has been an attractor to at least four major inward investments in this period. The above conclusion fits well with the WPL ToC, however more case study data is required to completely confirm these observations.

The economic performance of a large city and relating this to any single transport intervention is always difficult, as is demonstrated by the lack of literature pertaining to successful evaluations. The approach taken in this research to evaluate the economic objective demonstrates a way of tackling this problem that is open to most practitioners and, while it isn’t possible to prove a position beyond all reasonable doubt, or within some pre-determined statistical margin, it is suggested that a reasonable balance of probability case has been presented.

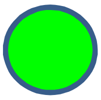
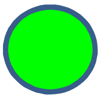
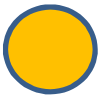
Key Conclusion: There is good body of evidence that the introduction of the WPL scheme has not adversely impacted levels of inward investment. This is an important conclusion as it effectively refutes one of the key barriers to implementing a WPL scheme, i.e. that it will negatively impact on inward investment as it is an extra cost on business. There is also evidence from the examples of inward investments, that the WPL Package has encouraged some employers to either locate or to remain in Nottingham. These findings are consistent with those from the evaluations of both the London Congestion Charge (TfL 2008) and the Perth PSL (Richardson 2010), both which conclude that there is no evidence of an adverse impact on business from their respective charges.

It is, therefore, concluded that there is progress towards this objective. However, it is recognised that the evidence base to support the premise that the WPL Package is “enhancing” inward investment is sparse and more data is required to support this conclusion. The limitations of this evidence base are discussed in more detail in Section 5.3, but it can also be said that there is little evidence to suggest a negative effect either.

6.1.4 Summary of Key Conclusions Regarding Progress towards WPL Objectives

Table 6.1 summarises the above conclusions with respect to the three WPL Objectives

Table 6.1 Progress toward the WPL objectives

WPL Objective	**Status of Objective**	**Issues**
O1 - Constrain congestion in the AM and PM peak periods.		Most exogenous contextual factors serve to increase the demand for travel by car. However, the situation would be worse without the intervention.
O4 - Encourage sustainable travel and mode choice.		Suppressed demand for travel by car limits increases in mode share of sustainable modes
O5 - Enhance the attractiveness of Nottingham as a location for business investment.		More data is required to fully confirm the conclusions advanced in this research.

Status of objective:

Red = The WPL Package will not achieve this objective

Amber = Positive indications that the WPL Package may be moving toward this objective, but it is not possible to demonstrate this conclusively at this time.

Green = WPL Package is on track to achieve this objective

As discussed in Section 1.3 the three objectives which were evaluated in this thesis (see Table 6.1) are highly significant if a WPL approach is to be adopted elsewhere as they address the issue of public acceptance, i.e. there was skepticism that a WPL could be effective in reducing congestion and may prove damaging to inward investment. This research demonstrates that both the WPL, as a standalone scheme, and the other WPL Package elements contribute to congestion constraint. Additionally, while it has not been possible to conclusively demonstrate that the WPL Package transport Improvements have attracted investment to Nottingham, what can be concluded is that the additional cost to businesses of the WPL has not had a negative effect.

Crucially, the WPL Package has significantly increased both PT quality and capacity and this, in the long run, will leave Nottingham well placed to cater for population growth and economic growth, without suffering unsustainable traffic congestion or increasing road capacity. This increase in capacity ensures that a lack of transport capacity will not constrain economic performance and is a key output from the WPL Package.

6.1.5 Discussion of the WPL ToC and associated mechanisms for change

In the previous three sections it has been shown that, in general, the WPL ToC is operating as anticipated to achieve the three key WPL objectives (See Table 6.1). The main caveat to this is the magnitude of change. The difficulty of identifying a magnitude of change, either in absolute terms with respect to the key indicators, or in showing differential change against the comparator cities, is identified in Chapter 5.

In the absence of an expectation as to the magnitude of change, a consideration of the extent individual mechanisms of change are operating provides additional evidence that the WPL ToC is operating as anticipated. The following table considers the evidence in relation to the individual mechanisms.

Table 6.2 Evidence of the operation of mechanisms

ID	Summary of Mechanism	Evidence suggesting mechanism is active including relevant contextual changes (References to Research detail in Chapter 5 in bold brackets)	Active as predicted
M1	**Improved PT options funded.**	The WPL package has been fully implemented. WPL raises around £9 million per year. **(1.3)**	**YES**
M2	**Increased PT capacity**	WPL Package has now been implemented; bus patronage has increased in Nottingham from 2010, while it has fallen in the comparator cities. **(5.2.4)** Both PT mode share and patronage have increased following the completion of NET Phase 2. **(5.2.4)**	**YES**
M3	**Improved PT options result in better connectivity and convenience and image**	The commuter survey shows that improved bus services and new tram lines are a factor in mode shift away from the car. **(5.2.7.3)**	**YES**
M4	**WPL funds workplace travel plans, car park management and cycle infrastructure improvements**	There has been an increase in the uptake of travel plans and parking management schemes since the introduction of the WPL. **(5.2.5).**	**YES**
M5	**Direct increase in cost in commuting to work by car**	There was no data prior to 2012/13, however, at present 53% of WPP are covered by parking management schemes which pass on the cost to employees, certainly this has occurred as a result of the introduction of WPL. **(5.2.5)**	**YES**
M6	**Indirect increase in cost of commuting to work by car**	The latest available data from 2014 shows that on an average weekday, 426 vehicles parked using the "Early Bird" parking deal for a Council City Centre car park. This deal is aimed at commuter parking and, when considered in the context of a reduction in the number of Workplace Parking Places, demonstrates that this mechanism is active.	**YES**
M7	**Decrease the supply of Workplace Parking**	The number of WPP has fallen by around 25% following the introduction of the WPL. **(5.2.5)**	**YES**
M8	**Enhanced effect of WPL package**	None	**Unknown**

ID	Summary of Mechanism	Evidence suggesting mechanism is active including relevant contextual changes (References to Research detail in Chapter 5 in bold brackets)	Active as predicted
M9	**Congestion Constraint**	Congestion has risen more slowly in Nottingham than three out of four of the comparator cities **(5.2.7.1)**. Paper 4 details time series modelling and shows that for every 1% fall in LWPP, DVM will fall by 0.55% if all other variables remain constant. **(5.2.7.2)**	**YES - but impacted by contextual factors**
M10	**Reduced cost of congestion to businesses**	JTVM has risen by 5.6% between 2010 and 2016. However, this is also the case within some of the other medium sized cities, i.e. Sheffield, and Leicester and may be due to the emergence of the national economy from recession (C3) **(5.2.7.1)**	**NO**
M11	**Increased PT capacity and efficiency makes Nottingham more attractive as a business location due to workforce mobility**	There is some evidence from inward investment examples that the additional PT provided by the WPL Package has attracted inward investment. **(5.3.3.2)**	**Data is limited; more required.**
M12	**Employers choose to pass on the cost of the WPL**	53% of LWPP are covered by parking management schemes which pass on the cost to employees **(5.2.5)**	**YES**
M13	**Increase in cost of operating a business in Nottingham**	Investment enquiries and subsequent successes have increased since the introduction of the WPL when compared to the previous 4 years, although it needs to be accepted that this could be due to the emergence from recession (C3) as much as any effect of the WPL package. This, however, also suggests that the cost element of WPL is not having a detrimental effect. **(5.3.3.2)**	**Partly**
M14	**Suppressed demand for travel by private car**	A survey of car users conducted in late 2016 showed that a quarter had switched to the car since 2010, convenience and time saving were important factors in their decision to do so. **(5.2.7.3).**	**YES**
M15	**Agglomeration economies**	None, no economic data for the period after the opening of NET Phase 2 is currently available	**Unknown– further research required**
M16	**Labour Force Effects**	None, no economic data for the period after the opening of NET Phase 2 is currently available	
M17	**General Equilibrium Effects**	None, no economic data for the period after the opening of NET Phase 2 is currently available	

Table 6.2 shows that the majority of mechanisms *are* operating as expected. However, congestion has increased not decreased and although it has increased less than in three out of four of the comparator cities, this cost is still increasing, thus M10 is not active. Additionally, evidence is weak as to whether the WPL Package measures are combining to be greater than the sum impact of each scheme, M8. M13, the increased cost on businesses of the WPL charge, is partly offset by M12 where employers pass on the cost to their employees. As the key PT improvement, NET Phase 2, was only opened in August 2015, it is, therefore, too soon to expect the neo classical economic mechanisms, M15, M16 and M17 that rely on an enhanced PT system, to operate at the moment

Evidence from the survey of 2000 commuters reveals that suppressed demand for travel by car, M14, is acting to limit the congestion constraining effect and overall mode shift.

The Package has been implemented in a period of economic recovery which, as literature has suggests in Chapter 2, is likely to increase the demand for travel by car and this has led to a general increase in congestion in Nottingham and all four comparator cities. This contextual factor, C3, is thus likely to reduce the effectiveness of the WPL Package in delivering an actual reduction in congestion.

The conclusion is, therefore, that while the WPL ToC appears to be operating as intended to deliver the outputs and short term outcomes, the evidence suggests that the mechanisms that facilitate the desired long term impacts are either hindered by exogenous and local context and/or there is currently insufficient data to confidently conclude that they are active.

Wider Significance of the WPL Theory of Change - This research has tested a WPL ToC for the Nottingham WPL Package and concluded that, while there are a few caveats, it is operating as intended to facilitate the intended impacts, once exogenous contextual change is taken into account. This output from the ToC Evaluation approach can now be used a template that is transferable to other Cities wishing to implement a similar package using a

WPL as a core funding mechanism. Provided the differing context in the city is taken into account, the approach should produce similar outcomes and impacts. The ‘modular’ nature of the WPL ToC whereby individual mechanisms and contextual factors can be identified and adjusted will assist this process.

At the time of writing a number of UK cities are investigating the possibility of introducing WPL Packages and thus a modified version of the WPL ToC outlined in this research has the potential to be a cornerstone of any future Business Case elsewhere.

6.2 IMPACT ON SPONSORING COMPANY

Relationship with DfT - Nottingham City Council has an obligation to evaluate the transport schemes which it introduces, including the Workplace Parking Levy, against set objectives. This commitment is given in the Nottingham WPL Business Case 2008 (NCC 2008). This EngD research has played a lead role in addressing that obligation by evaluating the three key objectives for the scheme that were agreed with the UK Department for Transport. The DfT is the principle audience for that evaluation and has an active supervisory role within this research by approving the evaluation framework outlined in Chapters 3 and 4, contributing to the ToC as a stakeholder and validating the research output as and when it becomes available. It is important that NCC demonstrates that it can deliver an impartial evaluation of major transport investments as it is increasingly a condition for receiving capital funding from the DfT.

Informs Future Policy - As the Unitary Administrational Authority for Nottingham, it is important for NCC to understand whether its transport policies are working toward the Council’s wider policy objectives or, indeed, if they are having perverse or unintended effects. This evaluation contributes to this understanding and should enable future policy to be refined.

6.3 IMPACT ON THE WIDER INDUSTRY

While the WPL has been implemented and is running smoothly in Nottingham, decision makers in other Local Authorities, who may be considering implementing a similar scheme, will also need to understand whether or not the WPL package is achieving its wider objectives. Additionally, they will need to be able to demonstrate both a congestion and economic benefit in order to gain approval for such an approach both from the DfT and local businesses.

This research will be an important asset in this process as it will inform any future business case for a WPL by providing direct evidence from a UK medium sized city as to these impacts. Furthermore, the consideration of individual mechanisms and contextual factors within this evaluation will allow a consideration as to how differing circumstances that will almost certainly be present in other cities are likely to influence the intervention's effectiveness.

Measuring change in an open system subject to external exogenous factors, such as a large city and relating this to any single intervention is always difficult as is demonstrated by the lack of literature pertaining to successful similar evaluations. Thesis Objective 7 is to provide best practice as to how to evaluate large scale or controversial transport interventions. The approach taken in this research demonstrates a way of tackling this problem that is open to most practitioners and has a good chance of providing useable conclusions as to the intervention's effectiveness.

6.4 CRITICAL REVIEW OF THE RESEARCH

It is important to reflect on this research and provide a critical review of the methods and conclusions.

The following addresses the key limitation of this research:

- The WPL ToC was arrived at as an early research action for this project i.e. after the WPL had been implemented - Academic and government literature recommends that this should be done at the scheme appraisal stage prior to implementation. In this case, however, the Nottingham WPL Business case provided a good deal of background to the ToC and this could be augmented with current data and stakeholder input. The availability of early post implementation data, if anything, enabled the WPL ToC to be more accurate and thus is not considered to be detrimental to the research.

- No expectation as to the magnitude of change expressed as part of the WPL ToC – The single largest ‘gap’ in the WPL ToC is the lack of a target in terms of the scale of the expected impacts which would constitute success expressed in terms of a percentage change to key indicators. The issue of target setting was discussed with the DfT at the outset of this project and it was agreed that, because of potential contextual change over the study period and the lack of data from similar interventions, it was not possible to set meaningful targets. However, stakeholders certainly agree as to the direction of change and it may also be possible to agree a general magnitude of change. To this end a survey of stakeholders was specified, however, the level of specialist knowledge required to offer an informed opinion was considered to be too onerous to impart to the stakeholders and the survey was not carried out.

- Within the time series model in Paper 4 some of the data required interpolation to derive weekly values; this is discussed in Section 5.2.7.2.

- Inability to detect change in high level indicators combines with a lack of data at corridor level - Detecting change in indicators that apply at a Nottingham unitary authority level may be difficult as, overall, the change could be quite small. The change caused by the WPL Package may vary across this area, being more distinct in areas with a high density of WPL liable employers or along tram corridors. While it is possible to track some indicators in specific areas others, particularly macro-economic indicators, only apply to the whole city and cannot be disaggregated. This research could be improved by a more disaggregate approach based on mapping the data across different areas of the city. While some assessment has been made of the impact in the corridors affected by NET Phase 2, the research would benefit from some spatial mapping of the density of WPL liable employers and investment. This was not carried out due to a lack of resource within NCC and a lack of time within the project team.

- It has only been possible to include a basic analysis of the survey of commuters detailed in Chapter 5, Section 5.2.7.3. The survey was only conducted late in 2016, one year after the opening of NET Phase 2, as a 12 month "after" period was required to allow travel patterns to settle and the wider impact of this major PT improvement to be felt. The consequence of this was that the data only became available in January 2017 which did not allow sufficient time for a full and exhaustive analysis of what is a complex and rich dataset. While the analysis provided is robust, a fuller analysis will be conducted over the next year to ascertain if further knowledge can be generated.

6.5 RECOMMENDATIONS FOR INDUSTRY AND FURTHER RESEARCH

Overall, it is recommended that other Local Authorities with dense urban areas consider introducing a WPL as the core funding mechanism for PT and cycle infrastructure and as a transport demand management measure. While it is recognised that this is a long term strategy the findings of this research are broadly supportive of such a strategy. However, as the WPL Package was only finally fully delivered in August 2015 it is too soon as yet to fully evaluate the longer term impacts. Decision makers should continue to consider the outputs from the ongoing evaluation of the Nottingham WPL package with respect to the longer term impacts on congestion and the economy.

The following areas for further research are recommended:

- Suppressed demand for travel by car – This may offset congestion constraint delivered via transport demand management measures. It will take the form of both latent demand due to the inability to afford a car and supressed demand caused by existing congestion. Neither of these contextual causes are considered in detail in this study and it would be useful to be able to quantify both effects.
- Network Capacity – In Chapter 2 the tendency for a decline in effective network capacity in urban areas is highlighted as Local Authorities re-allocate road space to non-car modes or add new pedestrian and cycle crossings. In this research it was assumed that the network capacity remained stable, however, additional research which quantifies this effect would provide important local context with respect to congestion constraint.
- Empirical Study of impact of full package on congestion – The approach used to assess the impact of the WPL scheme on congestion (see Paper 4) should be used to assess the impact of the full WPL Package by introducing a dummy intervention variable representing the opening of NET Phase 2.
- This evaluation would benefit from more empirical evidence for the impact of the WPL package on the wider economy. This was not possible in this research due to lack of data availability, but as subsequent year's data become available, or other data sources are identified, a more empirical approach, utilising time series modelling, may become more practical.
- Research into the impact of the WPL impact on land use. As employers reduce their parking provision this should free up land for other uses and thus potentially generate economic benefit. For example, Nottingham Trent University redeveloped a major car

park in Nottingham City Centre following the introduction of the WPL. Thus, research could involve a survey of employers and then an assessment of the economic benefit.

6.6 SUMMARY OF UNIQUE CONTRIBUTION TO KNOWLEDGE FROM THIS THESIS

In summary, this thesis makes a unique contribution to knowledge in three main areas:

1. As the Nottingham WPL is the first of its kind in the UK and Europe, the research provides a unique evaluation of the impacts of such a scheme.

2. The evaluation approach used within this thesis is based on a Theory of Change (ToC) approach. Despite guidance from the UK Department of Transport encouraging such methodology, this is the first large scale transport intervention of its kind to be subject to such an evaluation approach.

3. This research not only identifies that change has occurred, but seeks out the causality between this change and the WPL. A good example of this is the research referenced in Paper 4 and outlined in Chapter 5, Section 5.2.7.2, which provides, for the first time, statistical evidence that a WPL has resulted in a reduction in traffic congestion.

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APPENDIX A PAPER 1

Workplace Parking Levies: the answer to funding large scale local transport improvements in the UK?

Dale, S. J., Frost M.W., Ison S. G. and Warren, P., 2014, Workplace Parking Levies: the answer to funding large scale local transport improvements in the UK?, *Research in Transportation Economics,* Vol 48, page 410 to 421

Abstract

Despite positive experiences in Australia of utilising area wide workplace parking place charges to pay for public transport improvement, only one UK local authority, to date, Nottingham City Council has chosen to implement a Work Place Parking Levy scheme (WPL). This scheme intends to allocate the revenue raised to fund (amongst other things) two new tram lines.

Acceptance by the public and the business community are seen as key barriers to implementing a WPL. The two major criticisms of the Nottingham scheme prior to its implementation were that a WPL would discourage business investment and thus damage the economy while its intended impact on traffic congestion would be minimal.

Therefore a detailed assessment of the Nottingham WPL scheme's performance is essential in order to facilitate transferability of this approach to other UK and European Cities and thus bring WPL into the mainstream for funding transport improvements.

This paper outlines the barriers to implementation of the Nottingham WPL scheme, and the rationale behind the chosen use of revenue and how the scheme's performance will be evaluated as a transport demand management measure, as well as some initial performance monitoring data following the first year of operation.

The results to date are discussed with a view to identifying any early indications as to whether traffic congestion and business investment has been impacted by the scheme's introduction.

1. Introduction

Currently both Road User Charging and Workplace Parking Levies are available to Local Authorities in the UK as instruments for raising revenue but any revenue raised must, by law, be used to fund transport improvements. This hypothecation of such revenue is not a new idea, indeed it was used in the UK in the late 1800s when the Road Fund Licence (Later to become the Vehicle Excise Duty) was used to finance road construction. (Ison and Mulley 2013).

This paper will consider to what extent current data suggests that a Work Place Parking Levy is the answer to funding large scale public transport improvements in the UK. This will be facilitated by briefly considering the performance of similar Parking Space Levies in operation in Australia and by examining the only scheme currently in operation in the UK, in Nottingham, in terms of its objectives, barriers to implementation and the data that is currently available to measure progress towards these objectives.

The background to the WPL scheme in Nottingham is covered, the current literature relevant to hypothecation of funding for transport schemes, how the hypothecated funding from the Nottingham WPL scheme will be spent and barriers that mitigate against the introduction of WPL schemes in the UK. The paper concludes by outlining the monitoring framework for the WPL including objectives, relevant indicators and data collection methodologies before drawing conclusions based on current data as to how the Nottingham WPL scheme is performing after its first year of full operation.

2. Background

Nottingham is one of 8 English core cities, situated 180km north of London it is the largest conurbation in the East Midlands with a population of 670,000. Figure 1 shows its location and principal transport links. With a smaller population of 304,000, the Nottingham City Council administrative area covers the central area of the city only with the urban suburbs of Beeston, West Bridgford, Hucknall, Gedling and Arnold lying in the surrounding boroughs.

Nottingham has long experienced peak period traffic congestion which it is estimated costs the economy £166 million per year (NCC 2013). A population growth of around 9% over a 15 year period from 2011 is also expected (NCC 2013) It is thus not surprising that tackling congestion by promoting sustainable transport modes is at the heart of the City Council’s transport policy. A central pillar of this approach has been the introduction of a Workplace Parking Levy with the dual purpose of acting as a transport demand management tool in its own right as well as funding large scale public transport improvements.

The Nottingham Workplace Parking Levy (WPL) scheme uses the provision of the UK Transport Act 2000 and the subsequent Workplace Parking Levy (England) Regulations 2009 to levy a charge on occupied private non domestic off street parking spaces i.e. Workplace Parking Places (WPP) occupied by employees, regular business visitors or students. The WPL covers only the Nottingham City Council administrative area and currently the charge per WPP is £334 per year. This charge will rise at above the rate of inflation until 2015, there after it will rise at the rate of inflation. This ‘escalator’ is intended to coincide with the completion of the public transport improvements supported by the scheme. Employers apply for a licence for each of their premises (where parking places are provided) which states the number of WPP they wish to use and then pay the appropriate Levy. It should be noted that it is the employer’s responsibility to pay the levy, not the individual employee’s, although some employers choose to effectively pass this cost onto their employees by running their own internal car park charging schemes. Thus, a WPL may act as a transport demand management tool by either:

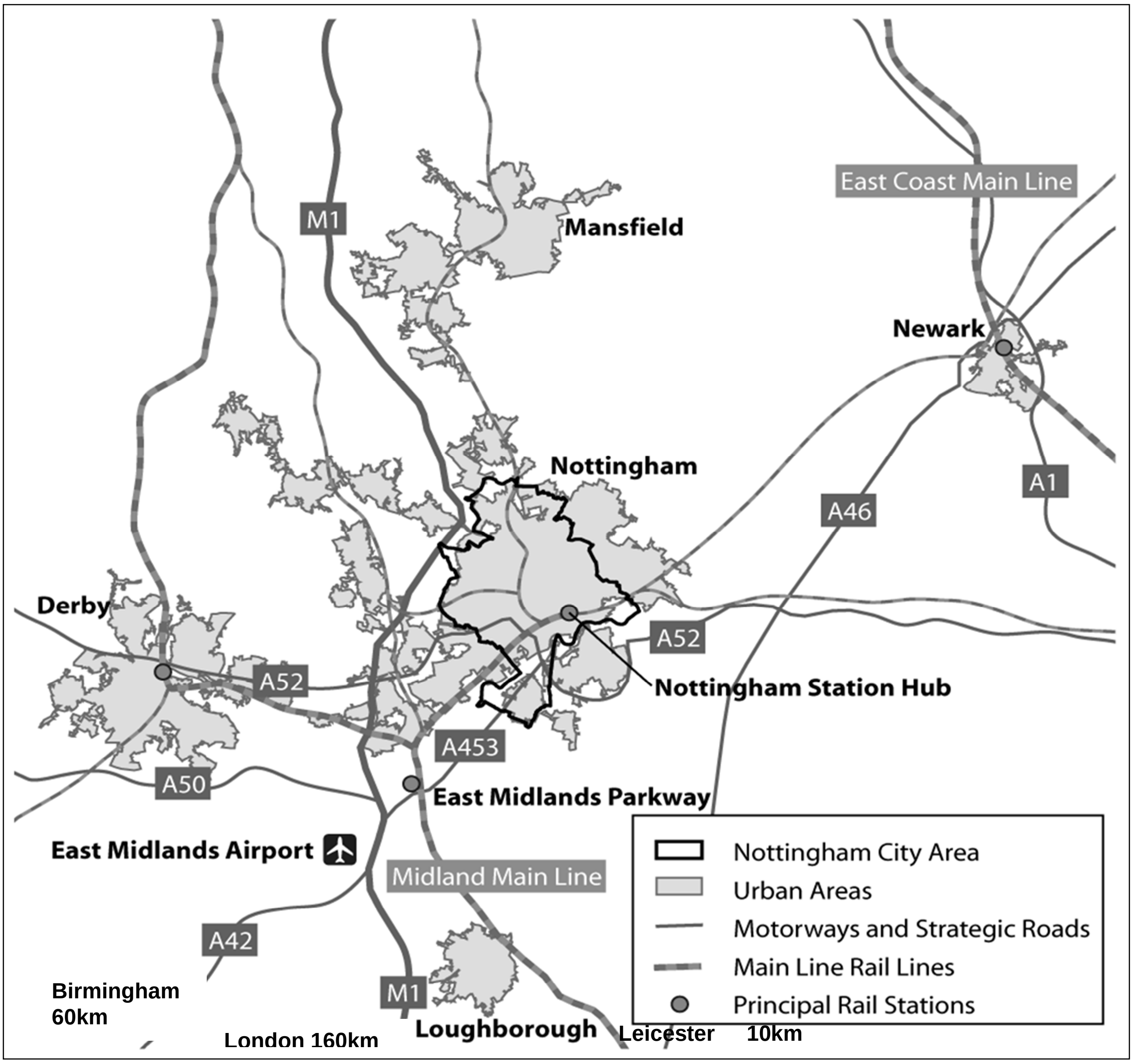
- increasing the cost of commuting by car when the charge is passed on by the employer to the employee or
- by the reduction in the supply of Workplace Parking Places due to employers reducing their provision in order to limit their liability.

The following are exempt from this charge or receive a 100% discount:

- Premises from which frontline health services are provided by or on behalf of the NHS.
- Premises occupied by the emergency services.
- Places occupied by customers, disabled blue badge holders and delivery vehicles.
- Employers with 10 or fewer WPP.

Licensing was introduced in October 2011 and charging commenced six months later on the 1st April 2012.

Figure 1 Nottingham Conurbation and its major transport links



Source: Nottingham City Council.

The revenue raised by the WPL will be used to part fund a package of transport improvements which include the Nottingham Express Transit Phase 2 (two new tram lines), improvements to Nottingham Railway Station and Linkbus services to connect between the tram corridors.

To date Nottingham is the only UK city to introduce a Workplace Parking Levy (Frost and Ison 2008), and it was recognised by the City Council that tracking the scheme's performance would play an important part in its transferability to other Cities. Thus the 2008 Business Case for the Nottingham WPL (NCC 2008) included the expectation that the performance of the scheme would be monitored against a broad set of objectives.

Although a WPL is a legally binding levy and thus will be an effective mechanism for raising hypothecated funding for transport improvements, its overall success will be dependent on its ability to gain acceptance by the public and the business community as well as co-existing with other important policy objectives. If these conditions are not satisfied then history suggests that the schemes could be short-lived and that it could prove politically unacceptable for other cities to introduce a similar scheme. An example of such a failure can be seen in Vancouver which experimented with charging a levy on parking. This levy was based on a charge on parking surface area per square metre. Although this was introduced in 2006, heavy opposition from business prompted a re-think and it was quickly replaced by a tax on transactions for paid parking (Litman 2011). With this lesson and considering the demise of other unpopular taxes, (such as the community charge (poll tax) in the UK), six scheme objectives were developed by Nottingham City Council to fit a broad policy agenda as well as a revenue raising aim.

These objectives are based on the 2008 Business Case and its subsequent review from the "Examination in Public" (Dodd 2007) and are summarised in Table 1. In practice, although these objectives are branded as objectives of the WPL scheme, they also apply to the WPL package as a whole, which includes the public transport improvements that the levy part funds. For example, the Nottingham WPL Business Case (NCC 2008) recognised that the initial effect of the levy as a stand-alone transport demand management measure may be quite small and that it would be the combined effect of the WPL and the public transport improvements that would be needed to effect major change.

For the WPL to become a mainstream option for funding public transport in the UK, the scheme in Nottingham will need to demonstrate that it can raise revenue as well as gain acceptance and complement other policy objectives.

3. Literature Review

This section examines the literature regarding the nature of hypothecation and the characteristics and effectiveness of existing parking space levy schemes.

What is Hypothecation?

Hypothecation can be defined as the allocation of particular tax revenues to specific areas of government spending (Ison and Mulley 2013).

In Australia there are examples of revenue from parking charges being hypothecated for transport improvements in both Perth and Sydney. In Perth the revenue has been used to provide a Central Area Transit bus system and expansion of the Free Transit Zone (Enoch 2001), while in Sydney the revenues have been spent mostly on commuter car parks and interchanges (Ison and Mulley,2013).

In general hypothecation has the advantage that it provides a stable revenue stream for a given purpose (Deran 1965), especially in the case of levies on property which the WPL essentially is. It also has the advantage that clearly identifying the use of a tax or levy can be more acceptable to those that pay it (Ison and Mulley 2013).

Deran (1965) explained a number of limitations to hypothecation, these mostly referred to the inherent lack of flexibility for policy makers to switch the funding to alternate purposes when 'over funding occurs' or indeed when policy priorities change. However, it has to be considered that if the legislative description of a potential use of the revenue is sufficiently broad then these criticisms should be offset. There is a case that hypothecation for “transport improvements” is highly unlikely to result in over funding, and such funding is always likely to be an important policy area**.**

Nottingham WPL Objective	Performance Indicators	Metrics to be used to monitor indicator
Objective 1: Constrain congestion in the AM and PM peak periods	Congestion (Car Journey Times)	AM peak period journey time per vehicle mile (dec
	Area-wide traffic mileage	Millions of vehicle miles p.a. in Nottingham City
		Millions of vehicle miles p.a. in Greater Nottingham
	Single occupancy car journeys	% of single occupancy cars against multi occupancy cars observed at Inner Traffic Area Cordon mode share sites in AM peak period
	Bus services running on time	Excess waiting time for frequent services in City
		Excess waiting time for frequent services in Greater Nottingham
		% of non frequent buses on time at timing points in City,
		% of non frequent buses on time in Greater Nottingham
		% of buses starting on time in City
		% of buses starting on time in City
Objective 2: Increase uptake of workplace travel plans & responsible parking management strategies	% of employees covered by a travel plan	Percentage of employees covered by a travel plan
	Number of places and number of employers covered by workplace parking management schemes	Number of workplace parking places (WPP) and employers covered by parking management schemes
	Take-up of support packages number by type	Number of employers taking up travel planning or parking ,management support packages
Objective 3: Contribute to the implementation of major transport schemes and the Local Transport Plan.	Net WPL Revenue	Total Revenue (£) minus operating costs, business support and traffic management expenditure
	City Council WPL operating costs including business support and traffic management costs	Expenditure on business support and traffic management (£)
	City Council WPL operating costs	Operating costs (£)
	Number of WPP places, premises and employers covered by each exemption/discount	Total number of exempt WPPs excluding those occupied by disabled Blue Badge holders

Nottingham WPL Objective	Performance Indicators	Metrics to be used to monitor indicator
Objective 4: Encourage sustainable travel and mode choice	Mode share of public transport at Inner Area Traffic Cordon in AM peak period	% of travel by public transport on main radial routes + rail
	Local bus and light rail passenger journeys	Millions of passengers on trams and buses in City
		Millions of passengers on trams and buses in Greater Nottingham
	Cycling trips	Cycle counts at strategic points in City
	Mode of journeys to school	Proposed "Hands up survey" at schools TBC
	Single occupancy car journeys	% of single occupancy cars observed at Inner Traffic Area Cordon mode share sites in AM peak period
Objective 5: Enhance the attractiveness of Nottingham as a location for business investment.	Employee numbers (or similar indicators from City Economic Review)	Number of jobs in the City
	Business Births and deaths	Balance of VAT registrations and de-registrations
	Level of inward investment enquiries	Number of enquiries and subsequent successes as recorded by NCC's inward Investment Team
	Business location decisions	Research Project TBC
Objective 6: No significant displaced parking problems	Displaced parking analysis, number of complaints, number of schemes by type , cost of schemes	Number of WPL related complaints per year

Existing parking place levies and their effectiveness

Table 2 summarises the characteristics of five similar parking levy schemes. From the Table it can be seen that Nottingham is the most restricted in the type and use of places upon which a charge is made. Nottingham has opted to charge only occupied places supplied to employees, students or regular business visitors by employers i.e. public on street or off street parking and customer parking is not chargeable. The annual charge is lowest in Nottingham while Sydney is the highest. All four current schemes have similar exemptions based on type of use.

However important differences occur between the schemes with respect to how small businesses are charged. Nottingham has opted to exempt small businesses by giving those with 10 or fewer chargeable workplace parking places a 100% discount. This goes further than the similar exemption offered by Perth, while Sydney and Melbourne offer no such concessions. Despite the city wide nature of the Nottingham WPL, the above factors make the annual revenue from the Nottingham scheme much lower than its Australian counterparts.

All five schemes are primarily aimed at targeting traffic congestion via both the pricing element as well as investment of the revenue raised into public transport infrastructure.

Nottingham's more timid approach to the annual charge and exemptions for small businesses could be attributed to the proximity of competitor cities close by while a city like Perth is isolated from its competitors. However this may also reflect cultural and political differences.

Effectiveness of existing parking place levy's

Richardson (2010) studied the outcome of the Perth scheme. He reports that following its introduction, parking supply contracted by 10% before slowly rebounding but not recovering to pre 1999 levels. This reverses the pre 1999 trend of steadily increasing parking supply.

Clearly a reduction in workplace parking supply is not a guarantee that congestion will decrease. However Richardson (2010) presents figures from the Australian Bureau of Statistics for Perth which shows that there has been a significant shift in modal share. Prior to implementation only 35% of journeys to work were by public transport; however by 2010 this had risen to over 50%, while modal share by car had fallen by a similar amount clearly demonstrating a shift to public transport. Indeed public transport use has grown by 67% in the 10 years from 1999 to 2009.

Richardson reports that the volume of car traffic on radials providing access to the city reduced by between 3% and 20% in the three years following implementation of the scheme and that traffic within the city has continued to decline.

It is important to note that, over a decade after the introduction of the Perth Parking Licence Fee, Perth is still seeking to address traffic congestion due to a booming economy with a large increase in population (Martin, 2012).

Table 2: Summary of area wide parking place levy schemes. Sources: NCC (2008), NCC(2012), Enoch (2001), Richardson (2010), Hamer et al (2009), Translink (2012), State Revenue Office Victoria (2012), Transport for NSW (2013), DoT (2017) and Litman (2011).

Location	Area	What's Liable for charge					Introduced	Main Exemptions	Approx annual revenue	Charge per place	Objectives	Uses Of Revenue
		General Description	On Street Parking	Public Car Parks	Un occupied Spaces	Small Business						
Perth – Parking Licence Fee	Central Business District (CBD)	All non residential parking bays that are in use	YES	YES	NO	NO	1999	Disabled spaces Loading Bays Pubic service bays Businesses <6 space Spaces incidental to primary business activities	30m	Long Stay: A$630, Short Stay: A$600 (2012)	Cut congestion by effecting modal shift and fund Central Area Transit bus system	Hypothecated for transport CAT bus system Free transit zone
Sydney – Parking Space Levy (PSL)	CBD + five other outlying business areas	Off street private non residential parking, occupied or un-occupied, does not apply to public car parks.	NO	NO	YES	YES	1992	Disabled spaces Loading Bays Pubic service bays Spaces incidental to primary business activities Retail, restaurant, hotel parking, etc in outlying areas	97m	A$2100 CBD and North Sydney, A$740 in other areas (2011)	Discourage car use Fund infrastructure to encourage public transport use	Hypothecated for public transport. Interchanges, bus/rail/ferry. Park and Ride. Rapid bus only transit way. Light rail. Electronic passenger information system.
Melbourne – Congestion Levy	CBD	All public and private long stay non residential car parking spaces currently in use	NO	YES	NO	YES	2006	Business visitors. Emergency vehicles. Council and charities. Shift workers. Spaces incidental to primary business activities.	38m	A$930 (2013)	Reduce Congestion by encouraging commuters to use public transport. Create more parking for shoppers and visitors.	Not hypothecated but some revenue is used for public transport improvements.

Table 2: Summary of area wide parking place levy schemes. Sources: NCC (2008), NCC(2012), Enoch (2001), Richardson (2010), Hamer et al (2009), Translink (2012), State Revenue Office Victoria (2012), Transport for NSW (2013), DoT (2017) and Litman (2011).

Location	Area	What's Liable for charge					Introduced	Main Exemptions	Approx annual revenue	Charge per place	Objectives	Uses Of Revenue
		General Description	On Street Parking	Public Car Parks	Un occupied Spaces	Small Business						
Vancouver – Parking Site Tax	Greater Vancouver	Non residential parking areas. Charged by area size.	NO	YES	YES	YES	2006 -2007	Buildings not subject to property tax. Translink Properties Spaces incidental to primary business activities.	NA	$1.02 per square meter (2006) (approx $32 per space)	Used to fund Translink, Vancouver, British Columbia Transport Authority.	Expansion of road and transit system.
Nottingham – Workplace Parking Levy	City of Nottingham	Occupied private non residential off street workplace parking	NO	NO	NO	NO	2011	Customers. Emergency Services. Disabled Spaces Loading Spaces Employers with < 11 spaces. NHS or NHS Contractors delivering frontline services.	£7m	£334 (2013)	Constrain Congestion. Encourage modal shift to more sustainable modes. Fund transport infra structure.	Hypothecated for transport. Light rail expansion. Linkbus Services. Redevelopment of Nottingham Railway Station.

It should be noted that in the media and public debate in both Perth and Nottingham this continued congestion has been used to suggest the schemes have been ineffective. However the literature suggests that the Perth Parking Levy has affected both modal shift and an initial drop in traffic levels. The issue is that this is being obscured by continued economic growth, which has led to further congestion which if not combated may have had its own constraining affect.

Hamer et al (2009) carried out a review of the outcomes of the Melbourne Central Business District (CBD) parking levy. They used census data and data from household questionnaire surveys to quantify changes to the number and nature of trips, i.e. travel demand. This was split between all trip purposes and commuter trips and within these trips those that terminated in off street car parks within the CBD.

They conclude that the data revealed that although the total number of trips to the CBD had remained stable, the number and proportion of cars entering the charging area has fallen. However they conclude that the levy is having only a minor impact on congestion.

The WPL is perceived as an additional cost by businesses (Burchell and Ison 2012) and there is concern that this will lead to a potentially negative impact on Nottingham especially with reference to Inward Investment (NCC 2005). However the extra WPL cost needs to be understood in the context of a city’s overall offer which includes the transport infrastructure and public transport provision (Smyth and Christodoulou 2010). Nottingham City Council believes that the overall offer will be sufficiently enhanced by public transport improvements that the WPL package will deliver that this will offset the perceived deterrent effect on investment of the additional cost of WPL (NCC 2008).

A study commissioned by Core Cities, Passenger Transport Executive Group and Yorkshire Forward and carried out by GVA Grimley (Core Cities et al 2006) examined the competitiveness of Manchester, Birmingham and Leeds by carrying out detailed face to face and telephone interviews with businesses. The results were considered to be transferable to other English Core Cities including Nottingham. The results supported Smyth and Christodoulou’s (2010) conclusions and the results of the Invest Thames Gateway study in that they revealed that there was a strong view amongst those interviewed that an efficient transport system was a key determinant in business location decisions, but it was perhaps not the most important factor. Smyth et al (2010) and the Core Cities (2006) both conclude that an efficient transport system can be considered an important prerequisite for business location.

The Core Cities study also revealed that many respondents described themselves as “footloose” i.e. if their location became less attractive they could move quite easily. The relative propensity of footloose, cost sensitive businesses to be discouraged by the additional cost of WPL (NCC 2005) combined with this finding is an area of concern for Nottingham as it attempts to sell the WPL to its indigenous business population.

Here in perhaps lies an “unknown” in business location research - Clearly business values high quality transport networks but is it prepared to pay through an additional tax?

Transport for London (TfL 2008), used the level of VAT registrations and de-registrations as the principal metric for assessment of the level of business investment. They compared net annual change of this in the Central Zone pre and post implementation of the London Congestion Charge along with figures for outer London. Based on this they concluded that there is no evidence that charging has impacted on the level of investment in the central charging area. However, London is a special case due to its size and current infrastructure.

In Perth, Australia, the following objective was set out in the Perth Parking Policy 2012; “Ensuring the continued economic and social vitality of central Perth;” (State of Western Australia, 2012). Richardson (2010) reported that concerns expressed as to the way that the levy would act contrary to that objective cannot be supported. Richardson evidenced this statement by observing that both floor space and employment have enjoyed strong growth.

While data from Perth and London suggest that there is no evidence that congestion charging has produced a negative impact on business investment applying these conclusions to Nottingham is of limited value since both the nature of the charging schemes and the status and proximity of competitor cities are different. It can be speculated that Nottingham would be more vulnerable to adverse effects of congestion charging on business as it has competitor cities close by.

The limited literature on WPLs suggests that it is primarily seen as a revenue raising tool with a secondary effect as a TDM Tool in its own right. However when this revenue is reinvested in the provision of public transport alternatives, evidence from Australia where parking charges have been implemented in Perth, Sydney and Melbourne, suggest that a WPL package can be effective in achieving significant modal shift.

4. The use of hypothecated funding from the Nottingham WPL

In the UK it is mandatory for each local authority to produce a Local Transport Plan (LTP) and submit it to the Department for Transport in order to receive a share of the funding available from central government. A LTP presents the transport strategy and the plan for implementing that strategy. The schemes in the LTP are summarised in Table 3.

Table 3: Issues tackled by programmed major transport schemes in Nottingham

Intervention	Description	Issues addressed by scheme
Workplace Parking Levy	Levy payable by employers on parking places provided to employees, regular business visitors and students,	Constrain Congestion by increasing the cost of commuting to work by car, help provide funding for public transport improvements
Nottingham Express Transit Phase 2	Provision of two additional tram lines to Chilwell and Clifton linked to the central public transport hub at Nottingham Station	Constrains peak period congestion and enhance transport connectivity, Provision for future growth
Regeneration of Nottingham Rail Station	Refurbish Nottingham Station to provide high quality public transport hub	Transport Connectivity to other cities and international and national gateways
Ring Road Major Scheme	Improvements to junctions to ease congestion and improved public transport interchanges along the Ring Road	Congestion, local connectivity
Provision of Link Buses	Provide high quality link bus services between the tam corridors	Congestion, local connectivity
*A453 Dualing	Convert the link road from junction 24 of the M1 to dual carriageway	Transport Connectivity to other cities and international and national gateways, Provision for future growth

*the A453 scheme is a Highways Agency trunk road funded scheme but is supported by Nottingham City Council.

Based on the rationale presented in the Nottingham LTP it is possible to summarise the issues which are drivers for investment in public transport in Nottingham (NCC 2013):

1. Congestion: The City Council estimates, that peak period congestion costs the city economy £166 million a year and is particularly acute on key radial routes
2. Connectivity: The City Council believes that strong connectivity to other urban centres and national and international gateways are essential if Nottingham is to remain competitive as a location to do business.
3. Significant Growth. The City Council forecasts that the population is set to rise by 9% over a 15 year period from 2011 driven by a growth in science and technology, knowledge intensive and creative industries.

The Workplace Parking Levy therefore has a dual role to play in the City Council’s strategy as it’s both a transport demand management tool and a major source of funding. Table 4 presents the cost of each scheme and the contribution made by WPL revenues.

This data shows how the money raised by the WPL is leveraged by investment from Central Government. An important benefit in the current economic climate of investing in large scale public transport schemes is that this provides a significant boost to the local economy while they are implemented.

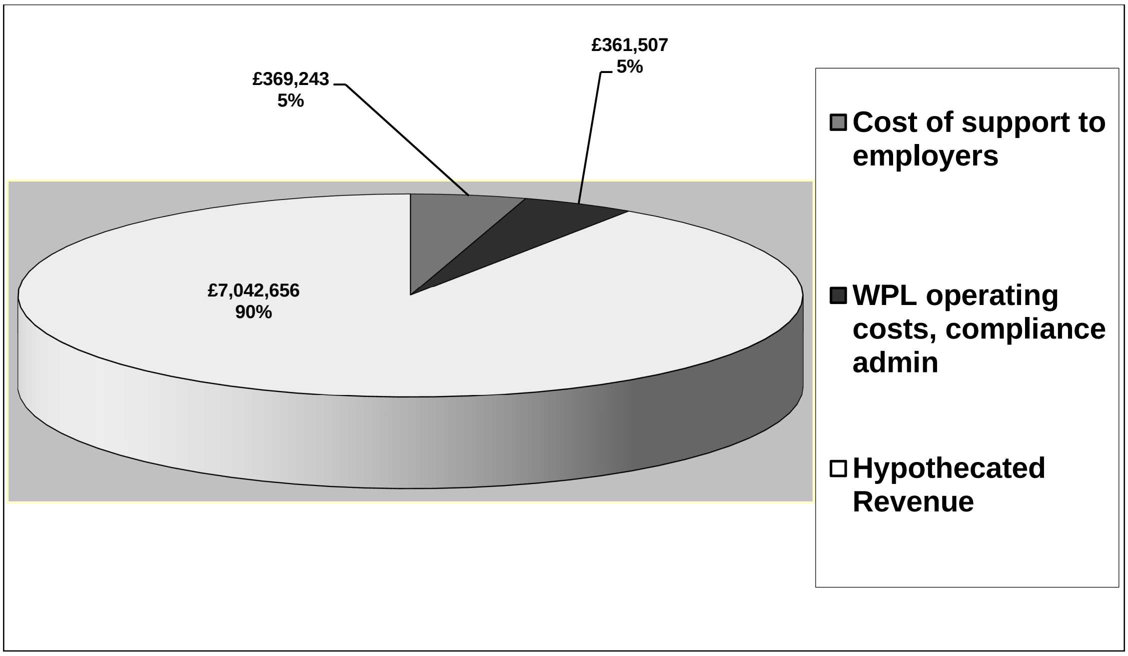
Table 4 Funding of programmed major transport schemes in Nottingham

Scheme	**Total Cost (£millions)**	**NCC “Local” Contribution not including WPL contribution (£millions)**	**WPL Contribution (£millions)**	**Completion date**
NET Phase 2	**570**	**29**	**170**	**2014**
Ring Road Major	**16.175**	**3.2**	**0**	**2015**
Provision of Link Buses (Capital only)	**8.8**	**0.3**	**3.78**	**On going**
LTP	**6 pa**	**0**	**0**	**On going**
Refurbishment of Station	**60**	**0**	**11.7**	**2014**

Source: Nottingham City Council 13/06/2013

Figure 2 below shows the financial data pertaining to the WPL scheme. This reveals that Nottingham City Council spent £369,243 to help manage the impact of the WPL on employers and to encourage sustainable transport. This is 5% of the WPL revenue.

Figure 2 Use of WPL Revenue from first year of operation



A further £361,507 is spent on the WPL's operating cost, 5% of revenue. Figure 2 also reveals that the WPL scheme contributes 90% of its revenue towards further transport improvements. Although the London Congestion Charge raises more money in absolute terms than the WPL as one would expect, it is less efficient with 49% of revenue taken up by costs. Thus a WPL can be considered more financially efficient than road user charging options which was one of the reasons a WPL was chosen by Nottingham City Council.

Table 5 below shows a breakdown of how the revenue collected is derived across the different sizes of employers in term of WPP provision. This table shows a comparison between the actual data from the first year of operation and an estimate of the number of WPP provided by the Off Street Parking Audit survey (OSPA) in 2010. The number of chargeable places is those WPP provided by employers liable for the charge, as opposed to those subject to exemption or discount. This excludes those occupied by blue badge holders or those provided by employers who are eligible for a 100% discount.

This illustrates that the largest 42 WPP providers account for 55% of the revenue but form less than 10% of liable employers. This is an important consideration as it makes compliance and enforcement easier to target in terms of securing the revenue.

It can also be seen that the supply of WPP has reduced by approximately 18% from the 2010 estimate. While the methodology used in the OSPA surveys had inherent limitations, notably that it relied on the employers providing accurate figures not on direct observation, it would appear that the WPL has prompted some contraction in parking supply. The puzzle is that this does not appear to have resulted in an immediate reduction in car use or congestion.

Table 5: WPP provision by WPP size bands

Space Ranges	Pre WPL Estimate		2012/13 Actual figures		% Change in WPP 2010-13	Revenue
	Liable Employers	Chargeable WPP	Liable Employers	Chargeable WPP		
<11	0	0	116	439	NA	250409
11 -100	511	14502	373	11480	-20.8	3324463
101 - 5000	45	17723	42	14545	-17.9	4198534
Total	556	32225	531	26464	-17.9	7773406

The 2012/13 revenue figures take account of licence variations that came into effect prior to the end of the financial year thus the revenue figure is not always 288 multiplied by the number of chargeable places. Revenue raised within the banding 1-10 is due to these employers being liable by virtue of associations with other employers which push them over the 10 place threshold.

Source: Nottingham City Council 20/05/2013

While the above shows that 556 employers are liable to pay the WPL charge a further 1865 employers licence their workplace parking places but are covered by one of the discounts and thus pay nothing. The vast majority of these are small businesses with less than 11 workplace parking places. It should be noted that the 556 liable employers account for the majority of workplace parking places and thus are those contributing the most to peak period congestion. While this could be considered suboptimal from a revenue raising perspective, the discounts are regarded as a practical compromise to both the political realities of introducing the scheme and a perceived desire not to burden potentially more vulnerable small businesses with costs that could make a larger proportion of their turnover. It could be regarded to be better to succeed in introducing a WPL by providing concessions where necessary than to risk the scheme failing due to a lack of political will or economic acceptability.

5. Barriers to implementation

The major barrier to the implementation of any congestion charging scheme is that of public acceptance (Frost and Ison 2008) and this is closely linked to the issue of political risk for the decision makers. Evidence from Nottingham City Council's consultation prior to and during the "Examination in Public" and subsequent press coverage, suggests that typically the WPL is criticised on 3 grounds (Dodd 2007, Westcott 2012 and Nottingham Evening Post 2012) namely being:

1. an additional burden on business and thus damaging to a city's economy.
2. in-effective as a tool to combat congestion.
3. unfair on the motorist who already carries a high tax burden.

Research carried out to assess business attitudes to a WPL scheme has revealed that, not surprisingly the business community are less than positive (NCC 2005, Burchell and Ison 2012 and Nottingham and Derby Chamber of Commerce 2012).

A survey of key stakeholders, mainly transport policy decision makers, conducted in 1999 (Ison and Wall 2002) showed that they considered peak period congestion and its associated problems to be fairly serious. They also viewed a WPL as one of the least acceptable measures but most effective measures to combat the problem.

A study carried out by Price Waterhouse Cooper (PwC) on behalf of Nottingham City Council (NCC 2005) showed that although the WPL charge was likely to be less than 1% of a businesses turnover, businesses were highly critical of having to bear this cost. 60% of businesses interviewed by this 2005 study said they would relocate some activities away from Nottingham and more than 50% said they would reduce planned investment. 66% felt the Levy would not be offset by improvements in public transport. This identifies a contradiction in both the general non specific perception that a high quality transport system is important to business location, and the relatively low percentage of turnover being asked to fund this and the strong re-action of businesses to this cost. This then raises the question as to what businesses will actually do?

The barrier of acceptability to the business community has been strengthened as a result of the present government's "Red Tape Review" which included a consideration of WPL schemes as (see below); it stressed the requirement that any future scheme must be acceptable to the business community.

> **"**within the road transport red tape challenge theme, dft placed over 400 regulations online for your views. After removing those that have already lapsed, 376 remain – of which 142 will be scrapped or improved following a vigorous process of challenge". Plans include:
> "- local authorities will now have to ensure business interests are properly considered as part of any future proposed Workplace Parking Levy scheme. They must show they have properly and effectively consulted local businesses, have addressed any proper concerns raised and secured support from the local business community."

Source: Cabinet Office 2013

Given the evidence of business views presented above this could prove a challenge. Clearly, no local authority wishes to damage the economy of their area and if there is evidence that the presence of the WPL is damaging to the economy in the medium term then the scheme may need re-thinking. However there will be a lag between the introduction of a WPL and the completion of the public transport improvements and some short term "pain" may be acceptable.

The political stability of Nottingham allows decision makers to take a medium to long term view as they know that they are extremely unlikely to be voted out of office over a single issue such as the WPL provided the economy performs adequately over the medium term. This however is not the case in other similar UK Cities. For example, Bristol is more finely balanced politically and re-action to an initially unpopular idea can make a big difference electorally. Bristol has considered and rejected the idea of a tram scheme, major bus improvements, re-opened rail services and a WPL and one can speculate that this is probably due to political factors rather than an objective examination of the pros and cons of such schemes in what is accepted as a congested City.

6. Evaluating performance; Monitoring framework, methodologies and available data to date

6.1 The monitoring framework

As stated previously Nottingham City Council has identified 6 key objectives for the WPL scheme (see Table 1). A framework of indicators to measure performance of the scheme against these objectives has been developed.

This paper concentrates on Objectives 1 and 5 relating to congestion and business investment. Based on the discussion in section 5 it is considered that these are the primary objectives in terms of a successful outcome for the WPL package (which includes the major public transport improvements discussed above) and also for its transferability to other cities.

6.2 Objective 1: Constrain congestion in the AM and PM peak periods

This is being monitored using the following indicators

- Journey time per vehicle mile (JTVM)
- Area wide traffic mileage
- Bus services running on time
- Percentage of cars with just one occupant

These four indicators combine to give a view as to how congestion in Nottingham changes over time. Only JTVM can be considered as a direct measure of congestion, the other three should be viewed as supporting indicators as they do not necessarily track congestion directly but rather give indications as to whether it is likely to be moving in the right direction. This is particularly the case with the bus punctuality indicator which is significant in terms of public transport performance, but is not directly related to congestion as recurrent congestion is "built" into the timetable, thus the following discussion focuses on the other 3 indicators.

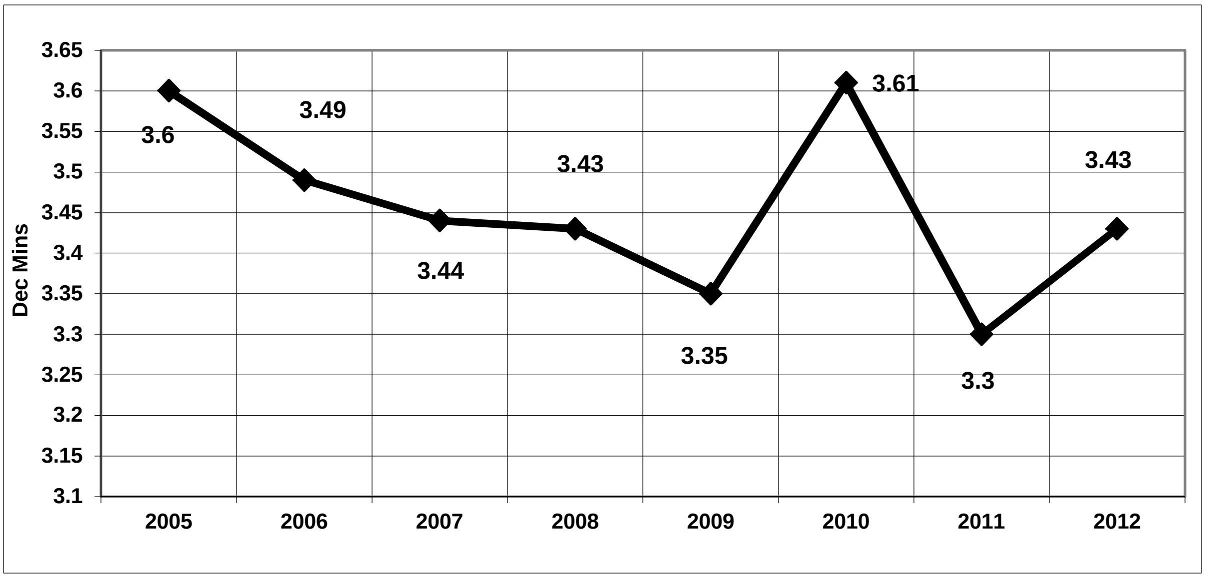
Journey Time per Vehicle Mile (JTVM)

Journey time per vehicle mile has been monitored on the network shown in Figure 3 for over a decade by using the moving observer method. Survey staff are required to drive inbound along predefined radial routes and around the Nottingham Ring Road between 7am and 10am Monday to Friday. Each route is surveyed on at least two different dates in the neutral autumn months.

A GPS recorder is used to collect the positional data which is then analysed using a bespoke ACCESS application to generate journey times on each segment of each route. 2010 has been identified as the appropriate baseline year since this is the year prior to the introduction of the WPL.

Figures 3 summarise the data available to date for this indicator. JTVM fell significantly in 2011 and then rebounded in 2012 to pre-recession levels. It should be noted that 2010 was the 1st year since 2005 that JTVM had increased and thus can be seen as a "blip". Nevertheless initial results from the alternative data sources confirm that this is not an error therefore at present it will still be used as the baseline year. It should be noted that prior to 2010 the monitoring was split between Spring and Autumn over an academic year; it is not thought that the change to monitoring in the Autumn has had significant statistical effect.

Figure 3 Journey Time per Vehicle Mile: Time Series (moving observer data)



Source: Nottingham City Council 06/06/2013

It can be concluded that there is no evidence to date to suggest that WPL has resulted in a reduction in congestion based on JTVM. It is however too early to conclude that it will not, in time, have a favourable effect even as a stand-alone transport demand management measure.

Area wide traffic mileage

Area wide traffic mileage is a measure of how much traffic uses the specified road network in a calendar year and is calculated using automatic and manual traffic counts across the conurbation. As can be seen in Table 6, this fell between 2010, the base year, and 2012 possibly due to the economic conditions.

Table 6: Area wide traffic mileage 2005 – 2012

Area/Yr	2005	2006	2007	2008	2009	2010	2011	2012
Greater Nottingham	1881	1880	1878	1837	1847	1838	1805	1787
City	665	667	662	650	658	655	648	640

Source: Nottingham City Council 06/06/2013

The percentage of cars with one occupant

The percentage of cars with one occupant is calculated from data generated from annual modal share surveys carried out at fourteen sites on radial routes as they cross a nominal cordon line into Nottingham in the AM peak period. A manual modal share survey is conducted at each site on the cordon in the Spring or Autumn, in the AM peak period (7am-10am) for inbound traffic. A classified traffic count is augmented by occupancy surveys of buses, trams and multiple occupancy cars (i.e. the occupancy of all cars with more than 1 occupant) crossing the cordon line. The total people movement by mode can then be calculated and thus the percentage of travel by each mode. The number of single occupancy cars can be calculated by subtracting those observed with two or more occupants from the total number of cars recorded in the classified count. A decrease in this percentage i.e. an increase in average occupancy is seen as a positive outcome. The percentage of cars with one occupant fell from the 2010 baseline year level of 82% to 80.6% in 2011 before rebounding in 2012 to 82.5%. This pattern replicates that observed with JTVM data indicating at first a positive movement of the indicator followed by deterioration in 2012. However this change is very small and could be covered by margins of survey error.

At present none of the above indicators used to monitor this objective show any evidence that the WPL is having an impact on congestion. The pattern across the three years, 2010 to 2012 shows a general positive movement in modal share and journey time indicators in 2011 followed by a deterioration in 2012. The reasons for this are not fully understood at this time and further research is required, however economic conditions may have played a role as observed in Perth.

6.3 Objective 5: Enhance the attractiveness of Nottingham as a location for business investment.

Along with Objective 1, this is considered a critical objective, as those who oppose the WPL often cite the extra cost on business as a factor which is likely to damage the economy. Monitoring this objective is seen as a major challenge.

The indicators can be split into macro economic indicators for which data is currently available albeit several years in arrears and micro-economic indicators for which data is not yet available. It is an important aim of the ongoing monitoring project to design and act on a methodology for collecting the micro economic data.

The macro economic indicators reviewed are as follows, in all cases the base line year will be 2010 although where possible this has been contextualised via a time series:

- Number of jobs – This indicator is based on official Office for National Statistics (ONS) data. Up to 2008 the data was collated from the Annual Business Inquiry Survey (ABI). However from 2008 onwards the ONS replaced the ABI with the Business Register and the 2005 -2007 ABI figures have been corrected to reflect the differences between 2008 values produced by the two methods.
- Business births and deaths – Net VAT registrations and de-registrations from the ONS Business Demography, an annual publication.
- Level of investment enquiries to the Nottingham City Council’s Inward Investment Team.

The number of jobs based in the Nottingham City Area

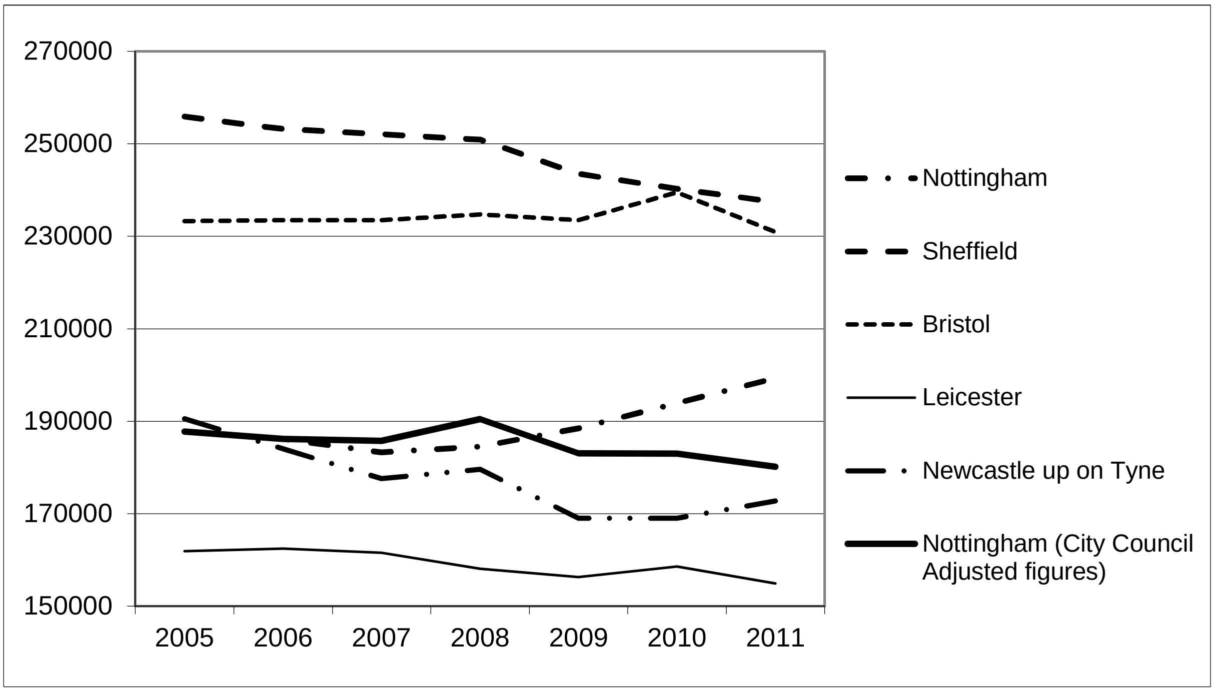
Table 7 and Figure 4 present a time series of data showing the number of jobs in Nottingham, other similar “comparator” English cities and England as a whole. The official data from the ONS shows the number of jobs in Nottingham increased by 2.8% between September 2010 and September 2011 which compares favourably with the situation for both comparator cities and England as a whole.

Table 7: Number of jobs in Nottingham, other similar Cities and England,

City	Year: Annual Business Inquiry adjusted to BRES 2005	2006	2007	Business Register and Employment Survey (BRES) 2008	2009	2010	2011	% change 2010-11
Nottingham	**187774**	**186149**	**183306**	**184500**	**188500**	**193900**	**199300**	2.8
Sheffield	255917	253175	252058	250900	243500	240300	237400	-1.2
Bristol	233270	233474	233474	234700	233500	239500	230900	-3.6
Leicester	161877	162487	161573	158100	156300	158600	154900	-2.3
Newcastle upon Tyne	190516	184017	177619	179600	169000	169000	172800	2.2
Nottingham (City Council Adjusted figures)	**187774**	**186149**	**183306**	**190500**	**183100**	**183000**	**180200**	**-1.5**
England	23164458	23044634	23261934	23331300	22670400	23085300	23058900	-0.1

Source: Office for National Statistics supplied by Nottingham City Council 06/06/2013

Figure 4: No. of jobs in Nottingham, other similar cities and England 2005-11



Source: Nottingham City Council 06/06/2013

However, one must question why Nottingham shows such a positive upward trend while other similar cities suffered a reduction in jobs in the same period during which the national economy was in recession. A more detailed analysis of this data carried out by Nottingham City Council, which takes into account several organisations that have chosen to register all their national employment in Nottingham in recent years, has adjusted the ONS figure downwards to compensate for this. This shows a more realistic trajectory as can be observed in Figure 4. Furthermore the employment and unemployment data does not support the strong growth in jobs in Nottingham suggested by the ONS jobs data.

Unfortunately as a similar adjustment cannot be made for the comparator data it should be noted that the comparison is not like with like. However there is some evidence to suggest that the phenomena of national employers registering all their employment in one city is less pronounced in the comparator cities than it is in Nottingham.

Firstly the trajectory of the time series appears to be intuitively correct and more closely matches that of England as a whole with a decline in job numbers following the financial crisis and subsequent recession in 2008-2009. As it is an issue surrounding how jobs are allocated, the figures for England remain the same and thus form a reliable reference point.

Secondly, City Council's adjusted figures match the above pattern much better which in its self suggests a valid comparison.

Assuming that one accepts that Nottingham City Council's revised job figures for Nottingham is more accurate than those contained in the official ONS figures then Nottingham saw a 1.5% reduction in jobs between 2010 and 2011. The England figure, a small rise of 0.1%, is a poor yardstick to measure Nottingham's performance since the business demographics of a core City are very different to that of England as a whole which is heavily skewed by London and the South East. A fairer benchmark is the data for other similar sized cities. As Table 7 demonstrates, of the five Cities, Nottingham is second only to Sheffield in respect to minimising job loss between 2010 and 2011.

Whichever version of the Nottingham ONS data is considered, all the available data suggests that Nottingham has faired no worse in terms of job losses than other similar cities and it is possible to conclude that, to date, there is no evidence to suggest that the introduction of the WPL has resulted in any negative impact on the number of jobs based in Nottingham.

Business births and deaths

The business births and deaths are based on the balance of VAT registrations each year (as used in London). As it does not take into account the size of the employer and will miss expansion and contraction of major employers it can be considered as indicative of general economic health rather than being of use as a direct outcome from the WPL (most of VAT registered employers will be exempt from the WPL by virtue of having less than 11 workplace parking places).

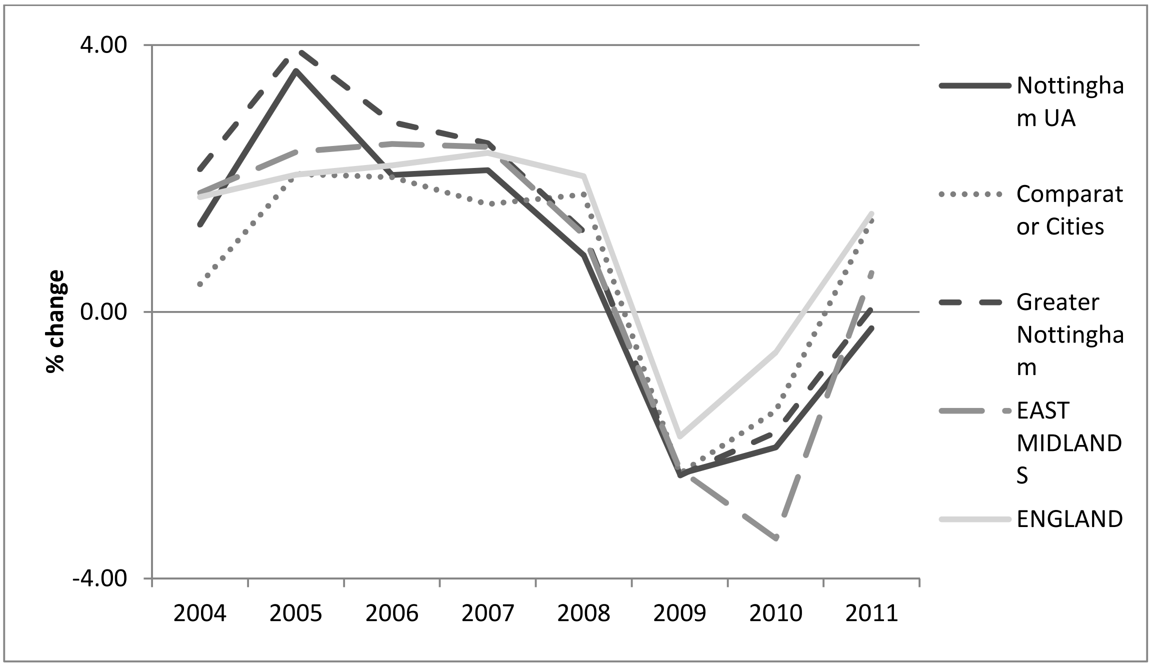
Table 8 and Figure 5 demonstrate that the balance of VAT registrations is negative for Nottingham and the other comparator areas in the baseline year of 2010. All areas improved in 2011, however only Nottingham and Sheffield remain marginally negative. Nottingham is thus lagging behind in its recovery from the recession.

Table 8 Business births and deaths: A summary for 2010, i.e. the baseline year

Area	2010				2011			
	Registrations	De-registrations	Net change in year	Net change in year per 10,000 population 16+	Registrations	De-registrations	Net change in year	Net change in year per 10,000 population 16+
Nottingham	805	970	-165	-6.4	935	955	-20	-0.8
Greater Nottingham	1,840	2,185	-345	-7.9	2,030	2,020	10	0.2
East Midlands	14,325	19,545	-5,220	-6.6	16,055	15,150	905	2.4
England	207,520	219,920	-12,400	-2.9	232,460	202,365	30,095	7
Bristol	1,725	1,645	80	2.2	1,975	1,480	495	14.2
Newcastle	725	815	-90	-3.7	895	775	120	5.2
Sheffield	1,440	1,860	-420	-9.1	1,595	1,730	-135	-3
Leicester	1,040	1,270	-230	-9.5	1,240	1,075	165	6.3

Source: UK Office for National Statistics, Business Demography supplied by Nottingham City Council 06/06/2013

Figure 5 Trends in NET VAT registrations year on year change 2004 - 2011



Source: Nottingham City Council 06/06/2013

Nottingham City Council's Transport Strategy Team considers that Nottingham often lags behind other areas in times of economic recovery due to a more conservative view of risk amongst Nottingham's business community. If so the question is therefore; is the prospect of WPL exacerbating this conservatism and putting businesses off starting up in Nottingham? If this is the case, this must be a view based on a lack of understanding of the scheme as most businesses will not be impacted as discussed above.

On balance it is possible but unlikely that the above slow recovery in business VAT registrations is due to the implementation of the WPL. However additional years' data are required to confirm this view.

Level of inward investment inquiries to Nottingham City Council

Data from the Inward Investment team which tracks the number of enquiries concerning investing in Nottingham and those which then go on to actually invest shows that 2012/13 was a bumper year for both the level of enquiries and the number of successes moves to the City and subsequent job creation. However it cannot be assumed that the level of inquiries to Nottingham City Council necessarily reflects investment levels as a whole and thus this indicator must be used as complementary evidence to support or refute conclusions drawn using more comprehensive macro economic indicators. Table 9 shows this data.

Table 9: Enquiries to the Inward Investment Team and subsequent successes

Year	Inquiries	No. of successes	Jobs created
2008/09	91	3	360
2009/10	156	5	85
2010/11	110	2	85
2011/12	146	5	65
2012/13	175	9	1100

Source: Nottingham City Council 10/05/2013

Although the location of a major retail distribution centre in the north of the City is partially responsible for this, it is only 1 of 9 successes. This would tend to confirm the above ascertation that Nottingham is recovering successfully from recession albeit perhaps more slowly than other areas. It will be interesting to see if the 2012 job figures and VAT registrations, neither of which are available until the autumn, reflect this trend.

7. Concluding comments

The Nottingham WPL scheme is the first of its kind in the UK. The outcomes from this scheme and the public transport improvements which it makes possible, by part funding, may determine if the WPL option is adopted by other UK cities over time and thus becomes a main steam option for funding large scale public transport improvements.

Existing literature points to a reduction in levels of congestion without a negative impact on business investment, being of paramount importance to the schemes acceptance.

Literature indicates that the Australian parking space levy schemes have had a positive effect by encouraging mode switch to public transport, this is especially so in Perth. There is also evidence to show that this has been achieved without negatively impacting on the local economy.

However, because of cultural, geographic and economic differences it is not possible to conclude from the literature that the outcomes in Nottingham will be similarly positive. Nottingham differs from the Australian examples in that it is located in close proximity of competitor cities and evidence from literature shows that acceptance by local business and the public is also a barrier to future implementation of WPL schemes. Therefore a thorough evaluation of its performance is essential if these barriers are to be overcome and other schemes introduced.

In its first year of full operation the WPL has raised £7millon of hypothecated revenue for public transport improvement. While the data from Nottingham to date suggests that, as yet, the scheme has had minimal impact on levels of congestion in the City, the evidence from macro economic indicators is demonstrating that Nottingham has faired no worse than other similar sized UK cities since the chosen base year for WPL monitoring, 2010. It should be noted that although the WPL has only been fully operational for a year, the business community has been aware that it was going to be implemented since 2010 and thus it is possible that any negative economic impact has had 3 years to take effect. This consideration increases confidence that the WPL is not having a negative effect on the macro economic indicators presented in this paper.

It is important to note that of the overall package of transport interventions that will take place in Nottingham between 2010 and 2015, only the WPL itself is currently in place and while it is proposed that even as a standalone measure the WPL will have a positive impact on some of the scheme objectives, the main benefits may not be realised until all the interventions which the WPL part funds are in place.

Therefore, considering the above it is thus perhaps not too surprising that there is, as yet, little impact on congestion.

While it is desirable to await further years data to confirm conclusions regarding the WPL's effect on the key outcomes for objectives 1 (congestion constraint) and 5 (inward investment), there is evidence of positive changes in employer behaviour and also the supply of Workplace Parking Places. Take up of travel planning has increased by 1.7% since 2010 as has the implementation of parking management schemes which seek to pass on the cost of the WPL to employees. These now cover 36% of Workplace Parking Places. Conversely there is evidence that the number of workplace parking places has fallen by 18% following the introduction of WPL. Furthermore, the WPL scheme has operated smoothly in its first year with no legal challenges and 100% compliance from WPL liable employers.

So is a WPL the answer to funding large scale local transport improvements in the UK? It's too early to answer this question definitively as more post implementation data is required in order to evaluate whether the scheme meets its objectives and, as has been discussed in this paper, this has implications for its acceptability and transferability to other UK towns and Cities and indeed worldwide. However, what can be said is that the scheme itself has been successfully implemented and is raising Nottingham's local contribution to the NET Phase 2 funding and other public transport alternatives. As such, it is a robust approach to funding large scale local transport improvements in the City of Nottingham. The issue is whether or not the longer term impacts of the WPL package are sufficiently positive to make it an attractive and politically acceptable policy to be applied elsewhere in the UK.

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APPENDIX B PAPER 2

EVALUATING TRANSPORT DEMAND MANAGEMENT INTERVENTIONS USING THEORETICAL EVALUATION

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ABSTRACT

Theoretical approaches to evaluating public policy initiatives seek to account for the effect of factors external to the initiative which could impact on the outcome of that initiative. The application of this approach within the transport sector is relatively new despite current government Department for Transport guidance advocating its use.

Nottingham is the first City in the UK to implement a Workplace Parking Levy (WPL) which places a levy on private non-domestic off street parking provided by employers. The scheme acts as a transport demand management measure with the revenue hypothecated for funding a package of transport improvements.

This paper analyses the application of a theoretical evaluation approach, using the example of the Nottingham WPL package as a case study. The analysis includes a logic map based on stakeholder consensus and literature, explaining how the package is expected to meet its stated objectives.

The paper concludes that a combination of two theoretical approaches, ‘Theory of Change approach strengthened by elements of ‘Realistic Evaluation, as an appropriate framework for evaluating transport interventions and that this has established a plausible model for change and expected outcomes and impacts for the Nottingham WPL Package. Additionally, it concludes that the available data supports the validity of the established Theory of Change for the Nottingham WPL package with regards to shorter term outcomes. This will be invaluable to any authority which chooses to pursue a similar approach.

INTRODUCTION

It is common for local authorities introducing new transport initiatives in the UK to monitor a set of indicators upon which the intervention is intended to cause change. Large or complex interventions however, which are implemented and assessed over a period of time may result in incorrect conclusions, since factors such as economic conditions may change over time. Thus monitoring must be considered against the overall background of change which is external to the intervention. This is generally referred to as the ‘context’ in evaluation literature (see 1 and 2). Thus ideally the aim is to research evidence in order to indicate that it is the intervention in question that is causing any observed change, anticipated or otherwise, rather other unrelated contextual factors. This is termed attribution (3). This wider consideration of context leading to attributing the medium and long term changes in indicators to the intervention being studied is termed evaluation (1).

In recent years UK government best practice guidance for evaluating major transport interventions has advocated Theoretical Evaluation approaches to address the issue of achieving attribution of affects to the scheme being evaluated. (3 and 4). Theoretical Evaluation is common in assessment of issues related to public health and social programs however there is little published on the use of such approaches in transport evaluation. The Nottingham Workplace Parking Levy (WPL) package is an example of a major transport intervention recently implemented in a medium sized UK City being used to manage transport demand and raise capital for public transport improvements. The effectiveness of the WPL package in meeting its stated objectives has to be evaluated and theory of change has been proposed for such evaluations.

This paper introduces the WPL and provides a literature review to explore the options for tailoring Theoretical Evaluation to evaluating a transport intervention. It then develops a theory of change for the Nottingham Workplace Parking Levy package which is a required component of a theoretical evaluation approach. This leads to the production of a logic model of how the WPL package can be expected to meet its key scheme objectives. The extent to which this theory is operating as expected is assessed against the latest available data. From this key elements required of such an approach are identified that can, in future, be applied to the planning stage of any similar intervention to aid scheme evaluation.

BACKGROUND TO THE WPL

In April 2012 Nottingham City Council introduced the WPL which uses the provisions of the Transport Act 2000 to levy a charge on occupied private non-domestic off street parking places that is Workplace Parking Places (WPP) occupied by employees, regular business visitors or students. It is the first charge of its type in the UK, and indeed in Europe. Currently the charge per WPP is £334 ($571) per year. Employers apply for a licence for each of their premises where such places are provided which states the number of WPP they wish to use and then pay the appropriate levy. Currently a third of Workplace Parking places have the charge passed onto employees via employer run workplace parking charging schemes.

The WPL therefore has a dual role to act as a transport demand management measure and also to raise hypothecated funds for transport improvements. The money raised by the WPL is funding two new tram lines, improvements to Nottingham Railway Station and additional bus services. The WPL scheme and the above mentioned public transport improvements comprise the overall “WPL package” and are intended to complement each other to enhance the transport demand management effect.

As part of the approval for the scheme a business case was prepared and submitted to government in 2008 (5), within this 6 key objectives of the WPL were identified (further discussed below) together with a commitment to evaluate these. For those interested in further detail on the Nottingham WPL and its implementation, Dale et al 2014 (30) provide a detailed case study of the scheme which provides further background information to support this paper.

THEORETICAL APPROACHES TO EVALUATION

Theoretical approaches to evaluation have evolved to address acknowledged weaknesses of experimental design fully accounting for context and attribution. Pawson and Tilley (1997) (2) introduced Realistic Evaluation, while in 1998 work carried out by the Aspen Institute put forward an alternative theory based approach; the Theory of Change (6). These approaches take into account contextual changes, as and when, they occur by incorporating them into a theory which describes the process of change the intervention is intended to achieve (7). Additionally theory based techniques, where a lack of data mitigates against experimental proof, are intended to have the ability to fall back on the underlying theory so as to make credible attributions in the absence of experimental evidence (8). It is important to stress that the term ‘theoretical’ is used to articulate that the evaluation uses a theory based on previous experience and is tested by collecting evidence prior to any conclusions being provided, rather being purely theoretical in that it is untested or unreal.

Theory of Change Approach

A Theory of Change Approach (ToC) describes the causal relationships between the events linked to an intervention which aim to meet a set of stated scheme objectives, in doing so it seeks to take into account context and any likely changes to this that can be foreseen. These events are commonly identified as follows (9 and 4):

- Context/setting – this describes the problem the action will attempt to mitigate and also any relevant contextual factors, Thus it could also be seen as setting the scene;
- Inputs – This describes the nature of the intervention and the resources required to implement it;
- Outputs – This describes what those resources deliver on the ground e.g. a new tram line;
- Outcomes – This refers to the immediate effect of the intervention in the short and medium term;
- Impacts - this is longer term strategic changes which the intervention has effected or contributed to.

A distinctive aspect of a ToC evaluation is that it relies on this causality being developed based on existing evidence from stakeholders, good practice elsewhere, previous evaluations, and academic studies leading to a consensus on the theory of change. Where knowledge gaps are identified bespoke research may be necessary. Modern applications of this approach have used logic maps to articulate and understand the theory (6, 9 and 3).Thus the theory proposes that if, given setting X, resources are committed then Y will be delivered. Given that Y is now in place this will result in Z outcomes which in turn will achieve W impacts. While clearly the larger the evidence base in terms of previous experience the better, this form of evaluation is effective in dealing with complex or innovative schemes due to the flexibility of evidence gathering in developing the theory.

Literature on how a ToC approach achieves attribution is somewhat general in nature. Connell and Kubisch (1998) (10) while recognizing that there is no guarantee that observed change is due to factors other than the intervention, argue that often, if the observed change is commensurate with the theory then stakeholders may be willing to accept that it is attributable to that intervention. They identify four points which they believe could be sufficient to demonstrate attribution when adopting a ToC approach, namely that the:

- theory is plausible;
- intervention was implemented as expected;
- magnitude of the outcomes following the above was as predicted by the theory;
- absence of any contextual shift that could account for the above outcomes.

Realistic Evaluation

Realistic Evaluation (RE) is a theoretical evaluation approach which is rooted in the realist philosophy of science and views the world as a series of open systems subject to causal factors that vary over time (2) i.e. they recognise that if intervention A has previously lead to outcome B it may not necessarily be the case in the future or in a different location because external causal factors may not be the same. In other words they embrace the concept that the outcomes to actions will depend on the wider context (11). RE can therefore be said to have a base formula for exploring this explanatory aim:

Mechanism + Context = Outcome

These 3 elements are explained as follows (12):

4. Mechanisms (M): That evaluators need to explore the mechanism that is intended to operate to make the programme effect the intended change. A mechanism is, therefore, a mini theory which says how an intervention will achieve change, e.g. a WPL, where it is passed on will raise the cost of travelling to work by private car thus utilising basic economic theory to reduce the percentage of people choosing that mode.
5. Context (C): It’s important to explore the context in which it is intended to operate and identify what factors will impact on the intended mechanisms.
6. Outcome Patterns (O): This is a postulation as to what outcomes will occur to whom and where. It includes an appreciation that the mechanisms and therefore the outcomes may not operate in a uniform fashion due to differences between contextual factors.

A realist theory therefore comprises a series of postulated Context-Mechanism-Outcome Theories (CMOs) and the output of the evaluation is refined and tested CMOs. Pawson and Tilley (2004) (12) provide a straightforward account of how realist evaluators approach attribution by identifying mechanisms and proceeding to test them empirically. They recognize that in complex programs potential mechanisms may be almost infinite and that the evaluator can only go so far. While the two approaches outlined above developed independently it is debateable if they are distinct and mutually exclusive. Pawson and Tilley (2004) (12) give a number of examples of the applications of RE to real life evaluations. It is important to that these were applied to a relatively narrow area of study with easily definable consequences, a far cry from a major transport intervention which can, arguably pervade many policy areas. Laws (2009) (11) used RE to evaluate Publicly Funded Demand Responsive Travel (DRT) Schemes in the UK. Laws (11) concluded that although the approach generated a reasonable level of knowledge the approach was extremely time consuming and the findings could lack precision. She recommended that such evaluation methods be limited to key areas of the scheme rather than adopted as an overall evaluation approach. Blamey and Mackenzie (2007) (7) conclude that it may be desirable to include an element of RE within an overall ToC evaluation framework in order to examine the cause of change in more detail.

THEORETICAL EVALUATION APPLIED TO TRANSPORT

To date there are very few published examples of how these approaches have been applied to the evaluation of transport projects. In general, as suggested by the literature it is considered that the basic methodologies for ToC or RE can be directly applied to transport interventions without major modification, however there are some points specific to transport interventions that should considered:

1. Scale of the intervention - Theoretical approaches lend themselves to schemes or packages that are complex and innovative as these approaches, while stronger for an existing evidence base, do not rely on this and are capable of generating conclusions from incomplete or sparse base and monitoring data. This is relevant to large scale transport initiatives as they are likely to influence whole conurbations with unique characteristics making traditional experimental comparative approaches difficult to design and implement.
2. Utility of a logic map - The current guidance on evaluating major transport interventions from the UK Department for Transport (3) strongly advocates the use of a logic map to express the theory of change, in doing so they are nudging evaluators towards a ToC approach.
3. Combining ToC and RE approaches - Given the discussion above it can be seen that an element of realistic evaluation can be used to strengthen the ToC approach. If the evaluator chooses this option then it will be important to limit the number of CMO theories or limit themselves to identifying key mechanisms and contextual factors.

The above issues are expanded in the discussion on the chosen approach to evaluate the WPL package in the following section.

A THEORETICAL EVALUATION APPROACH APPLIED TO THE WPL PACKAGE

Considering the above discussion, it is possible to make key statements about the characteristics of the WPL package relevant to the choice of evaluation approach:

1. The WPL package will be implemented over a 4 year time span during which both local and national context is liable to change.
2. The WPL package is unique in a European context and even the Australian schemes have significant differences to the Nottingham Package. It can therefore be considered to be an innovative and untested intervention.
3. The WPL and the schemes which it funds is a package, as it is a number of complementary interventions designed to act and interact to attain common objectives.
4. The presence of competitor cities within the region and other Core Cities of a similar size and socio-economic profile facilitates the identification of a comparator group for many indicators. It is not possible to identify a random control group as the WPL is area wide.

The above statements will be true for many large scale transport initiatives which incorporate innovative or new approaches where the existing evidence for their effectiveness is limited. Clearly because of the area wide nature of the package which mitigates against the availability of a random control group a true experimental approach is not possible. While other similar cities provide an acceptable comparator group only some of the chosen indicator monitoring data is available for those cities. This means that a quasi-experimental approach is feasible for some objectives but cannot be the complete answer.

Another consideration is that the WPL is an innovative measure that is untested in a UK or indeed European context, thus it is desirable not merely to report that change has occurred relative to the comparator cities but to understand why and how rendering information as to how specific context has contributed to that change. From the above it can be seen this kind of knowledge generation is only possible by adopting a theoretical evaluation approach. Neither before and after monitoring nor quasi-experimental evaluation approaches provide an understanding of how change is achieved and are not able to take into account changing contextual factors over time.

Additionally the formulation of a theory based on logic mapping would also be useful where no comparable data is available, for example bespoke business investment research, as attribution can be achieved by answering the questions. Based on (10):

- Is the theory is plausible?
- Was the intervention implemented as expected?
- Is the magnitude of the observed changes to the indicator as predicted by the theory?
- The absence of any contextual shift that could account for the above outcomes or if there was, has this been taken into account.

The above discussion clearly points to the desirability of an approach whereby a Theory of Change is articulated by producing a logic map based on the knowledge of stakeholders and key documentary evidence. Where feasible a quasi-experimental component to the evaluation will strengthen this.

Six objectives have been identified by stakeholders based on the WPL Business Case (see 13). In this paper the evaluation of the three most important objectives in terms of the packages long term aims and transferability are considered:

O1 - Constrain congestion in the AM and PM peak periods.

O2 - Encourage sustainable travel and mode choice.

O3 - Enhance the attractiveness of Nottingham as a location for business investment.

To develop an evaluation framework, a logic map (Figure 1) has been developed which represents, a theory of change for the WPL package against these objectives. This logic map is based on the 5 events inherent in a theory of change approach as described earlier. It is thus chronological in nature and identifies the stages and linkages flowing from the initial context to the inputs outputs, outcomes and eventual longer term impacts. It also shows which outcomes and impacts contribute towards which objectives. An element of a realistic evaluation approach has been used to add further explanatory detail to the theory presented in the logic map by identifying individual mechanisms of change and where within the logic flow each mechanism is anticipated to operate.

The mechanisms that have been identified try to balance the need for them to be defined and discrete with, a recognition, that if they were broken down into the smallest unit there could be double or triple the number. Thus individual mechanisms occur at more than one place within the logic map. Contextual factors that are relevant at the schemes inception are identified within the background and context box in Figure 1. Table 1 identifies a series of discrete contextual factors which are anticipated to impact on the effectiveness of the WPL package. Table 2 details the individual mechanisms which are anticipated to operate.

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TABLE 1 Context of the WPL Package

	Context	Evidence base to support context
C1	Socio-economic characteristics	Nottingham is a medium sized English city with a population of 308,000 (645,000 in the primary urban area). It ranks 20th out of 326 Local Authority areas for deprivation and should, therefore, be considered deprived. 90% of its GVA is accounted for by the service sector.
C2	Relevant Transport Policies	The Local Transport Policy background features extensive bus priority measures, activities to encourage green modes of travel including workplace travel planning, Park and Ride, 1 existing Tram Line and a general presumption against catering for growth in travel via road improvements.
C3	National Economic Conditions	The WPL package is being implemented in a period when the national economy is emerging from recession with associated improving economic growth figures.
C4	Cost of fuel	Standard unleaded fuel prices rose by 17% between January 2010 and December 2013 while diesel prices rose by 22% in the same period. (14)
C5	The Nottingham Offer	Key operational costs are lower in Nottingham than other comparable cities in the UK, with office costs at £19.00 per sq. ft. for Grade A office space (compared to £35-400 in Birmingham and Manchester, £30.00 in Leeds, £25 in Milton Keynes and £25 in Cardiff) – (15) and salary costs on average 10% lower than the national average (16). These are the main costs that a business will focus on when deciding on a new location and are key in terms of what Nottingham has to offer as a location.
C6	Existing Congestion Problem	Nottingham City Council estimates that congestion, mainly in the AM and PM peak period, costs the City's economy £160m pa (5), this will manifest itself as a cost to business in lost time, increased transport costs, difficulties in access for qualified workforce etc.
C7	Presumption of Growth	Population projected to grow by 9% 2011-2026 (17)
C9	Short term disruption to network by construction phase of WPL Package, Ring Rd Improvement scheme and Improvements to A453	Journey Time per Vehicle mile on Radial Routes into the City in the AM peak period affected by these road works rose by 31% between 2010/11 and 2013/14 while those isolated from them rose by 5.4%, less growth than in 3 out of 4 of the comparator cities

TABLE 2 Mechanisms Activated by the WPL Package

	Mechanism	Evidence base to support mechanism
M1	**WPL funds Improved public transport (PT) options.**	The parking space schemes in the Australian deliver stable hypothecated revenue for transport (5). The Nottingham WPL scheme has raised approx. £14 million to date (13)
M2	**Improved PT options result in increased capacity**, this will encourage new trips generated by growth to choose PT rather than the car.	In Nottingham the introduction a tram increased PT trips from 68,000 in 2003/4 to 74,000 in 2005/6. (18).
M3	**Improved PT options result in better connectivity, image and convenience when using PT**, encouraging modal switch from the car to PT.	
M4	**WPL funds business support measures** to encourage workplace travel plans, car park management and cycle infrastructure improvements which encourage employees to switch from car to PT, cycling or walking.	Studies show that Travel Planning is effective in encouraging mode shift (19 and 20). Concern for WPL is imposing a cost on business discouraging inward investment (21 and 22). Passing cost to employees via parking charges may address this concern and there is evidence that this is taking place (13).
M5	**Direct increase in cost in commuting to work by car due to Workplace Parking Charges.** Some employers choose to pass on the cost of the provision of these places to their employees, thus effectively increasing the cost of commuting to work by car. According to basic economic theory this should decrease the demand for this mode of travel.	Evidence from long standing parking space levy schemes in Australia suggests that they can contribute towards modal shift (23 and 24). The London Congestion charge prompted an initial drop in congestion, although it did later rebound, possibly due to external economic factors (25). A report on the economic and business impact of the WPL produced by Price Waterhouse Cooper on behalf of Nottingham City Council (21) predicted that a significant number of employers would choose to pass the charge onto their employees.

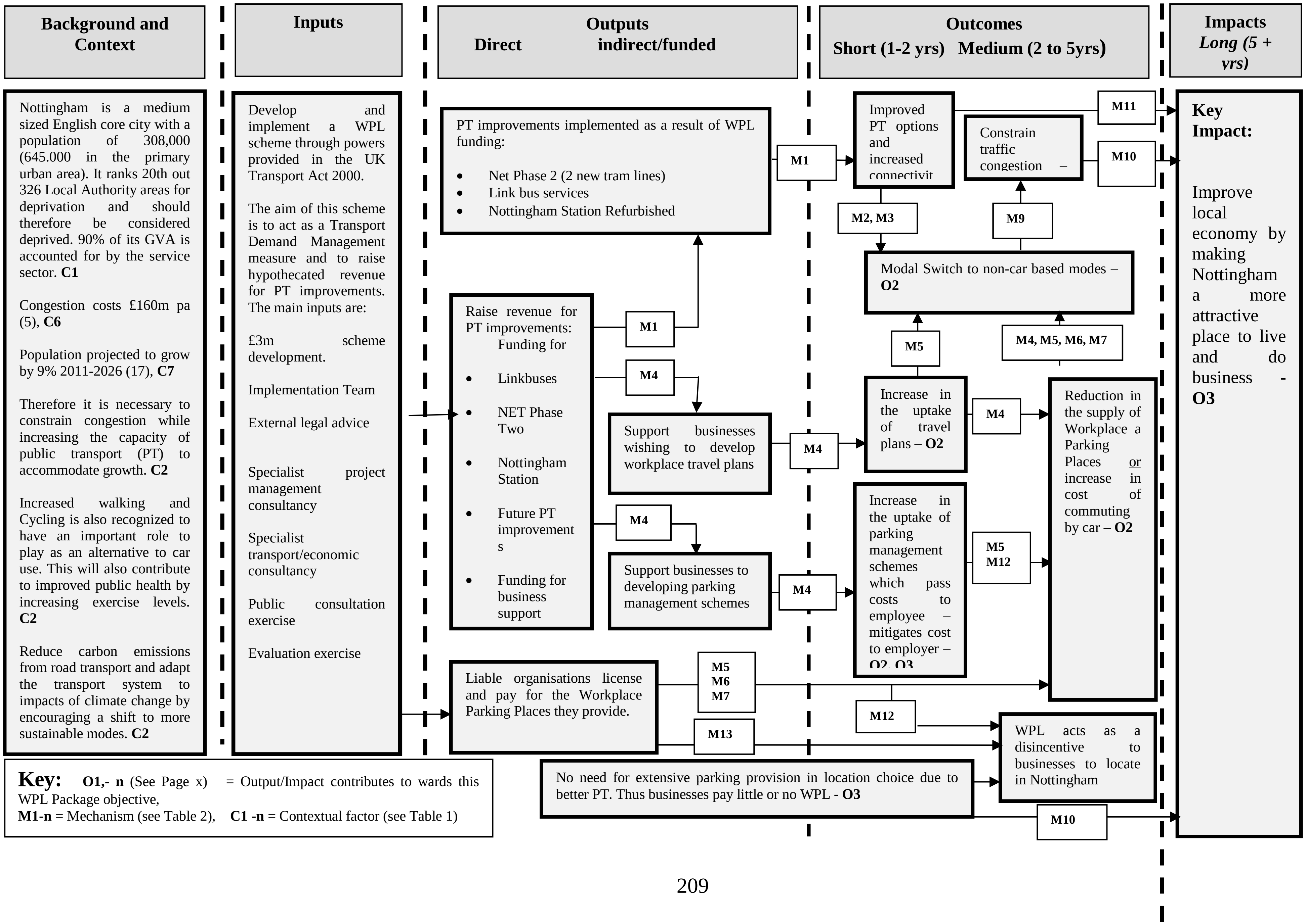
	Mechanism	Evidence base to support mechanism
M6	**Indirect increase in cost of commuting to work by car.** WPL causes a contraction in the supply of workplace parking resulting in an additional cost to commuting by car as paid for non-workplace parking is used thus decreasing the demand for this mode of travel.	There is evidence that the introduction of the Nottingham WPL has prompted a contraction in the supply of workplace parking places. (13).
M7	**Decrease the supply of Workplace Parking**. The WPL prompts employers to 'ration' the workplace parking places (WPP) they provide to employees causing a contraction in the supply of WPP in places where there is no alternative supply other modes will need to be utilised.	
M8	**Enhanced effect of WPL package.** The combined effect of the WPL Package: The WPL, NET Phase 2, the refurbishment of Nottingham Station and provision of Linkbus Services act as a combined package to greater effect than the individual schemes to encourage mode shift.	It is generally accepted that to be most effective Transport Demand Management measures need to be provided in an integrated package (26 and 27).
M9	**Congestion Constraint.** The improved PT quality and capacity combines with the increase in cost of commuting by car to prompt modal shift away from the car and thus reduces or constrains traffic congestion.	Evidence from long standing parking space levy schemes in Australia, which also use revenues generated to improve PT, suggest that they can contribute towards congestion constraint (23 and 24). The London Congestion charge prompted an initial drop in congestion although it did later rebound possibly due to external economic factors (25).

<table>
<tr><th></th><th>Mechanism</th><th>Evidence base to support mechanism</th></tr>
<tr><td>M10</td><td>Transport demand management effect of the WPL package reduces cost of congestion to businesses making Nottingham more attractive as a business location.</td><td rowspan="2">A study by the Core Cities Group showed that the availability of an efficient transport system is a prerequisite for business location; however it is not the most important factor (28). Nottingham City Council estimates that congestion costs the City’s economy £160 million pa (5), this will manifest as a cost to business in lost time, increased transport costs, difficulties in access for qualified workforce etc. The 2005 study carried out by PwC on behalf of Nottingham City Council (21) showed that employers recognised that congestion represented a cost to them.</td></tr>
<tr><td>M11</td><td>Increased PT capacity and efficiency makes Nottingham more attractive as a business location due to workforce mobility.</td></tr>
<tr><td>M12</td><td>Employers choose to pass on the cost of the WPL to their employees via parking management thus mitigating the WPL as a cost to business.</td><td>A number of larger employers now actively manage their car park and use this to pass on the cost of the WPL to their employees. (13).</td></tr>
<tr><td>M13</td><td>Increase in cost of operating a business in Nottingham. The WPL charge is absorbed by employers thus placing an additional cost burden on local businesses which risks a reduction in inward investment.</td><td>Studies carried out before and after the implementation of WPL show that businesses cite this as a key mechanism (21 and 22), although the 2005 study (20) concluded that it was debateable as to whether they would act on this as the WPL charge formed less than 1% of turnover for most.</td></tr>
<tr><td>M14</td><td>Suppressed demand for travel by private car. As congestion decreases demand supressed by the capacity of the network is released thus no real congestion benefit is derived.</td><td>This is the well documented effect of induced traffic in response to increased road capacity (29),</td></tr>
</table>

While Table 2 describes each mechanism it is important to understand how the contextual factors itemised in Table 1 are likely to impact on these mechanisms. The ability of the WPL to deliver the required revenue stream (M1) relative to commuters opting to switch mode due to an increase in costs/reduction in WPP supply (M5, M6 and M7) will be dependent primarily on C3, the National economic situation and on local economic factors, C1, determining to what extent employers and employees are prepared to bear the cost of the WPL and also how buoyant the economy is delivering growth to offset, M7, the reduction in Workplace Parking supply. Additionally the availability of PT alternatives is also a factor affecting these mechanisms, C2. Mechanisms 2, 3 and 4 will interact with C1, socioeconomic factors. As this will affect the propensity for use of different modes, it is likely that the more deprived the area the greater the propensity to use PT. C3 economic conditions, including C4, fuel prices will also play a part in perceived attraction of different modal choices. In general historic trends from Nottingham show that the less favourable the economic conditions and the higher the cost of fuel the greater the propensity for the use of PT.

As M8 is a secondary mechanism, recognising the combined effects of M1 to M7 the contextual factors affecting this mechanism are the same as the individual mechanisms. Mechanisms 10 through to 13 which describe how the benefits of reduced congestion and less car use encourage inward investment will be heavily influenced by C5 the Nottingham Offer and its competitiveness with other locations. An additional factor will be the national and local labour market C2, and how the better PT acts as a positive for recruitment. It is anticipated that C6 and C7 are pre-existing conditions that are unlikely to vary sufficiently in the evaluation period to impact on the mechanisms.

FIGURE 1 Logic Map for Workplace Parking Levy Scheme



TESTING THE THEORY

Having developed a logic map and a theory of change this needs to be measured against the key metrics to assess its effectiveness as an evaluation tool. Dale et al 2013 (13) presented a table (Table 3 in Dale et al 2013 (13)) which describes the indicators that had been earmarked for tracking the WPL package's progress towards its stated objectives which have been linked to the original WPL business case. Monitoring these indicators, benchmarking them against other cities where possible and assessing if the direction of change and magnitude is commensurate with the theory of change will be an important part of the scheme's evaluation. Four UK Cities have been selected as comparator areas based on their similarity to Nottingham with respect to size, socio-economic and transport characteristics. These cities are:

- Leicester
- Liverpool
- Newcastle
- Sheffield

However comparative data from these Cities is only available for some of the relevant indicators which limits this approach. Where comparative data is not available, the evaluation must rely on comparison with the direction and magnitude of change predicted by the ToC for indicators.

However, in order to understand why change has occurred in more detail, these indicators must be used to assess if the mechanisms are activating as predicted by the theory and to what extent they are impacted by changes to the contextual factors.

Table 3 outlines how each mechanism can be evaluated, the available data to date (2013/14) and to what extent that indicates each mechanism is activated as predicted by the theory. Most of the contextual factors identified in Table 3 are currently static, however where this is not the case they are highlighted. With regard to current assessment of progress it has to be considered that the WPL has only been in place a short while and the PT improvements are currently being implemented many of the medium and longer term aspirations of the scheme will be difficult to evaluate at the moment. However assessment of short term aims can be made.

TABLE 3 Evidence of the operation of mechanisms

	Summary of Mechanism	Indicator	Evidence for Attribution	Evidence suggesting mechanism is active including relevant contextual changes	Active as predicted
M1	**Improved PT options funded.**	Provision of planned PT improvements. Annual WPL net revenue.	None required	Linkbus services and the refurbishment to Nottingham Station have been implemented. NET Phase 2 is under construction and is due to open in 2015. WPL raised over £7 million in its first full year of operation.	**YES**
M2	**Increased PT capacity**	PT Satisfaction Surveys.	None required	No PT satisfaction surveys yet planned. Direct interview surveys of commuters planned for 2015/16.	**?**
M3	**Improved PT options result better connectivity and convenience an image**	PT mode share at Inner Traffic Area cordon PT Patronage	Direct interview surveys of commuters asking if they have switched mode and why	Linkbus services and the refurbishment to Nottingham Station have been implemented. NET phase 2 is under construction and is due to open late 2014.	**?**
M4	**WPL funds workplace travel plans, car park management and cycle infrastructure improvements**	Number of employees/WPP covered by parking management or workplace travel plans.		Both PT mode share and patronage have declined slightly since 2010. However the main PT improvements are not yet complete. In 2010 25% of employees in Nottingham were covered by workplace travel plans, this has risen by 2013 to 33% almost certainly as a result of the WPL package	**YES**

	Summary of Mechanism	Indicator	Evidence for Attribution	Evidence suggesting mechanism is active including relevant contextual changes	Active as predicted
M5	**Direct increase in cost in commuting to work by car**	% of WPP where the employer passes on the WPL charge to the employee.	Direct interview surveys of commuters asking if they have switched mode and why	There was no data prior to 2012/13 however at present for 38.9% of WPP are covered by parking management schemes which pass on the cost to employees, certainly this has occurred as a result of the introduction of WPL	**YES**
M6	**Indirect increase in cost of commuting to work by car.**	Commuter parking in NCC public car parks.		A weekday average of approximately 426 vehicles are parked using the "Early Bird" parking deal for a Council City Centre car park, this deal is aimed at commuter parking and, when considered in the context of a reduction in the number of Workplace Parking Places, demonstrates that this mechanism is active.	**YES**
M7	**Decrease the supply of Workplace Parking**.	Number of licenced WPP	Comparison with comparator cities	The number of WPP fell by 18% from a pre implementation estimate of 32225 to 26464 following the introduction of the WPL and by a further 4% between 2012 and 2013 to 25320.	**YES**
M8	**Enhanced effect of WPL package.**	Decrease in the number of WPP			**YES**
M9	**Congestion Constraint.**	Modal shift Journey time per vehicle mile		NET Phase 2 not yet complete so it is not yet possible to assess the combined effect of the package Journey time per Vehicle Mile has risen by 3.8% between 2010/11 and 2013/14.However this is also the case within some of the other medium sized cities i.e. Sheffield, and Leicester and may be due to the emergence of the national economy from recession (C3). Additionally, in Nottingham the disruption caused by the construction phases of the major transport improvements are also a factor. (C9)	**?**
M10	**Reduced cost of congestion to businesses.**	Journey time per Vehicle Mile	Comparison to other core cities		**NO** **NO**

	Summary of Mechanism	Indicator	Evidence for Attribution	Evidence suggesting mechanism is active including relevant contextual changes	Active as predicted
M11	**Increased PT capacity and efficiency makes Nottingham more attractive as a business location due to workforce mobility**	Level of inquiries to NCC Inward Investment Team and subsequent successes. Volume of rental deals done by commercial estate agents Evidence from case studies of inward investors. Macroeconomic indicators	Case study based evidence from businesses. Indicators, when triangulated, move in the direction and magnitude commensurate with the theory of change.	Investment enquiries and subsequent successes have increased in 2012/13 and 2013/14 when compared to the previous 4 years, The number of deals done by commercial estate agents has also increased which supports this data. Nottingham has fared better than the other 4 comparator cities with respect to employment and output (GVA). Although it needs to be accepted that this could be due to the emergence from recession (C3) as much as any effect of the WPL package. However, the comparison to the comparator cities as well as the magnitude of the increases suggests that this mechanism may be active. This, strongly suggests that the cost element of WPL is not having a detrimental effect and case study data demonstrates that the availability of good PT options especially towards the city centre are an attraction to inward investors. The above fits with the Theory of Change but more case study data is required to confirm attribution.	**?**
M12	**Employers choose to pass on the cost of the WPL mitigating the impact on employers**	% of WPP whereby the employer passes/absorbs the WPL charge to the employee.	NA	There was no data prior to 2012/13 however in 2013 39% of WPP were covered by parking management which passes on the cost to employees; anecdotal accounts from employers enables us to be certain that this is a recent development in response to the introduction of WPL.	**?**
M13	**Increase in cost of operating a business in Nottingham.**	Level of investment inquiries to NCC and subsequent successes.		Inward investment market buoyant, see M11, this suggests that overall business costs are not a barrier to business location in Nottingham.	**YES**
M14	**Suppressed demand for travel by private car.**	Enabling Mechanisms operate but congestion does not decrease, no. of trips on all modes increase	None required	None at this time	**NO**

Table 3 reveals that the mechanisms that facilitate the short term outcomes appear to be operating as predicted by the theory. There is strong evidence that the supply of WPP is reducing while the revenue remains stable due to the pre-planned increase to the WPL charge enabling the planned PT improvements to be implemented. Additionally employers are increasingly passing on the cost of the WPL to their employees and taking up workplace travel plans. Congestion and mode switch appears to be moving in a direction similar to other similar cities. However the following contextual factors must be considered:

- the national economy is emerging from recession and traffic volumes are increasing nationally
- the key PT improvement, the provision of two extra tramlines, are not yet open.
- the construction phase of the above and other non WPL package schemes have created considerable disruption on the network.

These factors will all mitigate against mode switch and a subsequent reduction in congestion and therefore it should be concluded that, given the current context external to the WPL package, it would not be expected to see progress towards the longer term scheme objectives as the important mechanisms cannot be activated at this point in time. The project to evaluate the WPL is due to conclude in Spring 2017 by which time these contextual issues should be resolved and travel patterns normalised given the new PT options.

LESSONS FOR FUTURE EVALUATIONS OF TRANSPORT INITIATIVES

The process of deriving a theory of change is extremely resource intensive due to the iterative process of formulating and refining the theory via stakeholder engagement. For many transport interventions however this is implicit in scheme justification and this was the case with the WPL because of its innovative nature. The bulk of this process occurred in formulating the business case (5) via an extensive public engagement culminating in a public examination. Thus for the WPL there was little additional expense involved in creating the theory of change over and above the scheme justification. This however may not be the case for all transport interventions depending on the statutory requirements for scheme appraisal.

Data availability is a key area of concern when carrying out a Theoretical Evaluation (12) Issues have been experienced with the following areas of data:

- Obtaining equivalent indicator data from other comparable cities can prove difficult, and where data is provided it may not be in a comparable format.
- The process of identifying contextual factors and key mechanisms has proved illuminating. It requires a more detailed thought process from the evaluators as to how and why change occurred by breaking down the broad logic into stages that are measurable. This will be of advantage to any evaluation project.

Originally the authors generated 23 mechanisms for the WPL Package and these could be subdivided further. If these were then cross referenced with contextual factors it would have generated large numbers of CMO theories, this issue was predicted by the literature but seems to be a particular problem for the WPL Package. This is likely to be equally true when evaluating any area wide transport intervention. This is because transport impacts permeate many policy areas. For this reason it is suggested that a policy of identifying key mechanisms only is adopted when applying this evaluation approach, however evaluators need to accept that this may result in some loss of detail a balance must be struck depending on the audience and aims of the evaluation in question.

CONCLUSIONS

Theoretical Evaluation is being proposed as a tool to evaluate complex and innovative transport projects where there are many influences external to the scheme. The UK Department for Transport guidance advocates this approach, yet there is little published information as to how this has been applied to transport projects. The two main theoretical evaluation approaches, Theory of Change and Realistic Evaluation have been reviewed with their potential practical application to the transport sector in mind. This showed that:

- a full RE approach is likely to be impractical due to the complexity and resource requirements.
- a ToC approach is potentially more suitable due to its more generalised nature whereby an agreed theory of change can be derived.
- a ToC approach may not fully identify the mechanisms by which the desired impacts will be achieved. However, mechanisms that achieve the objectives to be evaluated together with influencing contextual factors can be used to strengthen a Theory of Change approach. This is therefore advocating including an element of RE.

It is concluded that a ToC Evaluation approach strengthened with elements of RE are an appropriate approach to evaluating major transport interventions. This is suggested for use to evaluate the Nottingham WPL Package and is presented as a practical example of the application of this approach. A review of relevant literature reveals that interventions of this nature require an evaluation approach which:

- takes into account changing context
- achieve causal attribution
- allows partial data

The above are seen a key features to be considered in any use of theoretical evaluation of transport projects. Using this approach a Logic Map summarising how the Nottingham WPL is intended to achieve its stated objectives has been produced. Such maps are seen as a vital element in developing theoretical evaluation of transport schemes. The logic maps should include -

- A model to explain how the intervention can contribute to any integrated transport demand management policy
- A framework in order to understand and evaluate any observed changes in key indicators relevant to the interventions main objectives.

The latest data from the WPL model reveals that whilst the mechanisms relevant to the shorter term outcomes for the scheme are operating as predicted by the Theory of Change, however it is too early at this stage to assess whether this will follow through to the longer term intended impacts.

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APPENDIX C PAPER 3

An Evaluation of the Economic and Business Investment Impact of an Integrated Package of Public Transport Improvements funded by a Workplace Parking Levy

Under a 2nd Review for *Transportation Research Part A: Policy and Practice*

ABSTRACT

Hypothecated revenue from the Nottingham Workplace Parking Levy (WPL) is being used to fund additional tram lines, refurbish the Nottingham Railway Station and to sustain the supported Linkbus network. This strategy aims to constrain congestion, cater for future economic growth and make Nottingham a more attractive location for business investment and to live, visit and work.

Literature reveals that the Nottingham WPL forms a relatively small proportion of a business' turnover and that the availability of an efficient public transport system is an important factor in business location decisions. Consequently, central to the WPL package is the expectation that an improved public transport network will prove sufficiently attractive to the business community to offset any perceived negativity of the WPL and hence make Nottingham an attractive business location relative to other UK and European Cities.

This paper aims to evaluate the economic and inward investment impact of the Nottingham WPL package.

The Theory of Change approach is used to analyse the impact complemented by benchmarking against comparator Cities. A range of available indicators are used including economic output, employment, net business VAT registrations, the level of investment enquiries and successes and investment case studies.

The paper concludes that there is strong evidence that the WPL is not having a significantly negative impact on inward investment. Additionally, strong growth in employment and output, combined with a positive movement of inward investment indicators, suggests that Nottingham remains relatively attractive to investors. There is emerging evidence from investment case studies that the public transport improvements are playing a role in this.

1.0 Introduction

The Nottingham Workplace Parking Levy Package (WPL Package) is an integrated collection of transport demand management measures aimed at constraining congestion, providing additional sustainable transport capacity to cater for growth and contributing to making Nottingham a more attractive City for business investment. The WPL Package includes the UK's first Workplace Parking Levy (WPL) which, as well as acting as a transport demand management measure, also provides the core funding mechanism for the package which includes a programme of public transport improvements totalling £600 million. The WPL levies a charge on employers who provide more than 10 parking places for their employees, regular business visitors and students. The current charge is £379 per parking place and the WPL is raising in the region of £8m per year. The WPL was introduced in September 2011 although charging did not commence until April 2012.

This paper focuses on evaluating the economic impact of the WPL package with specific reference to its effect on inward investment using a theoretical evaluation framework. This includes a quasi-experimental component which compares data for Nottingham to that of similar UK Cities.

The paper provides a literature review on the link between transport interventions, business location, and wider economic impacts together with the application of theoretical evaluation approaches as they relate to transport interventions.

The research approach and its application to the WPL package evaluation is then explained. As part of this a Theory of Change (ToC) approach is presented which maps the logic of intervention and subsequent change which is intended to lead to the desired economic impact.

The penultimate section presents the research findings and assesses changes to the chosen indicators against the ToC. Finally, the conclusion draws together the research findings providing evidence as to what extent the WPL package is contributing to enhancing Nottingham as a place for business location.

2.0 Background

Nottingham is a medium sized English city, situated 180km north of London with a population of 318,900 sitting within a wider conurbation with a total population of 695,300. The WPL operates within the Nottingham City area, but the benefits of the associated public transport improvements affect the whole conurbation. Nottingham City Council, the Municipal Authority for the City administrative area, has identified the following priorities which their Transport Policies will need to address (NCC 2015):

4. Congestion: It has been estimated that peak period congestion costs the City economy £160 million a year (EMDA 2007) and is particularly acute on key radial routes and the Ring Road.
5. Connectivity: The City Council believes that good connectivity to other urban centres and national and international gateways is essential if Nottingham is to remain competitive as a location to do business.
6. Significant Growth: Using data from the Office for National Statistics, City Council forecasts indicate that its population is set to rise by 9% over a 15 year period from 2011, resulting from increased job opportunities driven by a growth in science and technology, knowledge intensive and creative industries as well as underlying demographic factors.

The WPL contributes to the above in two ways; firstly to act as a transport demand management measure and secondly to provide the local financial contribution for a package of sustainable transport measures, specifically:

- two additional tram lines;
- the refurbishment of Nottingham Railway Station;
- ongoing support for key bus services connecting important employment and retail locations and hospitals to transport hubs (Known as LinkBus), including conversion of the fleet to electric power;
- support for employers to introduce parking management schemes and workplace travel plans.

The WPL and the transport improvements which it funds are termed the WPL Package and are intended to complement each other and work as an integrated set of measures to contribute to constraining congestion, cater for growth and facilitate connectivity. Thus, one of the key stated objectives for the WPL Package is the economic objective of enhancing the attractiveness of Nottingham as a location for business investment. This objective also addresses one of the main barriers to the implementation of WPL schemes, namely the criticism that, as the WPL liability lies with the employer, it is a business cost and will thus act as an impediment to inward investment (Burchell and Ison 2012, Nottingham Post, 2012). Evidence in Nottingham to date shows that a significant number of the larger employers have passed the cost on to their employees, thus mitigating the cost on their business, however, medium sized organisations have tended to absorb the cost. (Dale et al 2014).

A study carried out by Price Waterhouse Cooper (PwC) on behalf of Nottingham City Council prior to the introduction of the WPL (NCC 2005) showed that, although the WPL was likely to be less than 1% of a business' turnover, businesses were highly critical of having to bear this cost despite the transport improvements this would bring. Sixty percent of businesses interviewed for this study said they would relocate some activities away from Nottingham and more than 50% said they would reduce planned investment. 66% felt the WPL would not be offset by improvements in public transport. This identifies a contradiction; as there is wealth of literature which shows that a high quality transport system is important to business location (see section 3) yet businesses react negatively to contributing towards the cost of providing this. Nottingham City Council believes that the overall business location offer will be enhanced by the WPL funded public transport improvements and that this will offset the deterrent effect on investment of the additional cost of WPL (NCC 2008).

3.0 Literature Review

In this section we review literature concerning potential alternative approaches to economic evaluation. In doing so we also examine the conclusions drawn from literature concerning the role transport interventions play with respect to business location and wider economic impacts.

3.1 A Theoretical View of Business Location

Arauzo-Carod et al (2010) citing Haytar (1997) present a useful theoretical frame work for examining industrial location by identifying 3 principal theoretical perspectives which underpin research into this area:

Neo-classical – this assumes that rational actors choose a location based on profit maximisation and cost minimisation. Determinants are thus *external* to a firm. Transport infrastructure is one such determinant. Weber (1929) and Losch (1954) presented seminal theoretical models based on this neo-classical thinking.

Institutional – These theories acknowledge the relevance of neo-classical determinants but also seek to include factors based on the economic relationships with customers, suppliers and public administration which lead to profit maximisation. Congestion Charging is an example of an institutional factor which is put in place by the public administration.

Behavioural – Relates to theories which take into account individual preferences which are *internal* to a business and may not necessarily be entirely profit maximising or cost minimising choices. Behavioural determinants are problematic to include within empirical studies due to the difficulty of assembling relevant data sets and there is thus a dearth of literature reflecting this. However the research that has studied these determinants show them to be significant, for example, Figueiredo et al (2002), demonstrate that entrepreneurs are willing to accept higher locational costs in order to stay in the areas in which they already live.

In practice *determinants* from all 3 theoretical perspectives can be included within a study provided there is sufficient data to quantify them. The next part of this literature review summarises the methods that have been employed to achieve this.

3.2 Approaches to evaluating the role of transport interventions on business location.

Arauzo-Carod et al (2010) identify two predominant approaches that have been deployed for evaluating the reasons for industrial location, Discrete Choice Models (DCM) and Count Data Models (CDM). The DCM approach analyses data on individual location decisions determined from a fixed set of alternatives, while for CDM the unit of study is at geographical area level rather than at a firm level and requires a count of business locations in any given area. Bhat (2014) used a CDM technique incorporating neo-classical and institutional determinants to demonstrate that transport infrastructure provision was statistically significant in determining the level of firms locating to different areas of Texas.

While these approaches provide consensus that agglomeration economies, transport infrastructure, market size, wages and taxes are significant to business location no such consensus as to the dominant location factors emerge despite numerous examples of this kind of research. Button (1995) suggests that firms adopt ‘satisficing policies’ whereby provided that the transport infrastructure is seen as sufficient, then other factors not all of which lead to profit maximisation will determine the location choice. These include the preferences of existing staff, social amenities and a general image of a city as a place to live and work. This conclusion is supported by surveys of businesses conducted in the UK (Smyth et al (2010), (Core Cities et al 2006). Button (2010) argues that given these less quantifiable factors, the role played by transport can become almost impossible to define by empirical methods. If the presence of behavioral factors is accepted then this could explain the heterogeneity seen in the conclusions from empirical studies.

3.3 Approaches to evaluating the economic impact of transport interventions

The two main approaches are microeconomic; Cost Benefit Analysis (CBA) of individual interventions or Macroeconomic models which aim to capture the wider economic impacts of transport infrastructure (Lakshmanan 2011). The congestion charging schemes in London and Stockholm have utilised CBA in order to evaluate their economic impact. Eliasson (2009) used a CBA to demonstrate that, in Stockholm, the social surplus exceeds the implementation and operating costs. The evaluation of the London Congestion Charge also included a CBA, (Leape, 2006) and (TfL, 2008). This demonstrated that there was a social surplus, despite the considerable costs of implementing the scheme. Neither the London nor Stockholm CBAs captured wider economic benefits of the interventions. Transport for London addressed this by a quasi-experimental approach which compares key indicators between areas of London inside and outside the charging area (TfL, 2008). Within this approach there is a discussion of major exogenous contextual changes during the evaluation period however the presence of, otherwise similar comparator areas, are assumed to have allowed for this. The evaluation concluded that there has been no detectable negative economic impact from the scheme (TfL 2008). Anderstig et al (2016) studied the wider economic benefits of the Stockholm Scheme. They use an estimated relationship between accessibility and income and demonstrate that effects on labour income are positive when value of time heterogeneity between different wage levels is included in the model. Evaluation of the Perth Parking Space Levy, the scheme used as a model for the Nottingham WPL has used a simpler monitoring approach concentrating on employment levels and retail floor space and concludes that as these have continued to grow and that the scheme has had no negative economic impact (Richardson 2010).

Macro-economic approaches concentrate on modelling impacts brought about by mainly neo-classical mechanisms; agglomeration, labour productivity gains and general equilibrium effects (Graham 2007, Coombes et al 2008). For example Hensher et al (2012) combine two existing macroeconomic models in the Sydney region to predict the expected broader economic benefits of the Northwest Rail Link project. They identify 18% further economic benefit than that shown by a traditional CBA analysis arising from redistribution of employment activities together with gains in labour productivity linked to agglomeration effects.

Lakshmanan (2011) argues that these macroeconomic approaches ignore forward linkages as the impact continues to ‘ripple’ through the wider economy as time passes. Banister and Goodwin (2011) point out that statistical models which attempt to link transport interventions to macro-economic changes have two major drawbacks firstly that they often fail to take into account contextual factors and secondly that statistical correlation does not necessarily equal causality. Venables (2016) also recognises these forward linkages leading to land use change over time in response to improved transport. Venables suggests a more modular approach whereby individual mechanisms are studied empirically. Quddus et al. (2009) provide an example of such a study. They utilised time series analyses to study the impact of the introduction of the London Congestion Charge (LCC) on retail sales in London. They concluded that overall retail sales were not impacted by the LCC despite some localised negative impacts.

3.4 Theoretical Evaluation Approaches

More recently Theoretical Evaluation approaches have been recommended by the UK DfT in their guidance for the fuller evaluation of major transport schemes in order to provide a more flexible evaluation framework capable of incorporating empirical and qualitative evidence into an evaluation (DfT 2013). These approaches provide a framework for understanding, systematically testing and refining the assumed connections between an intervention and the anticipated impacts. This takes into account contextual changes, as and when they occur, by incorporating them into the theory (Blamey and Mackenzie 2007). Theoretical evaluation approaches also aim to demonstrate the attribution of the observed change of indicators to the intervention in question. This consideration of both context and causal attribution allows these approaches to potentially address the key criticisms made by Banister and Goodwin (2011) and Lakshmanan (2011) related to empirical micro and macroeconomic approaches.

The Theory of Change (ToC) approach to theoretical evaluation seeks to describe how an intervention is intended to meet its objective by identifying the logical flow of events that it is assumed will enable this to be achieved (HM Treasury 2011). Thus, a Theory of Change is articulated by examining the existing evidence base and a debate between stakeholders leading to a consensus on the logic of the intervention. This is often expressed as a logic diagram containing five sequential steps (Blamey and Mackenzie 2005, DfT 2013):

- Context/setting - the problem the action will attempt to mitigate and also any relevant contextual factors.
- Inputs – the nature of the intervention and the resources required to implement it.
- Outputs – what those resources deliver on the ground, e.g. a new tram line.
- Outcomes – the effect of the intervention in the short and medium term.
- Impacts - longer term strategic changes which the intervention has effected or contributed to.

This approach will therefore inherently consider forward linkages between a transport intervention and the wider economy over time as proposed by Lakshmanan (2011). A ToC must be tested against a set of indicators to see if they change in the direction and magnitude suggested by the theory. Within this process a broad consideration of the effect of contextual factors is included. Connell and Kubisch (1998) identify four conditions which, if satisfied, would be sufficient to demonstrate attribution of the observed changes to the intervention in question according to the ToC approach:

- The theory is plausible.
- The intervention was implemented as expected.
- The magnitude of the outcomes following the above was as predicted by the theory.
- The absence of any contextual shift that could account for the above outcomes.

Realistic Evaluation (RE) is another method of theoretical evaluation and has many similarities with ToC, but it differs in the level of specificity with which it itemises the causal logic (Blamey and Mackenzie 2007). Realistic evaluation aims to link a mechanism of change to contextual factors to identify an outcome, i.e. Mechanism + Context = Outcome (Pawson and Tilley 1997). For example, a ToC may link the introduction of a WPL to the outcome of a decreased demand for travel to work by private car and it would satisfy itself with the assertion that this is accepted wisdom. However, a realist evaluator would want to specifically identify the mechanisms which enable this outcome e.g. an increased cost to individuals for parking at work as employers pass on the cost of the WPL to their workforce via parking management schemes. This would then be placed in the light of context, for example, whether or not there is any free on street parking nearby or whether the economic situation is such that the workforce is enjoying a healthy wage rise thus obviating the increased cost of parking. Thus the method is sufficiently flexible to include neo-classical macroeconomic mechanisms by which improved transport infrastructure impact the economy such as agglomeration and labour supply effects (Hensher et al 2012) as well numerous micro economic enabling mechanisms. Importantly this allows for the inclusion of less quantifiable behavioural determinants proposed by Figueiredo et al (2002) within the Theory. Even if their presence cannot be proven empirically it is useful to be aware of when and how they can be activated and to seek qualitative evidence to support this. The principle drawback of RE is that the number of mechanisms and contexts for a large intervention may be so numerous that the approach becomes impractical (Pawson and Tilley 2004). The possibility of co-existence of the two approaches is acknowledged by Blamey and Mackenzie (2007), indeed they go on to conclude that this may be desirable with ToC providing the overall evaluation framework while RE is used to drill down into the detail of change. This fusion of RE within a ToC framework is not dissimilar to the modular, context specific approach suggested by Venables (2016) whereby economic impact is assessed by empirical evaluation of the known mechanisms by which transport interventions impact the wider economy.

3.5 **Literature Review: Summary of Findings**

In summary, there is a lack of detailed data available for Nottingham to support the application of empirical approaches discussed in section 3.2 which examine the causality of neo classical and institutional location determinants (including transport interventions) to business location decisions. Furthermore such approaches seldom include behavioral determinants which have been shown to be important in business location decisions. An alternative is presented in Section 3.3 which instead of examining business location uses micro economic CBA or macroeconomic approaches which link transport interventions to economic benefits in the wider economy. The assumption is thus that an ability to attract inward investment would be an essential ingredient for realising these economic benefits. While CBA has been used to examine ex-post monetarised benefit of transport interventions, the Nottingham WPL business case stressed the importance of the expected wider economic benefits of the WPL package thus a CBA would not be appropriate for this research. While macroeconomic approaches seek to include these wider economic benefits they have a limited ability to take into account forward linkages in the economy over time and limitations with respect to the consideration of contextual factors and causality beyond statistical correlation.

Given the practical consideration of data availability coupled with limitations of the approaches outlined in sections 3.2 and 3.3 an evaluation frame work based on a ToC as presented in section 3.4 would provide a more flexible approach capable of incorporating empirical and qualitative evidence. The literature reviewed above suggests that this approach could take into account temporal contextual changes and provide a means of attributing observed change to the elements of the WPL Package. These advantages have led to Theoretical Evaluation approaches being recommended by both the UK DfT (and the UK Treasury in guidance for the evaluation of major transport schemes (DfT 2013) (HM Treasury 2011). A ToC approach incorporating elements of RE has therefore been chosen to facilitate this research.

4.0 Method

As discussed above in section 3.5 it was determined that the evaluation of the WPL package including its economic impacts should be based around ToC framework which also identifies the principal mechanisms of change. It should also draw on other approaches including importantly a quasi-experimental element. While a more empirical approach may appear attractive for individual interventions such as NET Phase 2, the lack of data, the scale and diversity of the WPL Package along with the extended time period over which it will be implemented means any evaluation approach must be sufficiently flexible to allow for the use of multiple imperfect evidence sources and be able to take into account both temporal contextual changes and achieve attribution of cause and effect. Tables 1 and 2 present relevant contextual factors and mechanisms of change that have been identified. Figure 1 incorporates both the mechanisms and contextual factors into a logic map which illustrates the proposed ToC.

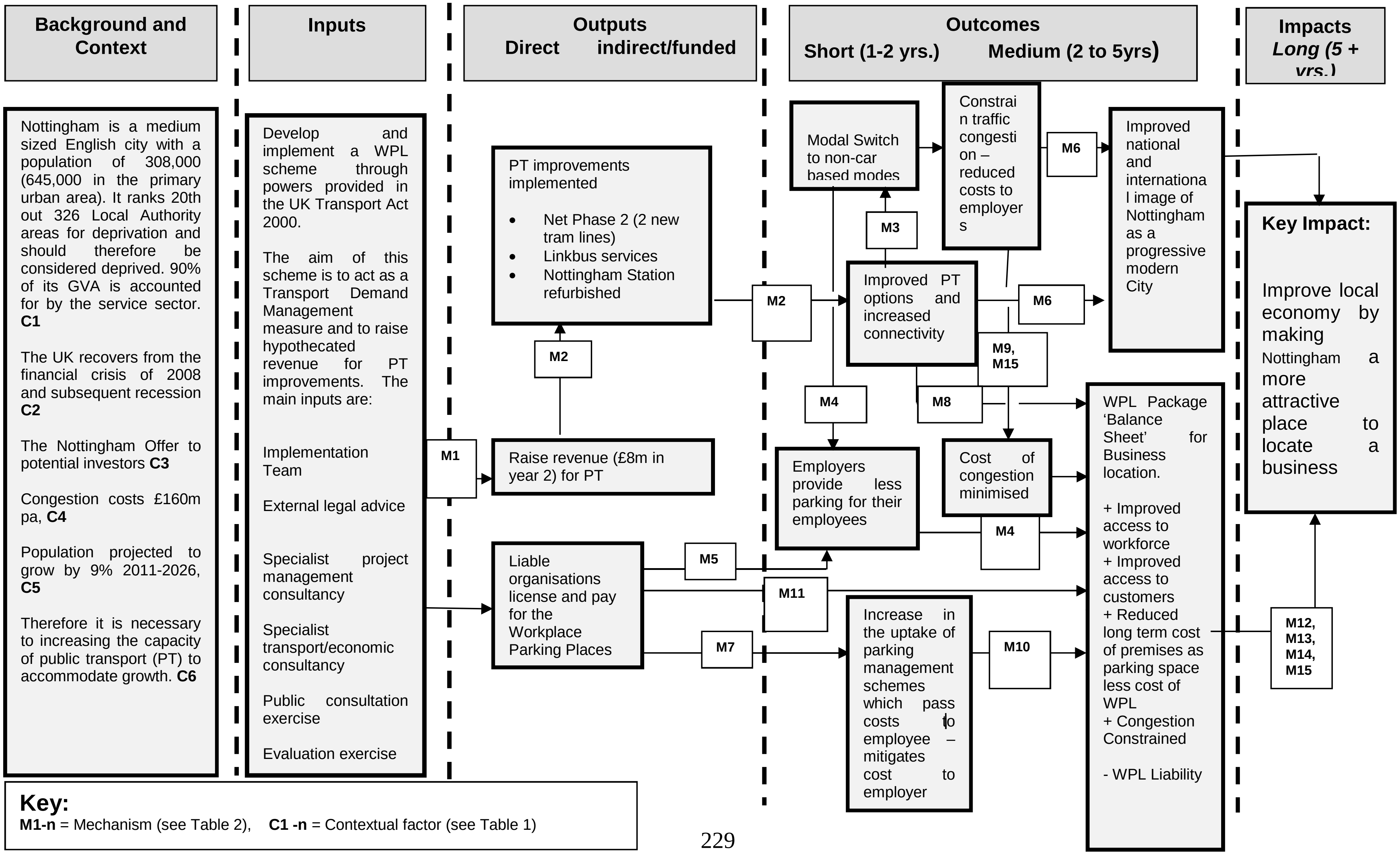
Table 1 Contextual Factors that could impact on the Economic Objective

	Context	Description
C1	Socio-economic characteristics of Nottingham	Nottingham is a medium sized English City with a population of 318,900 (695,300 in the whole conurbation). It ranks 20th out of 326 Local Authority areas for deprivation and contains pockets of high deprivation. 90% of its Gross Value Added (GVA) is accounted for by the service sector. (NCC 2015)
C2	National Economic Conditions	Most macro-economic indicators show that the WPL package is being implemented in a period when the national economy is emerging from recession.
C3	The Nottingham Offer	Key operational costs are lower in Nottingham than other comparable Cities in the UK, with office costs being at £19.00 per sq. ft. for Grade A office space (compared to £35-40.00 in Birmingham and Manchester, £30.00 in Leeds, £25.00 in Milton Keynes and £25.00 in Cardiff) and salary costs on average 10% lower than the national average (Lambert Smith Hampton, 2014) – these are the main costs that a business will focus on when deciding on a new location and are key in terms of what Nottingham has to offer as a location.
C4	Existing Congestion Problem	Nottingham City Council estimates that congestion, mainly in the AM and PM peak period, costs the City's economy £160m pa (EMDA 2007). This will manifest as a cost to business in lost time, increased transport costs, difficulties in access for qualified workforce, etc.
C5	Presumption of Growth	Population projected to grow by 9% 2011-2026 (NCC2015).
C6	Lack of existing public transport capacity to meet demand for travel generated by growth	Congestion levels currently show roads at capacity at key junctions. Extra capacity must be provided by achieving mode switch and providing extra PT capacity to cater for that.
C7	Availability of Commercial Premises	Currently there is a chronic shortage of large high quality commercial premises in Nottingham while rental values are not high enough to stimulate new build.

Table 2 Mechanisms for Change to achieve the Economic Objective

	Mechanism
M1	WPL raises hypothecated revenue for public transport improvements.
M2	Hypothecated revenue part funds major public transport improvements, for every £1 the WPL raises it brings in £3 of UK Government funding.
M3	Combination of increased cost of parking at or close to work and better PT options decreases demand for commuting by car.
M4	Less need for employers to provide parking. Improved PT reduces the need for employers to provide car parking places thus reducing the potential cost of a site.
M5	Employers provide less parking in order to reduce their WPL liability.
M6	Modern public transport system enhances Nottingham's image as a modern City thus making it more attractive as a business location.
M7	Employers introduce parking management schemes which pass on the cost of WPL to their employees.
M8	Increased PT capacity/efficiency makes Nottingham more attractive as a business location due to improved access to labour and customers leading to agglomeration economies, increased labour productivity.
M9	Transport Demand Management effect of the WPL package reduces cost of congestion to businesses making Nottingham more attractive as a business location.
M10	Parking management schemes pass burden of WPL to employees, WPL becomes cost neutral for employers.
M11	Increase in cost of operating a business in Nottingham. The WPL charge is absorbed by employers thus placing an additional cost burden on local businesses which risks a reduction in inward investment.
M12	Agglomeration economies associated with quicker journey times and reduced production costs
M13	Labour Force Effects – shorter commutes leads to an increase in quantity and quality of labour and associated productivity improvements
M14	General Equilibrium Effects – improved access to jobs for existing labour force.
M15	Reduced production Costs – Time savings from congestion constraint reduce the costs of production

FIGURE 1 Logic Map for Workplace Parking Levy Scheme Objective 5; Enhance The Attractiveness Of Nottingham As A Location For Business Investment



This ToC is based on the above literature review, The 2008 WPL Business Case (NCC 2008) and stakeholder input. This approach includes elements of RE in order to strengthen the ToC. In order to test the ToC, a wide basket of indicators are required including at least one of which provides attribution of observed changes in the indicators to the WPL Package. This is because there is no single economic indicator available that can definitively demonstrate that the WPL package has achieved its economic objective. However, the indicators can be triangulated against each other and, if the majority of indicators move in the direction suggested by the ToC and cross validate one another, then it should be possible to draw a balance of probability conclusion.

In order to strengthen this approach four comparator Cities; Leicester, Liverpool, Newcastle upon Tyne and Sheffield, have been chosen to benchmark macroeconomic indicators. These were chosen based on their geographic and socio-economic similarities with Nottingham.

The indicators can be roughly divided into high level macro-economic indicators and more specific local indicators which track inward investment.

4.1 Macro-economic indicators

There are 3 macro-economic indicators; jobs located in Nottingham, economic output and business births and deaths. All three are high level indicators of an area's economic health and as the data is available nationally by Local Authority Area it is possible to benchmark against the four chosen comparator Cities. While a better performance than those comparator Cities would be expected given the proposed ToC, such a performance is not necessarily attributable to the WPL Package without further evidence, because of the contextual differences between the Cities.

Employment levels in Nottingham

The number of jobs generated within Nottingham City is reflective of the amount of investment that employers make in the City area. Hence, this is a key economic indicator for this evaluation and a differential rise when compared to the comparator Cities would be expected given the proposed ToC. The data for 2008 to 2013 are supplied by the Office for National Statistics (ONS).

Economic output

Gross Value Added (GVA) is the normal indicator for tracking regional economic output. The data is available from the ONS by Local Authority Area. A rise in GVA is indicative of a growing local economy and while not the only cause, a healthy level of inward investment is often the driver of such growth.

Business births and deaths

The ONS compiles records of business registrations and de-registrations based on VAT records. The data is available by Local Authority Area and nationally and is contained in an annually produced dataset, the latest of which is "ONS Business Demography 2014".

However, for monitoring the effect of the WPL, this data is of limited value, because only a small proportion of the total business population is liable to pay the WPL. This data does not differentiate business size, either in terms of the number of parking places, or employees. Therefore, a change in the number of VAT registered businesses cannot necessarily be linked to the WPL. The churn in smaller businesses is much larger than that of larger WPL liable businesses, thus change in these small non WPL liable businesses is likely to mask any WPL related trends. However, this indicator is still useful as a measure of the economic health of the City. If the ToC is correct one would expect that it should at least keep pace with the comparator Cities, all contextual factors being equal.

4.2 Specific Indicators of Levels of Inward Investment

The three macro-economic indicators provide an overview of the economic health of the City and as benchmarking data is readily available, Nottingham can be compared to other similar Cities. However, in view of the often cited criticism of WPLs, i.e. that they could damage inward investment, it is important to consider inward investment specific indicators.

- Level of inward investment enquiries to the Municipal Authority
- Level of activity in the commercial property market in Nottingham
- Case studies of inward investment and de-investment decisions

The case study data is particularly important as this is the main indicator that provides attribution between the WPL package and the other economic indicators.

Level of inward investment enquiries

Nottingham City Council (NCC) has an internal team dedicated to working with employers interested in investing in Nottingham. This Inward Investment Team maintains a record of the level of enquiries which they receive and the number of those which end with successful inward investment. Tracking this data year on year will be indicative of the level of investment in the City. This data is limited to those investors that choose to contact NCC and thus this indicator must be assessed against the other indicators as the percentage sample of the total population is unknown and sample bias cannot be ruled out.

Level of activity in the commercial property market

A healthy commercial property sector is symptomatic of a buoyant inward investment landscape**.** Commercial property market activity measured by the volume of agreements completed on commercial property rental has been chosen to evaluate this. In general, the higher the volume of new rental agreements, the more positive for the economic objective. Thus, a rise in the volume of new rental agreements would support the ToC. However, this may not occur continuously as it is constrained by the quantity and size of the stock of commercial premises (C7 see Table 1). An under supply of commercial premises would constrain the indicator. The data is supplied by commercial estate agents via the Nottingham Office Review (Lambert Smith Hampton, 2014).

Examples of inward investment and de-investment decisions

These examples explore the reasoning behind important investment or de-investment decisions that have been managed by the City Council's Inward Investment Team. It gives an understanding of the causal factors which influence these decisions, including the role played by improving public transport options and the WPL. The purpose of this indicator is not to quantify the number of investment and dis-investment decisions (which is more comprehensively covered by the other indicators), but rather to provide evidence as to whether the changes observed in those indicators are attributable to the WPL package. The examples have been compiled based on the accounts of Nottingham City Council officers responsible for handling each relevant 'account' and are based on their experience and opinion rather than specific data supplied by the businesses themselves. The officers were responsible for negotiating and assisting each investor or dis-investor and were asked to comment as to whether the WPL or enhanced public transport was a minor or major factor in the investment decision. The reporting officers were also asked their views on the reasoning behind the decision. It is necessary to anonymise the examples for reasons of commercial confidentiality.

Major investments and disinvestments are relatively infrequent, thus there are only 10 examples known to Nottingham City Council since 2013. However, it is likely that this does represent the majority of all such decisions made by larger employers.

5.0 Findings

5.1 Macro-economic data

Jobs located in Nottingham

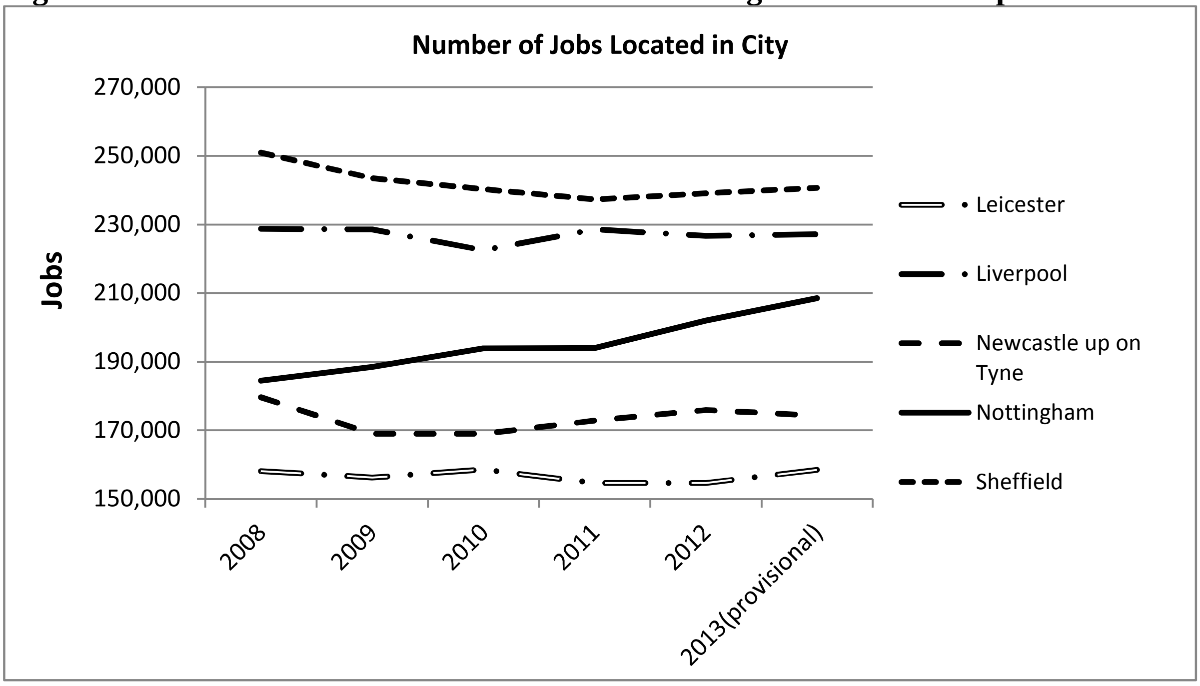
Table 3 and Figure 2 present a time series of data showing the number of jobs in Nottingham and the comparator Cities. The number of jobs in Nottingham increased by 7.5% between September 2010 and September 2013, which compares favourably with the situation in all four comparator Cities and England as a whole. This indicator has been cross validated against employment rates in the Cities.

Table 3: Number of Jobs Located in Nottingham and Comparator Cities.

City	Number of employees based in City administrational area						%Change 2010-13	%change 2012-13
	2008	**2009**	**2010**	**2011**	**2012**	**2013***		
Leicester	158,100	156,300	158,600	154,700	154,700	158,500	-0.1	2.4
Liverpool	228,700	228,600	222,500	228,600	226,700	227,200	2.1	0.2
Newcastle	179,600	169,000	169,000	172,800	175,900	174,300	3.2	-0.9
Nottingham	**184,500**	**188,500**	**193,900**	**194,000**	**202,000**	**208,500**	**7.5**	**3.2**
Sheffield	250,900	243,500	240,300	237,300	239,100	240,700	0.2	0.7

Source: Nottingham City Council (NCC) from the Office for National Statistics (ONS) 2014.
* = provisional

Figure 2 Numbers of Jobs Located in Nottingham and Comparator Cities



Source: NCC from the ONS 2014

Table 4 shows that the employment rate data broadly agrees with the jobs data with Nottingham seeing the highest rate of growth since 2010/11. This data also, however, reveals that Nottingham's employment rate was hit harder by the recession than the other comparator Cities, dropping by 8.2% between 2008/9 and 2010/11. That said it has since rebounded to a level fractionally below that in 2007/8. Only Sheffield has managed a similar performance while the other comparator Cities are still significantly below their 2007/8 levels. This data shows a positive differential growth in jobs compared to the comparator Cities and thus supports the ToC.

Table 4 Percentage employment rates in Nottingham and Comparator Cities

Year	Leicester	Liverpool	Nottingham	Newcastle	Sheffield
2007/8	65.7	63.5	**60.9**	63.2	69.4
2008/9	62.8	57.7	**61.8**	63.5	68.8
2009/10	62.0	60.2	**56.8**	59.9	65.7
2010/11	61.7	59.8	**53.6**	64.3	66.4
2011/12	62.0	59.6	**59.6**	63.0	64.0
2012/13	61.9	60.0	**59.1**	60.8	69.2
2013/14	61.2	61.2	**60.3**	60.6	69.0
% change 2010/11 to 2013/14	-0.5	1.4	**6.7**	-3.7	2.6

Source: NCC from the ONS, 2014

Economic Output

Table 5 shows that economic output increased in Nottingham at a faster rate between 2010 and 2012 than the average for the four comparator Cities. However, the provisional data for 2013 shows that GVA reduced slightly in Nottingham. This is considered an odd outcome as it contradicts both the local and comparator time series.

Table 5 GVA in Nottingham, Comparator Cities and England

City	2008	2009	2010	2011	2012	2013 (provisional)	% Change 2010-13
Leicester	6,044	6,013	6,194	6,368	6,552	6,873	11.0
Liverpool	9,630	10,620	10,532	10,427	10,512	10,646	1.1
Nottingham	7,900	7,953	8,402	8,633	8,774	8,726	3.9
Sheffield	9,899	10,150	10,529	10,506	10,922	11,199	6.4
Tyneside	15,511	14,877	15,509	16,657	16,650	17,181	10.8

Source: ONS 2014

It also contradicts the increase in jobs and employment, although it does not necessarily follow that if employment rises then so must GVA – it would depend on the nature of that employment. Until the 2013 data is finalised it would seem prudent to treat it with caution. It is important to wait and see if the 2013 provisional figure is confirmed prior to drawing a conclusion as to whether or not this indicator is supportive of the ToC.

Business Births and Deaths

Table 6 presents a time series showing the percentage change in the balance of businesses VAT registered in each calendar year. In 2010 all Cities experienced a similar level of net loss. However, in 2011 only Nottingham City and Sheffield were still experiencing a small net loss, subsequent data for 2012 shows that Nottingham has returned to a situation of net growth. Nottingham City would, therefore, appear to be "rebounding" more slowly than the surrounding areas and most of the comparator Cities, following a significant slump in 2009 when the whole of the UK was in recession. However, this conflicts with the data for employment which shows Nottingham recovering, if anything, faster than the other comparator Cities.

Table 6 Percentage change in VAT registered businesses for Nottingham, Greater Nottingham and Comparator Cities

City	2008	2009	2010	2011	2012	2013
Leicester	2	-2.6	-2.4	2.1	1.1	7.4
Liverpool	2.8	-2.9	-1.7	0.4	0.3	7.5
Newcastle	3.2	-1.9	-1.1	1.8	1.1	5.0
Nottingham City	0.9	-2.4	-2.0	-0.1	0.2	4.9
Greater Nottingham	1.2	-2.5	-1.7	0.2	-0.4	4.2
Sheffield	-0.7	-3.4	-2.7	-1.1	-1.2	2.6

Source: ONS Business Demography and NCC, Nov 2014

Additionally, it should be noted that Nottingham City shows a relatively strong performance in 2012 and 2013 compared with Greater Nottingham suggesting growth has been concentrated in the City area. According to the ToC a modest rise in enterprise growth would be expected which at least tracked that of the comparator Cities. At present the performance falls short of this, but it is noted, as explained above, that this indicator may not be directly related to the WPL package.

Synthesis for Macro-economic indicators

Nottingham shows a relatively strong performance in terms of job creation when compared to the comparator Cities while the situation concerning economic output and new business creation is more ambiguous. As noted above the Business Births and Deaths may not be a direct indicator for the WPL package due to the propensity for the data to be skewed towards small businesses which do not pay the WPL. Economic output is also subject to many opaque contextual factors.

5.2 Inward Investment Indicators

Commercial property market activity

Table 7 shows the commercial property market activity in Nottingham from 2011 to 2013

Table 7 Commercial property market activity in Nottingham

Floor space Sq. ft.	Year	Number of agreements completed on rental of commercial property
251768	2011	42
241900	2012	43
190789	2013	50

Source: Nottingham Office Review 2014

This shows that the number of new rental agreements was similar in 2011 and 2012, but they have risen in 2013. However, the total floor space involved in those agreements has declined since 2011. The increase in the number of new rental agreements reflects activity in the market by small and medium sized enterprises (SMEs). A growing important contextual factor for this indicator is a scarcity in the supply of good quality large properties and this has driven down the floor space involved overall in the last two years. This reflects that the larger indigenous businesses are in general staying in place. Overall, it is concluded that this indicator, given the context of an under supply of large commercial premises is tracking in accordance with the ToC and is, therefore, indicative of good progress towards the economic objectives of the WPL package.

Level of Inward Investment Enquiries to Nottingham City Council

Table 8 tracks the level of enquiries and subsequent successes since 2008/9. There is no evidence to suggest that the level of either inward investment enquiries or successes has fallen since the introduction of the WPL in 2011/12. Indeed, while one must be cautious in the absence of any counter factual data or meaningful benchmarking, it appears that 2012/13 and 2013/14 were the strongest years since 2008/9 for attracting inward investment.

Table 8 Enquiries to the Inward Investment Team and subsequent successes

Year	Enquiries	No. of successes	% Successes	Jobs created
2008/9	91	3	3.3	360
2009/10	156	5	3.2	85
2010/11	110	2	1.8	85
2011/12	146	5	3.4	65
2012/13	175	8	4.6	897
2013/14	176	15	8.5	301

Source: NCC, Nov. 2014

While this must be viewed in the context of a national economy emerging from recession and thus one would expect to see resurgence in inward investment, the magnitude of the increase from 2011/12 seems disproportionate suggesting additional mechanisms may be active.

Additionally, the percentage of enquiries which go on to become an actual investment have increased from 2010/11 perhaps showing that Nottingham is becoming a more competitive location.

This indicator suggests good progress towards achieving this objective and agrees with the ToC. However, in order to attribute this to the WPL package it will be necessary to examine the case study data concerning investment and disinvestment decisions.

Inward Investment Examples

Table 9 present five examples of employers who have either, moved into the City, or who are existing indigenous employers who have chosen to consolidate to premises within Nottingham rather than relocating elsewhere. Table 10 represents 5 examples of employers who have moved out of Nottingham. It should be stressed that this is the sum of all examples known to NCC (November 2014).

Table 9 shows that for 3 out of the 5 major investments, public transport (PT) connectivity was a major factor attracting these employers to locate in Nottingham. Two of these are located in the City Centre while the other is located in a business park within which a tram stop is now located as part of NET Phase 2. Interestingly, in one case, the WPL was a discussion point between Nottingham City Council and the employer, however, this issue was overcome by supporting the employer to minimise their liability for the WPL charge via reducing the demand for parking by providing workplace travel planning for staff. A further example indicates that public transport connectivity was a minor factor.

Table 10 shows 5 cases where businesses have moved out of Nottingham. Two cases cited the WPL as a contributory factor and in both cases this was considered as a minor factor. The principal drivers for both of these relocations were related to the suitability of the premises. In one case the lease expired on their current site which was no longer fit for purpose which combined with moving nearer to the majority of their workforce and consolidating their business into one site. The other business where the WPL was a minor factor moved out of their existing premises as a result of the growth of their business requiring larger premises which were found just outside Nottingham. The largest employer to leave was undergoing an international restructure related to a declining worldwide market and chose to move all its manufacturing away from the UK.

The above data supports the Theory of Change as it indicates that, while the cost of WPL is an extra cost to some businesses, it is such a small percentage of turnover that it plays a very small part in location decisions. Outweighing this it appears that businesses consider access to an efficient public transport network as an important factor when considering a potential location. Whilst cost is a significant factor when choosing a new location or considering remaining and re-investing in a location, the above evidence suggests that the additional cost of WPL does not present a barrier for a company.

Table 9 Summary of examples of Major Inward Investments

Type	Improved PT a factor	Size of employer	Stated reasons for decision	Notes
New business to the City	Major	Medium	Close to suppliers, access to workforce, PT connectivity	Moved to Nottingham despite other options elsewhere in Nottinghamshire, the UK, and Europe. Good PT access to site was an important requirement thus car parking and the WPL became a minor consideration
New business to the City	Not at all	Large	Close to suppliers, close to customers	Access to workforce and customers were key locational factors. WPL was a factor, but was mitigated by discussion with NCC via workplace travel planning support
Consolidation of indigenous business	Major	Large	Access to workforce, PT connectivity	Consolidated multiple Nottingham sites into City Centre location, access for workforce by PT critical
New business to the City	Minor	Medium	Availability of suitable property, PT connectivity	Company based on Business Park outside the City. The lease expired due to redevelopment of their site. They identified a premises located in the City which offered them proximity to transport links, a suitable premises and some parking. They have bought the building.
Consolidation of existing indigenous business	Major	Large	Access to workforce, PT connectivity	Expansion project as company consolidates a number properties into a large City building, ease of access for staff, ease of operation with single site in City.

Employer Size Key defined by number of jobs affected; 1-99 = Small, 100 – 199 Medium, Large 200+

Table 10 Summary of examples of major decisions to relocate away from Nottingham (disinvestment)

WPL factor	Employment implications	Stated reasons for decision	Notes
Not at all	Large	External pull factors	Down-sizing and moving all manufacturing out of UK
Not at all	Medium	External pull factors	Consolidating multiple East Midland's sites into one site. Business was car based so access to national and regional road network paramount, as was a central location
Minor	Small	External pull factors WPL	Consolidating into one site, current site not fit for purpose, WPL cited as a factor, half of staff were not Nottinghamshire based
Minor	Medium	External pull factors WPL	Company growth triggered seeking alternative premises. WPL was mentioned as a factor for the relocation outside of the City. However, greater weighting was given to the need for suitable premises that could provide office and warehousing for products and such a site was difficult to locate in Nottingham.
Not at all	Medium	External pull factors	Relocation to office in another City with some redundancies. Triggered by Nottingham office lease renewal and move to more flexible working arrangements.

Employer Size Key defined by number of jobs affected; 1-99 = Small, 100 – 199 Medium, Large 200+

When new investors are comparing Nottingham to other comparable Cities, the fact that Nottingham remains cost competitive, despite the small additional cost of the WPL, means that it is still considered. Nottingham offers lower property and labour costs (the two largest operational costs for a business) when compared with cities such as Bristol, Milton Keynes and larger Cities such as Leeds and Manchester which ensures that it remains competitive.

Synthesis for Inward Investment indicators

The findings from the investment examples appear to agree with both the other two inward investment indicators, commercial property market activity and the level of inward investment enquires, which show significant increases in inward investment interest in Nottingham in the last two years. The purpose of the investment examples is to attribute the changes observed in the other two micro-economic indicators to the WPL package elements.

Some attribution has been demonstrated in that 3 out of 5 investors quote public transport connectivity as an important factor in the decision to locate in Nottingham. However, this observation is caveated in that it is based on a small number of case studies.

6.0 Discussion

Table 11 summarises the movement of the indicators and compares this to what is predicted by stakeholder consensus within the Theory of Change. The magnitude of each change is merely described as large, small or none, any attempt to provide a numerical figure would be spurious as there is not enough existing data from similar interventions to accurately predict this. A similar approach is taken for differential change to the comparator Cities for the macro-economic indicators.

Table 11 is helpful when considering the triangulation of the indicators in order to gain an overall understanding of the effectiveness of the WPL Package in meeting the economic objective. The number of jobs located in Nottingham, the number of investment enquiries, the level of activity in the commercial property market and crucially the case study evidence all agree with the proposed Theory of Change in terms of both magnitude and direction.

However, the provisional 2013 GVA data for Nottingham and the net balance of Business Births and Deaths are more ambiguous and cannot at this stage help to strengthen the ToC. However, as this data is either provisional or less directly linked to the WPL than the other indicators, they are not, at this stage in the evaluation, a major cause for concern with regards to the veracity of the ToC. However, they must be continued to be monitored and further research is required to understand a continuing trend counter to the ToC.

The ToC highlights an expectation that in the long run efficiency savings in the wider economy will be derived from agglomeration effects, increased labour force productivity and other general equilibrium effects brought about by an enhanced public transport system (Hensher 2012, Lakshmanan 2011). It is possible that the strong performance from the inward investment indicators is the first sign of these effects kicking in, however it may be some time before these effects can be demonstrated as at this point in time the major transport infrastructure improvements have not had time to fully activate these mechanisms.

Table 11 Indicator trajectory and magnitude: As predicted by the ToC and Actual

KEY

⬆ ⬇	= Indicator increases/decreases at a greater rate than comparator City average <u>or</u> shows a disproportionate increase/decrease than the time series trend	⇧ ⇩	= Indicator increases/decreases, but not at a faster rate than the comparator Cities nor at a rate that demonstrates a departure from the time series trend.

Indicator	Change in indicator 2010/11 to 2013/14		Movement Relative to Comparator City Average from 2010	Comment
	Predicted	**Actual**		
Jobs located in Nottingham	⬆	⬆	**Greater**	Job creation and economic output is directly associated with a buoyant inward investment market. The ToC predicts a strong growth in these indicators as the WPL package combines with C2, an improving national economic situation.
Economic Output	⬆	⇧	**Greater** - up to 2012. 2013 data is provisional but shows small reduction in GVA in Nottingham but not the comparator Cities	
Business Births and Deaths	⇧	⇧	**Less**	Only weakly linked to level of inward investment as data is dominated by smaller business start-ups and failures.
Commercial property market activity	⇧	⇧	No comparable data available	An increase would be the predicted by the ToC, however, there is a finite amount of premises (C1) so the magnitude could be limited.
Inward Investment Enquiries and Successes	⬆	⬆	No comparable data available	The ToC predicts a large increase as the impact of the WPL package combines with C2, an improving national economic situation.
Case study data	Employers being attracted to Nottingham due to good PT connectivity. Few, if any, de-investors cite WPL as a significant factor	AS PREDICTED; 3 investors cite PT as major factor and 1 as a minor. 2 de-investors cite WPL as minor factor	No comparable data available	The ToC predicts that this should show evidence that the WPL is either, not a factor in dis-investment decisions, or a very minor one, while there should be a number of instances where businesses cite good public transport connectivity as a major reason for their location decision.

7.0 Conclusions

Considering the data and analysis presented in the previous section it can be seen to what extent the data shows that the indicators are moving in the direction and magnitude that would be expected according to the ToC and thus, how well the Nottingham WPL Package is achieving the intended economic impacts.

The number of jobs based in Nottingham has seen strong and sustained growth and suggests that Nottingham has fared better than average when compared to other comparator Cities. This supports the veracity of the ToC and, despite ambiguous performance on economic output and net business registrations, it is concluded that there is no observable negative effect on overall macro-economic performance associated with the introduction of the WPL.

The level of commercial property market activity and the number of inward investment enquires and subsequent successes have shown strong growth in 2012/13 and 2013/14 and also support the veracity of the ToC. The investment examples collated so far suggest that the WPL is a relatively minor consideration when businesses make investment decisions, while the availability of good connectivity to public transport has been a strong attractor to at least three major inward investments in this period. Where the WPL has been cited as a factor by a potential investor it has been shown that they can be persuaded that the cost can be mitigated by the business support measures put in place by Nottingham City Council and funded by the WPL. The above conclusion fits well with the Theory of Change that has been developed for this objective, but more case study data is required to confirm these observations.

When all the economic indicators are triangulated it is possible to conclude that:

- There is strong evidence that the WPL is having no significant negative impact on inward investment. This is supported by case study evidence that suggests that the WPL plays a very small role in business location decisions.
- The strong growth in employment combined with a positive movement in the inward investment specific indicators suggests that Nottingham is relatively attractive to potential investors. There is positive evidence from case studies of 5 major inward investments that the public transport improvement components of the WPL package are playing a role in this.
- Overall, while not yet conclusive, the evidence suggests that, on the balance of probability, the WPL package is making good progress towards this objective with the majority of chosen indicators moving in the direction and magnitude that would be expected given the agreed Theory of Change.

The economic performance of a large City and relating this to any single intervention is always difficult as is demonstrated by the lack of literature pertaining to successful evaluations. The use of pure statistical techniques is dogged by a complex web of dependent variables while no single independent variable can truly be said to demonstrate success.

The approach taken in this paper demonstrates a way of tackling this problem that is open to most practitioners and, while the authors do not pretend that it will be possible to prove a position beyond all reasonable doubt or within some pre-determined statistical margin, it is suggested that a reasonable balance of probability case has been presented by intelligent consideration of the available data which most stakeholders can agree is valid.

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APPENDIX D PAPER 4

EVALUATING THE IMPACT OF A WORKPLACE PARKING LEVY ON LOCAL TRAFFIC CONGESTION: THE CASE OF NOTTINGHAM UK

Dale, S. J., Frost M.W., Ison S. G., Quddus, M. and Warren, P., 2017, Evaluating the impact of a workplace parking levy on local traffic congestion: The case of Nottingham UK, *Transport Research Board 96th Annual Meeting Compendium of Papers 2017 DVD.* Washington: Transportation Research Board.

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ABSTRACT

A Workplace Parking Levy (WPL) scheme raises a levy on private non-domestic off street parking provided by employers. In April 2012 Nottingham became the first UK City to implement such a scheme with the revenue generated hypothecated for funding transport improvements.

The lag between the introduction of the WPL and the opening of related public transport improvements represents an opportunity to study the impact of a WPL on congestion as a standalone measure. In order to achieve this it is necessary to consider changes to variables external to the WPL, which also impact on congestion, which may obscure any beneficial impact of the scheme. An autoregressive time series model which accounts for the impact of these exogenous variables is used to evaluate the impact of the introduction of the WPL on congestion. Delay per Vehicle Mile is used as the dependent variable to represent congestion while the number of Liable Workplace Parking Places (LWPP) is used as a continuous intervention variable representing the introduction of the WPL. The model also contains a number of economic, transportation and climatic control variables.

The results indicate that the introduction of the WPL as measured by the number of LWPP has a statistically significant impact on traffic congestion in Nottingham. Additionally, external explanatory variables are also shown to impact on congestion, suggesting that these may be masking the true impact of the scheme. This research represents the first statistical analysis of the link between the introduction of a WPL and a reduction in congestion.

1 INTRODUCTION

In April 2012 Nottingham City Council introduced a Workplace Parking Levy (WPL) which levied a charge on occupied private non-domestic off street parking places. These are termed Workplace Parking Places (WPPs) and are defined as places occupied by vehicles used by employees, regular business visitors or students/pupils. It is the first charge of its type in the UK and indeed, in Europe.

The WPL has a dual role; firstly to act as a transport demand management measure and secondly to raise hypothecated funds for transport improvements. The money raised by the WPL is funding two new tram lines (NET Phase 2), improvements to Nottingham Railway Station and quality enhancements to the LinkBus services. The WPL scheme and the above mentioned public transport improvements comprise the overall "WPL package" and are intended to complement each other to enhance the transport demand management effect. For the 2016/17 financial year the charge per WPP is £379.

The aim of this paper is to report, *for the first time*, on a statistical evaluation of the impact of the introduction of the WPL on levels of peak period congestion in Nottingham. Hamer et al. (2009) noted that such schemes are seldom introduced in isolation which makes it difficult to isolate the impact of the charging scheme from that of other transport improvements or traffic restraint measures. However, the research detailed in this paper takes advantage of the opportunity to study the stand alone impact of the WPL by examining the time period from 2010, when employers started to take pre-emptive action to reduce their liability for the provision of WPPs, up to 2015 when the principal public transport intervention of the WPL package, NET Phase 2, was completed.

The paper explores the relationship between City wide levels of congestion, the introduction of the WPL and important explanatory variables, including the key contextual factors that may obscure any impact of the introduction of the WPL. In order to achieve the above aim this research utilises a statistical approach to compare relevant time series data which provides an assessment of the relative impact on congestion of these variables.

The paper is structured as follows. A literature review is followed by the methodology section which details the application of a statistical approach to assess the impact of the supply of workplace parking on traffic delay. The results of this research are then presented and discussed. Finally, the conclusions are presented, including limitations and a suggested direction for further research.

2 LITERATURE REVIEW

In order to meet the above research aim it is necessary to understand how to define and measure congestion, what factors drive congestion, the impact that existing parking space levies have had on congestion and finally what statistical approaches have been used successfully for achieving similar research aims.

Defining traffic congestion

The UK Commission for Integrated Transport recommended that a measure of congestion be based on the difference between free flow speed and actual speed (DfT 2000). This indicator was more fully defined in the follow up report "A measure of road traffic congestion in England" (DfT 2000a). This concept has become known as delay. Taylor et al. (2000)

identified a number of measures and definitions for congestion including the congestion index which compares total travel time on a link as a proportion of expected free flow travel time. This can be averaged for all vehicles on a link per time period and can be applied on a segment or corridor level by aggregating the travel times for multiple segments to form full corridors or routes. This approach is useful when comparing levels of congestion across different geographic locations (Wang, 2010). However, neither average delay nor the Congestion Index takes into account traffic flow.

The UK Department for Transport (DfT) outlined a methodology to calculate journey time per vehicle mile to monitor congestion on locally managed A roads (DfT, 2011). This normalises journey time by link length and flow. US Department of Transport Guidance for measuring effectiveness for highway schemes defines a similar measure which calculates delay per vehicle mile travelled (US DoT, 2013) and combines the advantage of a spatially comparable metric and a real world unit of measurement. Delay per Vehicle Mile (DVM), therefore, combines the advantages of both the Congestion Index and Journey Time per Vehicle Mile and thus this is the measure of congestion used in this research.

Drivers of congestion

In Nottingham, the reality has been that, since 2010, congestion levels have increased and similar increases are observed in other UK Core Cities (Dale et al., 2013). Despite a fall in the supply of WPP and other positive changes in employer behaviour, it has not been possible to observe any impact the introduction of the WPL has had on congestion in Nottingham. It is therefore important to identify the key factors or 'drivers' which are likely to impact on traffic congestion and may obscure any beneficial impact arising from the introduction of the WPL. These contextual factors can then be taken into account within any potential research methodology.

Tanner (1983) presented research that examined factors that contributed to congestion; he demonstrated the importance of income levels, fuel price and economic output in determining the demand for travel. More recently, and specific to the UK context, Transport for London carried out a detailed review of factors which contribute to traffic speeds in London (TfL 2012). Their work presents a reasoned narrative that points to the importance of household income levels and the effect of reductions in network capacity as road space is re-allocated to public transport and cycling. It also notes that not only overall population change is significant, but that the nature of this change needs to be considered, for example changes in the demographics of the working age population may result in changes to levels of car ownership and propensity for car use.

The DfT identified three key drivers for the demand for travel in a report detailing their road traffic forecasting (DfT 2013): (i) population growth, (ii) GDP per capita/disposable income and (iii) the cost of motoring.

DfT (2013) also points out the importance of the availability of alternatives to using the car as well as the cost of those alternatives.

There are also factors which impact directly on congestion by impeding the speed of traffic or by reducing capacity (DfT 2015). The DfT identifies weather conditions as being an important factor, for example, wintery weather slows traffic and can influence mode choice, while increased rainfall is postulated as a causal factor for an increase in journey times in recent years. Jia et al. (2014) examined the impact of rainfall of various intensities on traffic speeds in differing urban situations in Beijing and concluded that the closer to capacity the link and the lower the intensity the rainfall, the less impact on speed. However, they still demonstrated that precipitation levels were a significant factor in reducing speeds in an urban setting.

The impact of Workplace Parking Levies on congestion

Although Hamer et al. (2009) and Richardson (2010) report on headline indicators related to the impact of the similar schemes in Sydney and Perth in Australia, there is little empirical research which specifically seeks to attribute an impact on congestion to the introduction of a WPL as a standalone measure. Hamer et al. (2009) concluded that the impact on congestion of the Sydney scheme was minimal while Richardson (2010) reports that the Perth Parking Space Levy (PSL) was associated with a significant mode shift away from the car and associated reduction in traffic levels on major radials.

Statistical Methodologies

A range of statistical methodologies have been employed to evaluate the relative impact of differing causal factors on travel demand. For instance, Hahn et al. (2002) used a least-squares regression model to investigate the relationship between congestion, travel demand and road capacity in US cities. They determined that freeway lane miles, population density, net land area and bus revenue miles could explain about 61% of the changes observed in congestion levels. A linear regression model may however fail to control for serial autocorrelation inherent to a time series observations. Quddus et al. (2007) utilised an alternative time series analyses capable of compensating for serial autocorrelation to study the impact of the introduction of the London Congestion Charge (LCC) on retail sales in London. They employed the Prais-Winsten regression model, a log-linear model with AR(1) disturbance, to explore the impact of a number of potential explanatory variables including a dummy intervention variable representing the introduction of the LCC.

Li et al. (2012) utilised difference in difference (DiD) estimation to analyse the effects of the introduction of the LCC on road traffic casualties. DiD estimation requires a control group (unlike the other techniques mentioned in this review) and for their study accident rates in Birmingham, Leeds and Manchester were used. This approach can therefore allow for national and local trends as well as seasonality. Cole et al. (2014) employed an Autoregressive Integrated Moving Average (ARIMA) model to investigate the impact on the yields of recyclable and non-recyclable waste of changes to collection schedules and policy. This model was able to quantify the success of the interventions analysed and to predict the impact of seasons and the number of working days on quantities of waste recycled.

It is concluded from the above literature review that a delay based metric normalised by both flow and road length would be the most appropriate measure of congestion as it allows for temporal and spatial comparison and is a ‘real world’ unit. The literature review reveals that economic/demographic factors, weather conditions, the relative cost of travel by each mode and changes to network capacity are key determinants in the changes to levels of congestion and that these need to be accounted for in any research related to congestion changes over time.

An examination of previous research which applies time series modelling techniques to similar research questions shows that ARIMA models and DiD estimation are both options. However, it may be appropriate to use the Prais-Winsten regression model with AR(1) disturbance, as this provides easily interpretable and flexible output. The following section outlines this chosen statistical approach.

3 DATA DESCRIPTION

As discussed in the previous section the chosen statistical approach requires a dependent variable, an independent intervention variable and relevant independent exogenous variables to be specified. The morphology of these variables and data quality determines both the final form of the model and the quality of the output, therefore, a full understanding of these is required.

The available datasets varied in terms of observation frequency from annual to daily data and thus scale effects need to be considered. It was decided that using weekly data provided a sensible level of aggregation as it provides a sufficient number of data points while avoiding the inherent variability of daily data. There could also be data sparsity issues with some of the data sets if daily data was used. There are thus 260 weekly values in each time series. If the data was aggregated to a monthly level this would reduce the number of observations to just 60 and this is considered sub optimal for the statistical approach adopted, especially if explanatory variables are included.

The Dependent Variable -The dependent variable quantifying congestion, Delay per Vehicle Mile (DVM) is collated across all major radial routes inbound into Nottingham and in both directions on the main orbital route the A6514 (the Nottingham Ring Road) in the AM Peak period (07:00-10:00) for cars and LGVs. The total length of the network used in this study is 68.2 miles. This metric is calculated using average journey time generated from the Trafficmaster satellite navigation system fitted to many fleet and private vehicles in the UK. This data source is also used by the DfT to generate national journey time statistics in preference to other similar data sources. The mean DVM value across the study period is 1.22 minutes.

Continuous Intervention Variable - introduction of the Nottingham WPL – The mechanism by which the introduction of the WPL is likely to impact the demand for travel is by a reduction in both the supply and demand for parking at work. It is assumed that the reduction in both is, for the period between 2009 and 2013, a direct result of introducing the WPL.

This can be quantified by the number of Workplace Parking Places (WPP) provided across the Nottingham City area. Unfortunately, the time series pertaining to total WPP, which includes exempt employers, is not complete and therefore could not be used, thus the quantity of Liable WPP (LWPP) is used as a continuous intervention variable. LWPP refers to WPPs which are liable to the full WPL charge (i.e. are not exempt or subject to a 100% discount).

There are two main sources of data which contribute to this time series:

1. The April 2010 Off-Street Parking Audit (OSPA) – this was a pre WPL survey of LWPP in Nottingham.

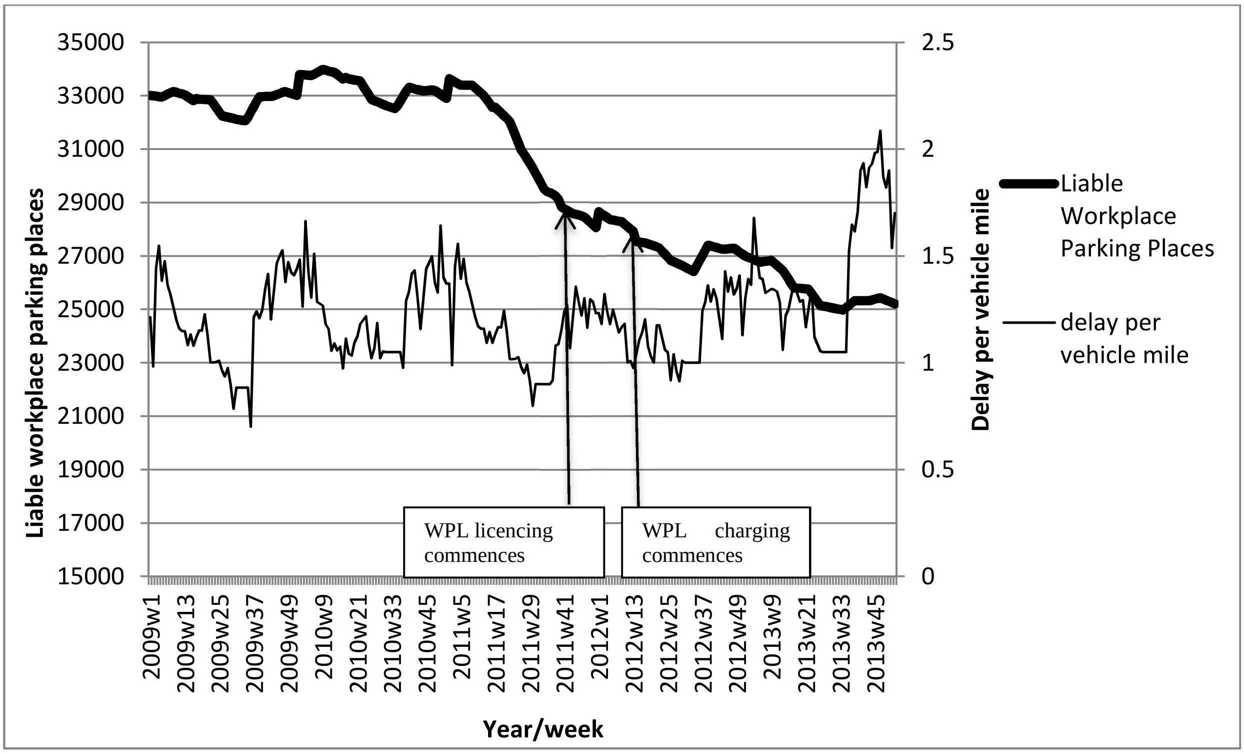
2. The number of LWPP licenced under the requirements of the WPL scheme.

As the supply of off-street parking is known to exceed demand, LWPP up to April 2010 is calculated based on the number of jobs located in the City using April 2010 as a reference.

Between the OSPA survey in April 2010 and the commencement of licencing in September 2011 it is assumed that the number of LWPP started to decline in response to the WPL 1 year prior to the introduction of licencing, but that the rate of decline increased the closer to the date of implementation. This assumption is supported by the chronology of actions taken by major employers to reduce their WPL liability as well as the programme of engagement undertaken by Nottingham City Council with employers to explain their responsibilities under the WPL scheme and to provide support in terms of limiting their liability. Therefore, the weekly values between the OSPA 2010 data point and first availability of licencing data in September 2011 have been estimated by using a non-linear interpolation which reflects this evidence. Finally, the seasonality observed in 2013 and 2014 was superimposed on the interpolated data prior to April 2012. The normal method of applying seasonal indices based on a moving average was used to achieve this.

Figure 1 shows the time series for the dependent and independent intervention variables. It is the nature of the relationship between these two time series and the introduction of the WPL which is the focus of this research.

FIGURE 1 Delay and Workplace Parking Places



Exogenous Independent Variables

These variables represent factors which, based on the literature review, are likely to impact on the dependent variable, DVM, but are external to the WPL intervention

They are:

- Monthly total rainfall

- Average minimum monthly temperature
- Working Age Population minus Total Benefit Claimants
- Index of road work activity
- Fuel price
- Season
- Public transport patronage
- Liable Workplace Parking Places (introduction of the WPL)

These variables are listed and specified in Table 1.

TABLE 1 Exogenous Independent Variables

Variable	Unit	Weekly average (2009-2013)	Frequency	Level of geographic aggregation	Time Period	Method used to synthesise weekly time series	Source	Notes and Justification for inclusion in model
Rainfall	mm	11.17	Monthly	Area	NA	Monthly total allocated to each week; see notes	Met Office Station at Sutton Bonnington	This is monthly precipitation in mm converted to weekly values. As discussed earlier, literature shows rainfall is linked to reduced traffic speeds. In order to allow for the differing number of weeks in each month the following method was used to divide up the monthly rainfall: RainMnth/(((365-28)/11)/7) , Except Feb which is calculated by: (RainFeb/4)
Average minimum temperature	deg C	6.12	Monthly	Area	NA	Monthly value applied to each week in that month	Met Office Station at Sutton Bonnington	This is an important as a proxy for wintery weather such as snow and ice which both slows traffic speed and reduces traffic flow.
Working age population minus Total Out of Work Benefit Claimants	persons	370337.46	Annual/ Quarterly	Greater Nottm	NA	Linear Interpolation	Office for National Statistics (ONS)	The working age population of Greater Nottingham rose steadily throughout the study period and this increase will potentially offset the impact of fluctuations in the number of out of work benefit claimants. It would therefore seem sensible to consider the total working age population that is not claiming out of work benefits. Note that data for Greater Nottingham is used for this metric.

Variable	Unit	Weekly average (2009-2013)	Frequency	Level of geographic aggregation	Time Period	Method used to synthesise weekly time series	Source	Notes and Justification for inclusion in model
Index of roadwork activity	numeric	1.34	Weekly	Greater Nottm	NA	NA	Nottingham City Council 2015	A road works index was compiled to quantify disruption to traffic caused by the construction phase of the following major transport improvements: • NET Phase 2; the construction of two new tram lines. • A453 Dualling • Major improvement scheme for the A6514 Nottingham Ring Road These were further subdivided by location and each element was rated out of three in terms of disruption to the network. The score for each week was then summed to create a weekly score.
Fuel Price	pence per litre of unleaded	124.26	Monthly	UK	NA	Linear Interpolation	http://www.petrolprices.com/the-price-of-fuel.html	It was decided that petrol prices were the most relevant cost of motoring as this is not a fixed cost and subject to short term market variations.
Season	Dummy Variable	NA	NA	NA	NA	NA	NA	This is a dummy variable

Variable	Unit	Weekly average (2009-2013)	Frequency	Level of geographic aggregation	Time Period	Method used to synthesise weekly time series	Source	Notes and Justification for inclusion in model
Public Transport Patronage	Journeys (millions)	1.44	Quarterly	Greater Nottingham	00:00 - 23:59	Quarterly figure divided by 13 and applied to each week in the quarter	Nottingham City Council 2015	Total combined quarterly bus and tram patronage in Greater Nottingham. This indicator is used to reflect the supply and relative cost of public transport options. It was not possible to synthesise a time series to reflect the local cost of public transport. due to complex ticketing arrangements.
Introduction of the Nottingham WPL	Liable Workplace Parking Places	29983.58	April 2010, then Sep 2011 then monthly from 01/04/2012	Nottingham City	NA	Non-linear Interpolation	Nottingham City Council 2015	Number of Workplace Parking Places in Nottingham which are liable for the WPL charge.

4 METHODOLGY

Having identified the relevant data sets that are available the next step was to consider the potential relationship between these variables in order to arrive at a testable hypothesis. Public transport patronage, working age population in work, fuel price, the time of year and the introduction of the WPL will all impact on Vehicle miles Travelled (VMT) by determining the demand for travel by car rather than directly acting on (DVM) i.e. congestion. Indeed, only the weather conditions and roadworks will impact directly on total delay by restricting capacity and/or introducing conditions that will physically slow the traffic. VMT and DVM are thus strongly related and it is likely that any time series model will highlight this were VMT to be used as an explanatory variable for delay (TfL 2012). This will not meet the research aim as it is important to know the relationship between congestion and those factors that impact on it by causing a change in VMT.

Figure 1 above shows superficially that a fall in the number of LWPP appears to correspond with a fall in DVM between late 2010 and early to mid 2012. However, it is also true that other external explanatory variables do show a trajectory which could also lead to a fall in DVM for example;

- The period 2011 – 2012 was relatively mild and dry.
- An increase in the number those claiming out of work benefit, i.e. a rise in unemployment.

However, the number of jobs located in Nottingham and the working age population continued to grow strongly throughout which would seem to support a steady growth in DVM over the period. Given these contradictory indicators, the following hypothesis will be tested by a suitable statistical model: *The fall in LWPP from 2010 and early 2012 has contributed to the observed reduction in DVM from late 2010 to mid 2012.*

There was a steep reduction in LWPP provision in the year prior to licencing and there has been a more gradual decline since. The steep fall in LWPP between 2010 and late 2011 can be validated by examining the behaviour of the larger LWPP providers on an employer by employer basis. This analysis shows that the largest 30 providers cut their WPP provision by 20% in that period.

As discussed in section 2, two statistical models that can be used to achieve the study aim are: Prais-Winsten regression and ARIMA models. A empirical analysis of the autocorrelation and partial autocorrelation functions indicates that an ARIMA model may not be essential if the Prais-Winsten regression model can handle serial autocorrelation in the time series of DVM. Therefore, the Prais-Winsten regression model has been chosen as the most parsimonious statistical model for this study.

Model Specification

Initially a simple linear-log model was employed given by

$$yt = \alpha + \beta_k Xt + \gamma lnLWPP_t + \theta_m Dt + \varepsilon t \qquad (1)$$

where, yt is the value of DVM, the dependent variable, for period *t* (in this case week t), X is a k vector of continuous explanatory variables some of which are logged, $LWPP$ is the continuous intervention variable that is expected to influence *DVM*, *D* is an m x 1 vector of categorical/dummy explanatory variables, ε is white noise. β, γ and θ are appropriately sized vectors of parameters to be estimated.

If the residuals from the above model are not normally distributed (by the use of Kolmogorov-Smirnov test) and there is a clear evidence of serial autocorrelation (by the use of Durbin-Watson *d*-test) in the dependent variable then the Prais-Winston regression model should be employed. In this model, the errors are assumed to follow a first-order autoregressive AR(1) disturbance as shown below:

$$\varepsilon t = \rho\varepsilon_{t-1} + e_t \qquad (2)$$

Where ρ $(-1<|\rho|<1)$ is the autocorrelation coefficient, and e_t is independent and identically distributed with zero mean and a constant variance σ2.

The model presented in equations (1) and (2) can be estimated by using the Prais–Winsten transformed regression estimator that is basically a generalised least-squares estimator (Prais and Winsten, 1954).

Multi-collinearity is unlikely to be a problem within these variables as they are, for the most part, intuitively unrelated. This would not have been the case if, for example, VMT had been included as an explanatory variable. A dummy variable is used to control for seasonality which is inherent in traffic congestion data.

5 RESULTS

Firstly, a simple linear regression model as shown in Equation (1) was developed using the data described in section 3. Although this yielded an excellent goodness-of-fit statistic (i.e. R^2 value of 0.87), the Kolmogorov-Smirnov test indicated that the residuals are not normally distributed and the Durbin-Watson *d*-test identified that there is a problem of serial autocorrelation. Therefore, the coefficients from the linear model may not be appropriate to evaluate the impact of the intervention. Subsequently, the Prais-Winsten regression model with AR(1) disturbance was employed. The results are presented in Table 2. The model goodness-of fit, the adjusted R^2, is 0.62 which is very good for this type of model and commensurate with similar work (Hahn et al., 2002). An *F*-value of 42.9 with probability close to 0 shows that, overall, the model applied can statistically significantly predict the dependent variable. The value of the autocorrelation coefficient was found to be 0.33 indicating that the errors are serially correlated and the application of the Prais-Winston regression model is appropriate. The Durban Winsten *d*-statistic of 2.04 demonstrates that the model has successfully compensated for serial correlation by applying the Prais-Winsten transformation.

Having established the model is a good fit to the data, an examination of the regression co-efficients and their statistical significance can now be undertaken.

TABLE 2 Model Results

DVM	Coefficient	t	P>t	95% Conf. Int		**Elasticities** of DVM w.r.t. Independent Variable
Continuous Intervention: $\log_e$ of LWPP	0.6735	3.48	0.00	0.2928	1.0542	0.55
Fuel price	-0.0038	-2.51	0.01	-0.0069	-0.0008	-0.39
Mean weekly minimum temperature	-0.0145	-3.1	0.00	-0.02363	-0.0053	-0.07
Weekly rainfall	0.0023	1.53	0.13	-0.0007	0.0053	0.02
Summer (Reference)	0					
Winter	0.1263	2.72	0.01	0.0347	0.2179	NA
Spring	0.0339	0.89	0.37	-0.0412	0.109	NA
Autumn	0.1484	4.73	0.00	0.0867	0.2101	NA
Log_e of WAPmOWB (Working age population - Out of work benefit claimants)	7.9138	3.05	0.00	2.8024	13.0252	6.47
Roadworks index	0.0427	5.21	0	0.0265	0.0588	0.05
Bus Patronage	0.6117	3.2	0.00	0.2349	0.9886	0.72
Constant	-107.6624	-3.2	0.00	-174.017	-41.3078	NA
Autocorrelation coefficient				0.33		
R-squared				0.63		
Adjusted R-squared				0.62		
Number of observations				260		
Durbin-Watson d-statistic (Original)				1.46		
				2.04		

The fitted model is: (see Table 2):

DVM= -107.66+0.6735lnLWPP – 0.0038FuelPrice – 0.0145 MinTemp+ 7.9138lnWAPmOWB+0.0427RoadWrks+0.6117BusPat+0.1484Autum+0.1263Winter+εt

Where $\varepsilon t = 0.3254\varepsilon_{t-1} + e_t$

Table 2 shows that LWPP has a statistically significant impact on DVM. The *t*-statistics and *p*-values for LWPP show that there is less than a 5% chance that the co-efficient predicted has occurred by chance i.e. the variable is statistically significant at the 95% confidence level. A further examination of the p values reveals that the model provides more than 99.9% certainty that a positive relationship exists between the intervention variable and the dependent variable, i.e. that a decrease in the quantity of Liable Workplace Parking Places would have resulted in a reduction in congestion if all other variables are kept constant. The elasticity for DVM with respect to LWPP[2] is calculated as 0.55. This indicates that a 1% reduction in LWPP explains a 0.55% decrease in DVM. Further interpretation is provided in the next section.

The following exogenous independent variables are also statistically significant with respect to having an impact on delay:

- Road Works Index - as the number of roadworks increases DVM increases. This is expected considering that roadworks will reduce capacity on a link through lane closures and pinch points such as temporary traffic signals.
- Average Minimum Temperature- as temperature decreases DVM increases. Lower temperatures are a proxy variable for ice and snow which slow traffic and reduce network capacity.
- Bus patronage- as bus patronage increases DVM also increases. This is somewhat surprising as it suggests that extra demand for travel is catered for by both modes, this is discussed in more detail in the next section.
- Working age population minus out of work benefit claimants (WAP-OWB) - as this metric increases DVM increases. This suggests that the more people economically active then the greater the demand for travel.
- Fuel Price - as fuel price increases DVM decreases. As the main non-fixed cost the laws of supply and demand dictate that as the costs of travel by a mode increases then demand will fall.
- Additionally, the season is shown to be relevant with autumn and winter shown as significant with respect to delay.

Gross household income was initially included in the model, however it was not statistically significant and did not improve the level of explanation and was thus removed.

[2] The elasticity of DVM with respect to LWPP is calculated by using the term: $\frac{\hat{\gamma}}{\bar{y}}$

In order to validate the above results the same data set was also analysed using an ARIMA model. This produced very similar results and it was decided the parsimonious model i.e. the Prais-Winsten regression model with AR(1) disturbance would be presented in this paper. Unfortunately, the need for brevity precludes a detailed discussion of the ARIMA approach but it does provide validation of the results presented here in.

6 DISCUSSION

In this section we discuss the results presented previously in this paper by placing them within the framework presented in Figure 2. However firstly it is important to keep in mind a number of limitations and resultant assumptions relevant to this research:

The availability and frequency of data placed some limitations on this research; firstly it was necessary to interpolate weekly values for a number of the variables, including the continuous intervention variable LWPP. Secondly, it was not possible to derive weekly values for Gross Value Added (GVA). Ideally one would have included this in the initial model as it is prominent in literature as a driver of congestion. However, as this research concentrates on congestion generated by peak period commuting, a variable measuring the number of individuals in work is preferred regardless of the practicalities of including GVA. The working age population minus the number of those claiming out of work benefits (WAP-OWB) is thus used as a more directly relevant macro-economic indicator.

Finally, it is recognised that, in utilising the WAP-OWB to represent the economic driver for demand for travel, the assumption is that, over the 5 year study period, the demographics of the WAP remain sufficiently similar so as not to change the overall propensity to choose any given mode of travel. Changes to the age structure and gender balance shown annually as part of the Annual Population estimates (ONS 2016) were very small and it was concluded that this was only likely to impact DVM in the long term.

Before the results from the time series model are discussed a significant observation concerning the LWPP time series shown in Figure 1 should be noted; LWPP shows an initial fall of 17.5% prior to the introduction of the WPL and a subsequent more gradual fall to around 75% of its 2010 levels. This differs from the impact of the Perth Parking Space Levy which observed both a smaller initial decline in provision of around 10% as well as a subsequent rebound in levels of off street parking supply (Richardson 2010). Assumptions concerning the likely impact of the Nottingham WPL were based on these findings from Perth (NCC 2008). Despite differences between the two schemes, this suggests that in a UK or European context, a WPL is likely to generate less revenue, but potentially be a more effective standalone tool for reducing congestion.

As indicated in the previous section the results reveal that that LWPP has a statistically significant impact on DVM. However the aim of this research was to evaluate the impact of the WPL on traffic congestion. In order to make this causal link to the WPL it is assumed that changes in the number of LWPP are a direct result of the introduction of the WPL. This assumption is considered sound given the relatively short study period of this research, however, in the long term other socio-economic and transport related factors may also influence this variable. The results from the time series model have also enabled us to draw conclusions as to both the scale of the impact and how it compares with other important exogenous variables which also impact DVM.

The results show that, based on the elasticities calculated in the previous section[3] for every 332 LWPP that were removed by employers in response to the introduction of the WPL, DVM was reduced by 0.4 seconds. This represents a time saving for the last quarter of 2013 of just under 15 seconds per vehicle mile, a total time saving in 2013 across the network and time period used in this study of 1,146 days. This can therefore be seen as a useful contribution to congestion constraint and confirms the expectations expressed in the WPL Business Case (NCC 2008).

These reductions in DVM need to be considered against a background of changes in the DVM time series driven by the other significant exogenous variables and thus it does not necessarily follow that an actual overall reduction in DVM will be observed but what is indicated by these results is that it was lower in 2013 than it would have been had the WPL not been introduced. It is thus important to understand how these exogenous variables are related to both the dependent and intervention variables. Figure 2 summarises the associations indicated by the results of this research. It also includes a number of variables which were not included in the model, either because suitable data was not available, or because they will only impact on DVM in the longer term, i.e. they change so slowly that it will take longer than the 5 year study period to influence congestion.

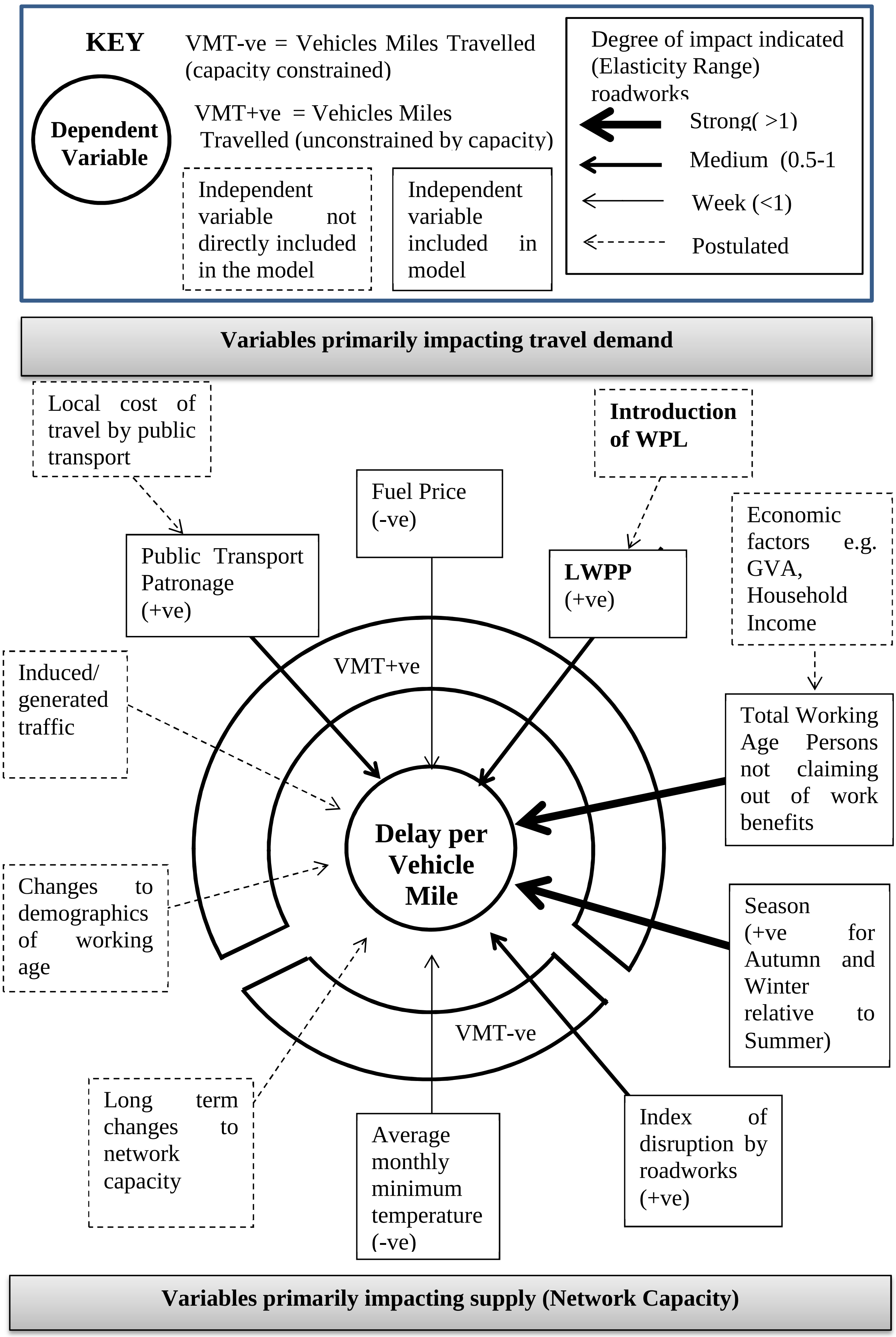
The relative impact of each variable on DVM illustrated in Figure 2 is taken from the elasticities contained in Table 2. We have used an ordinal scale with 3 categories; *Strong* where the variable's elasticity w.r.t. to DVM is in excess of 1, *Medium* where it is between 0.5 and 1 and *weak* where it is less than 0.5. Using the above definitions LWPP is shown to have a '*Medium*' impact. There are two exceptions to this approach; firstly because the Road Works Index is not a real world unit the elasticity produced does not reflect its actual impact which is estimated to be in excess of 5.5 seconds of DVM at their peak, the association is therefore shown as 'medium' in Figure 2. Secondly the seasonal variable is a categorical variable with four seasons (reference case= summer) and there is no difference in DVM between the summer season and the spring season. The values of the other coefficients (also known as differential slope coefficients) have been used as a proxy to determine the relative impact on DVM. The direction of the relationship is given by a '+ve' or '–ve' symbol in each box denoting positive or negative relationships with the dependent variable.

While an adjusted R^2 value of 0.62 shows that 62% of change in the dependent variable is accounted for by the set of independent variables included in the model this still leaves 38% of that will be due to variables not included in the model. While some of these will always be unknown it is possible to postulate what some of them may be based on the findings of the literature review in Section 2. These have been included in Figure 2 and are discussed below.

VMT is not included within the model used in this research as it will be closely related to DVM and will be impacted by almost all of the explanatory variables. It

[3] The elasticity of DVM with respect to the control variables in the form of lnX is calculated by using the term: $\frac{\hat{\beta}}{\bar{y}}$. The elasticity of DVM with respect to the control variables X is calculated by using the term: $\hat{\beta}.\frac{\bar{X}}{\bar{y}}$

FIGURE 2 Influence of independent variables on Delay per Vehicle Mile



will be positively related to DVM where network capacity has not yet been reached as it will reflect the demand for travel. However, if a network is at or close to capacity the relationship may be negative when roadworks, permanent network changes or inclement weather reduce the capacity or an increase in demand leads to a break down in flow as the network reaches capacity. This latter effect is demonstrated by traditional speed flow curves. Figure 2 illustrates this by differentiating VMT as +ve or –ve and relating this to the other independent variables. GVA and variables relating to the demographics of the working age population were discussed at the start of this section; both are included as variables in Figure 2 along with postulated links to DVM and other variables.

An additional observation can be made concerning the relationship between public transport (PT) patronage and DVM. A reliable time series of the local cost of travel by public transport was not available so public transport patronage is used as a variable to represent the attractiveness of public transport as shown in Figure 2. It would initially be expected that there would be a negative relationship between these two variables, however, this research reveals that there is a positive relationship at a statistically significant level, i.e. if congestion increases so does PT patronage. This implies that any increase in demand for travel is thus catered for by both private car and PT. However, there will be a point when PT capacity expands, as road network capacity remains constant or slowly declines, that any additional demand for travel must be absorbed by PT or active modes.

7 CONCLUSIONS

The impact of Nottingham's Workplace Parking Levy on levels of morning peak period congestion was analysed using a Prais-Winston regression model with AR1 disturbance applied to weekly time series data for Delay per Vehicle Mile (DVM). Liable Workplace Parking Places (LWPP) was used as an independent continuous intervention variable. Based on a literature review of exogenous factors likely to impact on congestion, indicators of economic performance, population, weather, network disruption due to roadworks, fuel price and public transport patronage were identified to be included as time series within the model as control variables alongside the intervention variable. This approach thus accounts for external contextual changes which may obscure the impact of the WPL on congestion.

Model output indicates that the introduction of the WPL has had a statistically significant impact on congestion in Nottingham. The results show that the reduction in the provision of LWPP would, if all other explanatory variables remained constant, reduce Delay per Vehicle Mile (DVM). It is shown that the elasticity of DVM with respect to LWPP is 0.55, i.e. a 1% reduction in the quantity of LWPP explains a 0.55% reduction in congestion. This confirms the hypothesis proposed in the Methodology Section of this paper:

"The fall in LWPP from 2010 and early 2012 has contributed to the observed reduction in DVM from late 2010 to mid 2012"

Additionally the model also shows that the following had statistically significant impacts on DVM;

- An increase in the number of people of working age who are not claiming out of work benefit will result in a rise in DVM
- Cold weather. A lower mean minimum temperature will result in a rise in DVM.

- A rise in fuel price will result in a fall in DVM.
- Disruption to the network due to roadworks. The more road work disruption the network experiences the higher the DVM.

Of these variables the number of people of working age who are not claiming out of work benefit is shown to have the most impact on DVM. While although LWPP (i.e. the introduction of the WPL) is perhaps less influential than this macroeconomic variable, it does never the less still have an important impact and thus contributes to congestion restraint. These results show that while the WPL contributed to the reduction in DVM observed in 2011 further ongoing beneficial impact has been obscured by external explanatory variables, particularly the high levels of roadwork activity from 2012 onwards.

The findings of this research are highly significant as it is the first time that evidence has been presented for a statistically validated link between the introduction of a WPL and a reduction in congestion. This will have implications for the transferability of the approach taken in Nottingham to other UK and World Cities as it demonstrates that a WPL can be an effective tool in the transport planner's armoury when it comes to constraining congestion.

Additional research is required as to the long term impact of suppressed demand for travel by car (stemming from both affordability issues and due to current levels of congestion) on the ability of measures such as the WPL package to restrain congestion while contributing to expanding public transport provision/capacity and to achieve favourable differential change relative to comparable Cities. Furthermore, it is recommended that future research should also aim to apply a similar time series modelling approach to the impact of the WPL package as a whole including the public transport improvements on levels of congestion in Nottingham.

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APPENDIX E CHOICE OF COMPARATOR CITIES

Nottingham Workplace Parking Levy Package Evaluation: Choice of Comparator Cities

Incorporating an experimental or even a quasi-experimental component to the evaluation of area wide public programmes is problematic, as identifying a geographic location that is not subject to that intervention, but that is otherwise identical, is almost always impossible (Rossi et al 2004). This is because a complex fabric of both national and local contextual factors will always act as differentials between the chosen areas.

This then begs the question as to whether any such quasi-experimental approach is at all valid. A view is taken in this evaluation that if the characteristics of comparator Cities are considered along with policy context then a broad comparison of relevant economic and transport indicators can form an important component of a mixed evaluation approach based on an agreed Theory of Change. It is, however, recognised that as a stand-alone evaluation the different contextual factors acting within the areas may be sufficiently powerful so as to make attribution of observed differences to specific causal factors difficult, if not impossible.

Thus the question to be answered by this approach is:

Are the observed differences between Nottingham and its comparator Cities supportive of the proposed Theory of Change behind the implementation of the WPL and its associated transport improvements? Any conclusion must be supported by a detailed consideration of relevant local factors, local transport policy for instance, in each area in order to consider if these are likely to be the cause of the observed differences. If no such factors can be identified, then it may be possible to conclude that it is the WPL package that is responsible.

The first step in this quasi-experiment is to identify a group of Core Cities which have broadly similar geographic, economic and transport characteristics.

It should be recognised that the choice is quite limited as there are only 5 Core Cities of a roughly equivalent size to Nottingham with London, Manchester, and Birmingham being significantly larger making comparison unsafe. Although not a Core City, it is attractive to include Leicester due to its proximity to Nottingham, indeed it could be considered to be a direct competitor to Nottingham. Given the limited number of choices the following is intended to provide a brief statistical overview in order to choose the most similar Cities in terms of size, economy and transport to use as comparators.

The issue as to whether comparison should be made just on the Core City Administrative area or the Primary Urban Area (PUA) which is a measure of the whole built up area (Centre for Cities 2014) is interesting, as although the WPL is only in operation within the Nottingham City administrational area, the benefits delivered by the general transport policy are intended to operate across the whole urban area. Indeed, Nottingham is somewhat of an oddity as its PUA does not include West Bridgford and the figures quoted in this report refer in Nottingham's case not to the PUA, but to an area termed Greater Nottingham which includes the whole urban area including West Bridgford. While it is preferable that both the Primary Urban Area and the Core City administrational area populations are similar, in reality the proportion of the urban area contained within the Core City Local Authority Administrative area varies considerably. Whether it is the PUA or the Core City LA area that is used for establishing similarities and differences depends on the nature of the attributes and is discussed below. The chosen attributes are as follows.

Population and Area. The size and geography of an urban area will impact on the transport choices people make and the transport infrastructure that can be provided, thus it is important that those chosen as comparator Cities are of similar size in both population and geographic area. Table 1 contains the data for the urban areas.

Table 1 Urban area size

LA Name	City LA Admin Area			Primary Urban Area*		
	Population	Area (hectares)	Residents per hectare	Population	Area (hectares)	Residents per hectare
Birmingham	1,085,400	26,779	40.5	2,439,600	68,681	35.5
Bristol	432,500	10,961	39.5	698,600	21,953	31.8
Leeds	757,700	55,172	13.7	757,000	55,172	13.7
Leicester	331,600	7,331	45.2	331,600	7,331	45.2
Liverpool	469,700	11,184	42.0	791,700	27,567	28.7
Manchester	510,800	11,564	44.2	1,892,500	68,023	27.8
Newcastle upon Tyne	282,400	11,344	24.9	832,500	27,320	30.5
Nottingham	**308,700**	**7,461**	**41.4**	**645,000**	**21,501**	**30.0**
Sheffield	557,400	36,795	15.1	815,700	65,449	12.5

Source: ONS 2012 mid-year population estimates and 2011 National Census

* Nottingham PUA = Greater Nottingham which includes West Bridgford

For comparison purposes it is the size of the whole urban area which is most relevant due to the pan conurbation nature of transport policy and because how each urban area is split administratively differs. For example, Nottingham City is less than half the population of Greater Nottingham while Leeds City contains the whole of the PUA. The PUA, therefore, will influence and interact with the Core City administrative areas which differ in size proportionally to the PUAs.

On this basis Table 1 shows that Bristol PUA and Greater Nottingham have similar population and area. While Sheffield PUA is larger, the PUA includes Rotherham. However, for the purposes of this study it is considered valid to treat them as separate entities which would make Sheffield a similar size to Bristol and Nottingham. Newcastle, Liverpool and Leeds are up to 30% larger. Manchester and Birmingham are more than double the size. On this basis it can be concluded that by virtue of their size, Manchester and Birmingham should not be used as comparators. For Leeds the PUA and Core City area is one and the same, thus the Core City area is much larger than Nottingham, Newcastle, Liverpool and Sheffield. This allied to the low population density is an area of concern and, therefore, Leeds will not be used as a comparator.

Economic. The spit between Manufacturing, Employment/Service sectors, GVA and Deprivation index (see Table 2)

Table 2 City economic characteristics

Area	Jobs based in area	Manufacturing %	Service sector jobs %	GVA (Millions £)	Index of Deprivation 2010 (Rank out of 326 LAs)
	LA	LA	LA	LA	LA
Bristol	231,800	5	90.2	11,740	79
Leicester	154,600	14.1	80.5	6,106	25
Liverpool	226,400	3.8	92.8	9,991	1
Newcastle upon Tyne	176,000	5.1	92.3	NA	40
Nottingham	196,800	5.7	90.1	8,258	20
Sheffield	239,300	10.1	85.4	10,264	56

Sources: ONS: Business Register and Employment Survey 2012, DCLG: Index of Deprivation 2010 and ONS: Regional GVA 2012.

For this category of attribute the data is considered at a City administrative area level as the direct economic effect of the WPL acts only in the area in which it is applied. Therefore, for economic indicators to be comparable only the City administrational areas can be used.

Table 2 shows that Nottingham, Liverpool, and Newcastle are, in general, similar. .

Bristol and Sheffield have larger economies with Sheffield having a greater proportion of manufacturing. Bristol is also noticeably less deprived with a ranking of 79 in the UK which is high for a large City.

Leicester, however, has a significantly smaller economy and has over 14% of its economy devoted to manufacturing. Because of its proximity to Nottingham and that over 80% of its economy is in the service sector, it is probably still worth including as a comparator City.

In conclusion, despite some differences, Newcastle, Liverpool and Sheffield can be used as comparator areas. Bristol, however, is a concern as it is significantly more prosperous with a lower level of deprivation and a greater GVA. This may lead to a different propensity to choose any given mode of travel as reflected in the mode share in Table 3 below. With this in mind Bristol will not be used as a direct comparator.

Leicester has an economic mix where manufacturing is more prominent, however over 80% is still based on the service industry so, despite this difference, there is no compelling reason to reject it as a comparator City. However, as it is not a Core City and is significantly smaller in both area and population it should be viewed separately to Newcastle, Liverpool and Sheffield.

The Nature of Transport - Mode share of journey to work

Transport policy will operate on a PUA level so the comparative statistics here refer to the PUA; for example in Nottingham the tram network serves Greater Nottingham. Table 3 contains the mode share to work data.

Table 3 Cities Mode Share to Work

City	%Drive to work	% Public Transport to work
Bristol	63.9	9.6
Leicester	60.3	14.9
Liverpool	62.3	20.1
Newcastle upon Tyne	60.7	21.8
Nottingham	62.9	16.8
Sheffield	66.4	16.3

Source ONS: 2011 National Census

Table 3 shows that all six Cities have broadly similar car usage for travelling to work and the same can be said for public transport with the exception of Bristol which is significantly lower at only 9.6%. While this suggests that green modes and car sharing activities may be taking up the slack in Bristol, it does present a problem because this evaluation is looking at the impact of public transport improvements and thus if a comparator area has a lower propensity to use public transport then this represents a risk. Thus Bristol will not be used as a comparator.

Conclusion

Based on the above data Newcastle, Liverpool, Leicester and Sheffield will be used as comparators.

Leicester will be kept separate in recognition of its smaller size and increased reliance on manufacturing, as well as its potential to be a competitor City to Nottingham in the East Midlands.

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APPENDIX F INWARD INVESTMENT EXAMPLE FORM

Inward Investment Example Form

Q1 Employer Name

Q2 Name of recording Officer **Date decision confirmed**

Q3 Decicsion Type Investment ☐ Dis-Investment ☐

Q4 Desciption of Decision

Q5 Approximate Scale of decision (£)

Q6 Investors Stated Reasoning:

Close to Suppliers ☐

Close to Customers ☐

Access to work force ☐

PT Connectivity ☐

Other - Please describe

Q7 Dis-investors' stated reasoning

- WPL ☐
- Congestion ☐
- Other City Council Policies ☐
- Lack of access to skilled labour ☐
- External Pull Factors ☐

Other - Please describe

Q8 Officer's opinion on reasoning behind investment decision:

- Close to Suppliers ☐
- Close to Customers ☐
- Access to work force ☐
- PT Connectivity ☐

Other - Please describe

Q9 Officer's opinion on reasoning behind dis-investment decision:

- WPL ☐
- Congestion ☐
- Other City Council Policies ☐
- Lack of access to skilled labour ☐
- External Pull Factors ☐

Other - Please describe

	Major actor	Minor Factor	Not at all
Q10 WPL cited by investor as reason behind decision			
Q11 Good PT cited by investor as reason behind decision			

Q12 Jobs gained or lost

Additional Notes (refer to question where appropriate

Date Completed

APPENDIX G CONGESTION TIME SERIES ANALYSIS USING TRAFFICMASTER DATA

Delay per Vehicle Mile by Route

Route Id	Route Name	Route Length (m)	From	To	Delay Per Vehicle Mile 2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Description
A60N	A60, Mansfield Rd	6842	Leapool Roundabout	Forest Road	1.79	1.66	1.78	2.06	2.47	2.42	Eastern Radial
B684	Woodborough Rd	7426	Nottingham Road	Huntingdon Street	1.58	1.50	1.64	1.79	1.91	1.93	Eastern Radial
B686	Carlton Rd	4986	Colwick Loop Road	Lower Parliament Street	1.86	1.81	1.92	1.83	2.12	2.16	Eastern Radial
A612	Colwick Rd	10361	Burton Joyce	Pennyfoot Street	0.95	0.91	0.98	0.98	1.24	1.19	Eastern Radial
A6011LBB	Lady Bay Bridge	1363	Radcliffe Road	London Road	1.81	1.84	2.03	2.42	2.93	3.43	Western Radial
A52TB	Radcliffe Road, Trent Bridge, London Rd	4186	Gamston Roundabout	Canal Street	1.54	1.43	1.57	2.05	1.90	2.00	Western Radial
A606	Melton Road	7489	Tollerton Lane	Loughborough Road	2.80	2.77	2.98	3.24	3.25	3.20	Western Radial
A60S	Loughborough Rd	5627	Kirk Lane, Ruddington	Radcliffe Road	2.15	2.08	2.15	2.12	2.17	2.22	Western Radial
A453	Queens Drive	1957	Tottle Road	Castle Boulevard	0.70	0.58	0.86	0.96	0.84	1.30	Western Radial
A6005	Queens Rd, University Boulevard	9402	Toton Lane	Wiford Street	1.96	1.83	2.16	3.30	2.32	1.89	Western Radial & NET Phase 2 Corridor
A6200	Derby Road	2315	Middleton Boulevard	Canning Circus	1.33	0.93	1.00	1.15	1.22	1.44	Western Radial
A609	Trowell Rd, Ilkeston Road	8235	Festival Inn Trowell	Canning Circus	1.86	1.81	2.21	2.74	2.66	2.23	Western Radial
A610	Nuthall Road	9636	Awsworth Junction	Canning Circus	1.64	1.48	1.69	2.25	2.38	2.12	Western Radial
Rad	Radford Road	2189	Western Boulevard	Alfreton Rd	2.27	2.20	2.36	2.45	2.75	2.76	Other
B682	Sherwood Rise	6754	Hucknall Lane	Mansfield Road	2.02	2.00	2.06	2.35	2.53	2.54	Other

Route Id	Route Name	Route Length (m)	From	To	Delay Per Vehicle Mile 2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Description
A611	Hucknall Road	6426	Hucknall Bypass	Mansfield Road	2.22	2.05	2.36	2.54	2.54	2.42	Other
RRD Anti (A6514)	Ring Road Anticlockwise	7507	Mansfield Road	Derby Road	1.79	1.65	1.78	1.96	2.01	1.69	Orbital
RRD Clock (A6514)	Ring Road Clockwise	7003	Derby Road	Mansfield Road	1.06	0.94	0.90	1.29	1.29	1.53	Orbital
A453 (Full corridor)	Clifton lane	8895	Barton in Fabis	Castle Boulevard	2.51	2.17	2.96	3.60	3.60	0.67	NET Phase 2 Corridor
A52W (Full corridor)	Derby Road	10670	M1 Junction 25	Canning Circus	1.76	1.52	2.04	2.67	2.16	1.31	NET Phase 2 Corridor
All routes	**NA**	**109703**	**NA**	**NA**	**1.71**	**1.61**	**1.78**	**2.10**	**2.11**	**2.03**	**Network**

Journey Time per Vehicle Mile by Route

Route Id	Route Name	Route Length (m)	From	To	Journey Time Per Vehicle Mile 2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Description
A60N	A60, Mansfield Rd	6842	Leapool Roundabout	Forest Road	3.69	3.56	3.68	3.96	4.37	4.32	Eastern Radial
B684	Woodborough Rd	7426	Nottingham Road	Huntingdon Street	3.14	3.06	3.19	3.34	3.47	3.49	Eastern Radial
B686	Carlton Rd	4986	Colwick Loop Road	Lower Parliament Street	3.42	3.37	3.48	3.40	3.68	3.73	Eastern Radial
A612	Colwick Rd	10361	Burton Joyce	Pennyfoot Street	2.35	2.31	2.38	2.38	2.64	2.59	Eastern Radial
A6011LBB	Lady Bay Bridge	1363	Radcliffe Road	London Road	4.02	4.04	4.23	4.63	5.13	5.63	Western Radial
A52TB	Radcliffe Road, Trent Bridge, London Rd	4186	Gamston Roundabout	Canal Street	3.69	3.57	3.71	4.19	4.05	4.14	Western Radial
A606	Melton Road	7489	Tollerton Lane	Loughborough Road	4.11	4.09	4.30	4.56	4.56	4.51	Western Radial

Route Id	Route Name	Route Length (m)	From	To	Journey Time Per Vehicle Mile 2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Description
A60S	Loughborough Rd	5627	Kirk Lane, Ruddington	Radcliffe Road	2.86	2.80	2.86	2.84	2.88	2.94	Western Radial
A453	Queens Drive	1957	Tottle Road	Castle Boulevard	2.99	2.87	3.15	3.24	3.13	3.59	Western Radial
A6005	Queens Rd, University Boulevard	9402	Toton Lane	Wiford Street	3.42	3.29	3.62	4.76	3.78	3.35	Western Radial & NET Phase 2 Corridor
A6200	Derby Road	2315	Middleton Boulevard	Canning Circus	3.48	3.07	3.14	3.29	3.36	3.58	Western Radial
A609	Trowell Rd, Ilkeston Road	8235	Festival Inn Trowell	Canning Circus	3.41	3.36	3.76	4.29	4.21	3.78	Western Radial
A610	Nuthall Road	9636	Awsworth Junction	Canning Circus	3.55	3.39	3.60	4.16	4.30	4.03	Western Radial
Rad	Radford Road	2189	Western Boulevard	Alfreton Rd	4.48	4.41	4.57	4.65	4.96	4.96	Other
B682	Sherwood Rise	6754	Hucknall Lane	Mansfield Road	3.92	3.90	3.96	4.24	4.42	4.43	Other
A611	Hucknall Road	6426	Hucknall Bypass	Mansfield Road	4.18	4.00	4.31	4.50	4.49	4.37	Other
RRD Anti (A6514)	Ring Road Anticlockwise	7507	Mansfield Road	Derby Road	3.67	3.53	3.66	3.84	3.89	3.57	Orbital
RRD Clock (A6514)	Ring Road Clockwise	7003	Derby Road	Mansfield Road	3.05	2.92	2.89	3.28	3.28	3.52	Orbital
A453 (Full corridor)	Clifton lane	8895	Barton in Fabis	Castle Boulevard	4.24	3.9	4.69	5.33	5.33	2.4	NET Phase 2 Corridor
A52W (Full corridor)	Derby Road	10670	M1 Junction 25	Canning Circus	3.39	3.15	3.67	4.3	3.79	2.94	NET Phase 2 Corridor
All routes	**NA**	**109703**	**NA**	**NA**	**3.38**	**3.28**	**3.45**	**3.76**	**3.78**	**3.69**	**Network**

APPENDIX H NOTES FROM MEETINGS WITH REPRESENTATIVES FROM COMPARATOR CITIES

LIVEPOOL

Meeting at Cunard Building in Liverpool with John Davies Assistant Highways Manager, Liverpool City Council

11th April 2016

The purpose of the meeting was to gain an understanding of major transport interventions that have taken place in Liverpool in the period 2010 to 2016 and their likely impact.

In general there have been a number of interventions in Liverpool in this time period the sum total of which is likely to increase network capacity for general road users. The removal of most bus lanes and two important road improvement schemes on key radials have facilitated this.

Liverpool has secured significant funding via the Regional Growth Fund for highway improvement circa £250m which will include a push to improve cycle and bus priority measures in the City, however the impact of this will not be felt until after the study period.

Relevant Transport Interventions 2010 to Present Day

The following schemes were discussed:

Edge Lane Dualling –Major radial duelled with associated capacity increase and decreased journey times. Completed: 2012, Cost: £65m

Hall Lane Improvement Scheme – This scheme provided a series of bypasses around residential areas which removed a number of bottlenecks thus increasing network capacity. Completed: 2011, Cost £90m

City Bus Lane Review - All 26 bus lanes in Liverpool were suspended from October 2013. Following an evaluation of this strategy, it was decided to reinstate 4 of these on strategic routes. This is a key intervention and will have had a significant impact on travel times for general traffic by increasing capacity. The thinking behind the removal of the bus lanes was that they were in part ineffective as delay was generally caused to buses at key junctions and pinch points. The strategy going forward will be to provide suitable bus priority measures at these junctions and to provide beneficial phasing of the signals, however this is yet to be implemented. The evaluation showed that overall average person journey times across all modes stayed almost the same although, on most effected routes, non-bus journey times fell while bus rose. Mode share was unaffected and remained stationary over the trial period. Completed: 2013/15, Cost negligible to date

Leeds Street -. This scheme added some additional junction capacity but was primarily aimed at improving the amenity of this gateway to the city in terms of the public realm. It included additional cycle and pedestrian links. Completed: 2015, Cost £3.5m

Summary

Infrastructure: Increased Road Capacity Improvements. The Hall lane and Edge Lane Schemes have contributed to an overall increase in highway network capacity.

Infrastructure: Improved PT Capacity. No significant changes in the study period but it should be noted that Liverpool already has a mass transit PT system with the Mersey Metro. This also includes links across the Mersey. This system is currently close to capacity.

Influence of roadworks. Many of the schemes mentioned above were predicted to cause significant traffic disruption during the construction phase and while some disruption was caused it was perhaps not as bad as predicted. In 2008 a number of schemes were implemented at the same time causing a lot of congestion. This became known as the 'Big Dig' and since then planners have been very careful to avoid significant periods of city wide disruption.

Legislative Changes – 22 of the 26 bus lanes have been removed in the study period leading to an increase in network capacity for non-bus modes and a fall in non-bus journey times.

Changes to Parking Provision for Commuters – there have been no additional park and ride capacity since 2010 nor has there been any reduction or increase in the supply of commuter parking.

Conclusion

The transport interventions in Liverpool have generally been aimed at increasing the network capacity for general traffic.

The removal of 22 of the 26 bus lanes is considered to be a significant intervention in terms of journey time per vehicle mile and is likely to manifest as a significant fall/constraint in this indicator.

There have not been many schemes in the study period which provide cycle or bus priority measures on main radial or orbital routes. There has been a policy of providing some cycle routes avoiding key radials so there has not been a reallocation of road space on key routes for this purpose.

It should be noted that funding has been secured going forward via the Regional Growth Fund (RGF) for a number of schemes which *will* provide bus and cycle priority measures at junctions including provisions for these modes with traffic signal timings. The viability of Red Routes is also being assessed. This policy is intended to mitigate the impact of the removal of the bus lanes on bus journey times and provide a more efficient network for all users. The impact of the RGF interventions will not be felt until after the study period.

LEICESTER

Meeting at City Hall in Leicester with Chris Randall and Andrew Webster

22nd March 2016

The purpose of the meeting was to gain an understanding of major transport interventions that have taken place in Leicester in the period 2010 to 2016 and their likely impact.

In general there have been no major interventions in Leicester since 2010 and transport policy has focused on promoting Bus, Cycling and Walking provision via a number of small scale schemes. That said there has been a number of junction improvements on the road network but these were not necessarily focused on increasing highway capacity for general traffic flow.

Relevant Transport Interventions 2010 to Present Day

The following schemes were discussed:

A426 Quality Bus Corridor – A426 from Blaby into Leicester City Centre which were estimated to cost £5m. This bid was successful and in March 2012, £2.56 million was awarded by the DfT with the condition that it be used by March 2014. The balance of funding for the project was provided by Leicester City Council, Leicestershire County Council and by Arriva Midlands as the main bus operator on the route. The scheme involved in transferring some road capacity over to bus lanes. The road works associated with this also caused some temporary disruption. Completed: 2014, Cost: £5m

Removal of Belgrave Flyover – scheme to remove a flyover on the inner ring road was mostly capacity neutral and aimed at improving the public realm.

Troon Junction Improvement - The outlined changes include creating new access to a new supermarket from the southbound carriageway of Melton Road, new toucan and pedestrian crossings, better street lighting, and a range of improvements to the carriageway, pavement and landscaping.

There will also be a new left turn slip lane from Melton Road to Troon Way, an extra right turn lane from Troon Way to Melton Road, and an additional right turn lane from Melton Road to Watermead Way.

A bus lane will be included on Melton Road, and additional bus stops added at Troon Way itself. The scheme will not significantly increase capacity but instead is aimed at catering for the new supermarket and provide additional bus and cycle friendly measures.

Connecting Leicester Limited - concentrated on promoting walking and cycling in the city centre and improving connectivity for these across the inner ring road. Although road capacity was reduced this mainly impacted roads in the CBD not the inner ring road or radials.

Welford Rd – In October the bus lane on Welford Road was suspended during the trial of a scheme to improve walking and cycling and there was little point restoring it as the trial had not affected bus journey times. This will, temporarily at least, provide extra capacity for general traffic. This may be reversed if road space is given over to new cycle lanes on Welford Rd.

Sanvey Gate Junction Improvement, completed in 2011 this improved the Sanvey Gate A50 junction and was aimed at congestion relief. This scheme is located close to the City Centre.

A50 Groby Rd Improvements. This is a County scheme but will impact the network in the Leicester Urban Area. The first phase of improvements to the A50 corridor will involve highway works that will provide:

- New traffic signals along with additional and improved traffic lanes at the A50 corridor at County Hall (Station Road).
- New traffic signals along with additional and improved traffic lanes at the New Parks Way roundabout junction including improvements to the Dillon Way junction with New Parks Way.
- Improvements to the Aikman Avenue junction with New Parks Way.
- New and improved off-road cycle paths are proposed on the A50 between the County Hall roundabout and at the Blackbird Road junction.

This intervention should provide extra capacity on a key radial in the NW of the City but has only just started (2016).

Summary

Infrastructure: Increased Road Capacity Improvements. The improvements on the A50 in Leicestershire and closer to the City Centre at Sanvey Gate should increase capacity and decrease journey times along that corridor however the former has yet to take effect as the scheme has only just started. Other highway schemes are focused on improved bus and cycle priority measures rather than providing extra general capacity.

Infrastructure: Improved PT Capacity. The A426 Quality Bus Corridor transferred road capacity from general traffic to bus priority measures, this will have reduced capacity for private vehicles with a potential for reduced journey times. A bus lane has been removed from Welford Road and should temporarily at least have the opposite effect. Additional bus and cycle lanes have been provided as part of the A50 Groby Rd improvement and Troon Rd Junction improvements schemes.

Influence of roadworks. Many of the schemes mentioned above were predicted to cause significant traffic disruption during the construction phase and while some disruption was caused it was perhaps not as bad as predicted.

Legislative Changes – There have been no significant changes to bus lane or parking enforcement which would impact on network capacity.

Changes to Parking Provision for Commuters – there has been no additional park and ride capacity since 2010 nor has there been any reduction or increase in the supply of commuter parking.

Conclusion

The road network in Leicester has been remarkably stable since 2010. There have been some isolated junction improvements but no new links. There has be some swapping of capacity from general traffic to bus and cycle lanes and vice versa which may well over all maintain the overall relative capacities. The prevailing policy both in the LTP and the Mayoral Plan is one of small incremental steps to encourage bus cycle and walk mode choice. It is noted that the ambition remains to apply some form of charging scheme, possibly a WPL to fund more significant interventions in the future. This stability makes Leicester an excellent comparator city for the Nottingham WPL evaluation.

NEWCASTLE UPON TYNE

Meeting at Civic Centre in Newcastle with Graham Grant Head of Transport Investment, Newcastle City Council

2nd February 2016 Newcastle City Council, Civic Centre Newcastle

The purpose of the Meeting was to gain an understanding of major transport interventions that have taken place in Newcastle in the period 2010 to 2016 and their likely impact. The following schemes were discussed:

Tyne Tunnel – Extra tunnel costing £260m opened in 2011and added significant extra capacity to the existing tunnel. This scheme has been successful in that it has carried more than expected in terms of traffic. Journey time improvements were limited as the junctions either end need improving which is scheduled but will not be completed within the evaluation period. Additionally there is interaction with the road works on the A1 where traffic flow has not increased despite generally rising demand for travel, it may be that this extra demand accounts for the larger than expected Tyne tunnel patronage and thus once completed there may be a re-distribution back to the A1 that when combined with the A19 junction improvements will lead to shorter journey times.

A1 Western Bypass Improvement – Started Summer 2014 and is ongoing with lane and speed restrictions on the A1 it's likely some traffic has been displaced onto local roads especially the Tyne Tunnel.

Bus lane enforcement – No car Lanes were altered to Bus Lanes thus no longer used for LGVs in 2013/14 but not enforced until summer 2015 and then only at limited locations. This will increase the volume of traffic on the general network and could negatively impact non PT journey times.

Metro Re-invigorations Total Cost, This is a refurbishment and does not provide extra capacity however it did involve some rolling closures which may have displaced some trips onto surface roads.

Local Sustainable Transport Fund – £12m. Similar in actions and scale to other Cities so perhaps no differential impact. It was noted that although these actions which mainly revolved around school and workplace travel planning are likely to have beneficial impacts, observing and attributing changes in mode shift and journey times is very problematic.

Cycling Infrastructure – While £16m has been secured via Cycle Ambition fund this will not be spent within the evaluation time frame.

UTC system. Completed 2012 this impacted Newcastle City Centre. Since that date the system has been extended to some but not all of the Radial Routes. Any resultant improvement on Journey Times is likely to have been gradual as the system was extended.

Summary

Infrastructure: Increased Road Capacity Improvements. **Infrastructure:**

The additional bore for the Tyne Tunnel has added capacity to the network but the planned junction improvements on the A19 are required to fully realise the benefits. The A1 Western Bypass Improvement is currently nearing completion.

Improved PT Capacity:

The Metro is being refurbished.

Influence of roadworks.

The A1 Western bypass improvement scheme has in all likelihood displaced traffic from the A1 to the rest of the network, especially the Tyne Tunnel.

Legislative Changes

The change of status of No Car Lanes to Bus Lanes coupled with increasingly efficient enforcement has displaced cars, taxis and LGV/HGV traffic from theses lanes onto the general network thus potentially impacting car journey times from 2014 onwards.

Changes to Parking Provision for Commuters

None

Conclusion

The situation with regard to capacity changes for general traffic in Newcastle is complex. While the addition of an extra bore in the Tyne Tunnel has increased capacity, it is likely that this has been offset to some degree by displaced traffic from the roadworks on the A1. Changes to the bus lane status and enforcement will have displaced traffic back onto the general network. Finally the upgrading of the UTC system will be befitting journey times. Overall it is difficult to assess the overall impact on congestion levels of the above interventions.

SHEFFIELD

Meeting at Howden Building in Sheffield with Tom Finnegan-Smith Head of Transport Strategy and Infrastructure

9th September 2016

The purpose of the meeting was to gain an understanding of major transport interventions that have taken place in Sheffield in the period 2010 to 2016 and their likely impact.

Within the study period the presumption has been that extra PT and cycle capacity must be achieved without a reduction in general network capacity. This has been achieved by road widening and an increase in capacity of existing public transport infra structure.

.**Relevant Transport Interventions 2010 to Present Day**

The following schemes were discussed:

Pennistone Road – Funded by The Better Bus Scheme this involved both PT, Cycle and General capacity improvements on this northern radial route leading to improved Car and PT journey times. The carriageway was widened to achieve this. The scheme was opened in Feb 2015.

North Sheffield Better Bus Improvements – These schemes are largely in the development process and have yet to have an important impact on journey times.

Sheffield-Rotherham Tram Train – Integration of heavy rail and LRT vehicles to produce continuous service between Sheffield and Rotherham. Costing £51m it will open in 2016. This thus extends capacity on this important O&D pairing.

Bus Rapid Transit North – This enhanced bus service connects Rotherham and Sheffield and thus serves the same corridor as the above. However it is a lower speed service with more stops thus serving local intermediate destinations. The scheme cost £16m and was opened in early 2015.

Super Tram – This scheme complemented the Tram Train scheme and has recently (2016) gone operational.

Dore Park and Ride Site – A large Park and Ride site was added in 2014 at Dore on the SW edge of the city.

Streets Ahead PFI - Streets Ahead is a city-wide highways maintenance project that will upgrade the condition the city's roads, pavements, street lights, bridges and other items on or around our streets. The majority of the work is taking place 2012 - 2017 upgrading two thirds of the city's roads. The PFI will run for 25 years. Whilst there have obviously been a significant number of roadworks associated with this, the work was primarily carried out off peak or overnight thus there has been minimal impact on peak period travel.

Changes to Public Transport Services and Ticketing - In addition to the above schemes there are a number of other factors influencing bus patronage related to network changes and ticketing arrangements. Initially this resulted in a decline in patronage in the latter part of the study period followed by a rebound as the changes bedded in and users began to understand the benefits of the integrated ticketing arrangements. Additionally, a rail replacement scheme from 2014 onwards has had a negative impact on PT patronage despite replacement bus services.

Summary

Infrastructure: Increased Road Capacity Improvements. **Infrastructure:**

Pennistone Rd Corridor improvements is the main scheme in the project period which produced extra network capacity for general traffic.

The general policy presumption of maintaining current effective network capacity has been complimented by improvements to the UTC system to optimise journey times.

Improved PT Capacity:

There has been significant additional capacity added on the Rotherham to Sheffield corridor via the Tram Train and BRT North schemes.

Influence of roadworks.

The construction of the Pennistone Rd scheme caused some disruption otherwise the level of roadworks has been consistent with normal network operation. The Streets Ahead scheme was conducted off peak or overnight and thus had little impact on peak period journey times.

Legislative Changes

Bus Lane enforcement cameras has been rolled out progressively over the last 10 years thus there will have been some displacement of private vehicles out of the bus lanes.

Changes to Parking Provision for Commuters

Additional capacity from the new Park and Ride Site at Dore. Additional Controlled Parking Zones has been rolled out during the project period.

Conclusion

The effective network capacity available to private vehicles has remained stable since 2010 while there have been some significant increases in Public Transport capacity with the addition of a park and ride site, additional new rolling stock on the tram network and the two large PT schemes linking Sheffield and Rotherham, Tram Train and BRT North schemes.

There has been some work to improve journey times for both private vehicles and buses on the existing network with refinements to the UTC system and remedial action to eliminate pinch points especially as part of the Pennistone Rd Scheme.

APPENDIX I COMMUTER SURVEY QUESTIONAIRES

Nottingham City Council

Enumerator

Commuter Survey- Bus Commuters.

Nottingham City Council is trying to find out more about why people choose to travel by bus to and from work in Nottingham. It would be great if you could find the time to take part in this survey. There will be a prize draw for all respondents for £20 of shopping vouchers for Victoria or Broadmarsh Shopping Centre.

Date: AM PM

Bus stop:

1. What is the purpose of your journey?

Commuting to work or education	
Commuting from work or education	
Business Travel	
Going shopping (non- food or food shopping)	
Accessing healthcare facilities	
Accessing sport, leisure and recreation facilities	
Visiting friends / relatives	
Other reason (Please Specify) ______	

<u>If to or from work/education go to question 2 otherwise go to question 15</u>

2. What is the FULL post code of the place where you started your journey (Address if not known)?

3. What is the FULL post code of your destination (Address if not known)?

4. Do you normally work/study?

Out of Hours (Within the period 20:00 - 07:00within 8pm to 7am)	
Normal Working Day (Within the period 07:00 – 20:007am to 8pm)	
Other	

5. Is your work/study? **Tick all that apply**

Part Time	
Full Time	
Temporary/Casual Staff	

6. Which of the following best describes the level of skill related to your job/study?

Professional/ Managerial	
Office	
Qualified Manual Work	
Non-Qualified Manual Work	
Student	

7. How far do you normally travel to your work or place of study?

Up to 1 mile	
Over 1 mile and up to 2 miles	
Over 2 miles and up to 4 miles	
Over 4 miles and up to 10 miles	
Over 10 miles and up to 20 miles	
Over 20 miles	

8. How long does it normally take you to get to your work or place of study?

0 - 15 minutes	
16 - 30 minutes	
31 - 45 minutes	
46 - 60 minutes	
Longer than 60 minutes	

9. What is your main reason for travelling by bus? Tick one 'main' reason in the first column and up to three of the other reasons that are applicable in the second column.

Reason	Main Reason	Other Reasons
Cost		
Can't drive / no car access		
Capability – e.g. restricted for a disability/impairment		
Confidence – I feel safe/confident travelling this		
Convenient / easier / less hassle		
Environmental reasons		
Direct service		
Frequency of service		
Highest quality journey option		
Quick journey time		
Avoids traffic congestion		
Reliability		
Routine/Habitual (i.e. always travelled that way)		
Weather conditions		
Other (Please Specify) ______________________________		

10. Have you changed your usual main mode of travel to your work or place of study since the 1st Jan 2010?
If you have changed more than once tell us about the most recent.

Yes ☐ No ☐ Don't Know ☐

If 'no' or 'don't know' please go to question 15

11. Do you know the Year of this change?

2010	2011	2012	2013	2014	2015	2016	Don't Know
☐	☐	☐	☐	☐	☐	☐	☐

12. Do you know the Month of this change?

Jan	Feb	Mar	Apr	May	Jun	
☐	☐	☐	☐	☐	☐	
Jul	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Don't Know**
☐	☐	☐	☐	☐	☐	☐

13. What was your previous usual main mode of travel to your work or place of study?

Tick one box only

Unless Park and Ride, tick the box for the longest part, by distance, of your usual journey to work.

	Usual choice
Park and Ride - Bus	
Park and Ride - Tram	
Park and Ride - Other	
Bike	
Car, on your own	
Car sharing, Share with others	
On foot	
Motorbike / Moped	
Tram	
Train	

14. Thinking about why you made the decision to change your usual mode of travel to the bus, please indicate how important each of the following reasons were in making that decision by giving it a score of 1 to 5 with 5 being very important and 1 being of no importance. Please indicate if the reason is not applicable (NA) to you.

Very Important ← Not important

	5	4	3	2	1	NA
Change of workplace						
Change of home address						
Employer removed access to parking at work						
Increase in cost of parking at work						
Improved bus service						
Deterioration in the quality of cycle lanes/storage/facilities						
Deterioration in rail service						
Change in family circumstances/Health issues						
Shorter journey time						
More reliable option						
Other – please specify ____________________ ____________________ ____________________						

15. Do you have any general comments about your journey by bus today?

16. Are you?

Male ☐ Female ☐

17. Are you?

Under 18	
18-25	
25-34	
35-44	
45-59	
60 or over	
Prefer not to say	

18. Do you consider yourself disabled?

Yes	
No	
Prefer not to say	

19. To which of these ethnic groups do you belong?

White	
Black	
Asian	
Mixed	
Chinese	
Other Ethnic Group (please specify below)	
Prefer not to say	

Other ethnic group

To be entered into the FREE prize draw with a chance to win a £20 Victoria Centre Shopping Voucher please provide the following contact information. The winner will be drawn w/c 12/12/2016 and will be notified by 23/12/2016.

NB: This information will only be used for the stated purpose and will not be passed onto a third party.

Name

Contact Telephone Number

Contact Email Address

Thank you for taking the time to complete this survey.

Enumerator:

Self Completion?

Commuter Survey- Your journey by bike.

Nottingham City Council is trying to find out more about why people choose to travel by bike to and from work in Nottingham. It would be great if you could find the time to complete this survey and post it to us in the pre-paid envelope by 21/10/2016. There will be a prize draw for all respondents for £20 of shopping vouchers for Victoria or Broadmarsh Shopping Centre.

Date: Time:

Location:

1. What is the purpose of your journey?

Commuting to work or education	
Commuting from work or education	
Business Travel	
Going shopping (non-food or food shopping)	
Accessing healthcare facilities	
Accessing sport, leisure and recreation facilities	
Visiting friends / relatives	
Other reason (Please Specify) ________________________________	

<u>If to or from work/education go to question 2 otherwise go to question 15</u>

2. What is the FULL post code of the place where you started your journey (Address if not known)?

3. What is the FULL post code of your destination (Address if not known)?

4. Do you normally work/study?

Out of Hours (Within the period 20:00 - 07:00)	
Normal Working Day (Within the period 07:00 – 20:00)	
Other	

5. Is your work/study? **Tick all that apply**

Part Time	
Full Time	
Temporary/Casual Staff	

6. Which best describes the level of skill related to your job/study?

Professional/ Managerial	
Office	
Qualified Manual Work	
Non-Qualified Manual Work	
Student	

7. How far do you normally travel to your work or place of study?

Up to 1 mile	
Over 1 mile and up to 2 miles	
Over 2 miles and up to 4 miles	
Over 4 miles and up to 10 miles	
Over 10 miles and up to 20 miles	
Over 20 miles	

8. How long does it normally take you to get to your work or place of study?

0 - 15 minutes	
16 - 30 minutes	
31 - 45 minutes	
46 - 60 minutes	
Longer than 60 minutes	

9. What is your main reason for travelling by bike? Tick one 'main' reason in the first column and up to three of the other reasons that are applicable in the second column.

Reason	Main Reason	Other Reasons
Cost		
Can't drive / no car access		
Convenient / easier / less hassle		
Environmental reasons		
Health and well-being		
Highest quality journey option		
Quick journey time		
Avoids traffic congestion		
Routine/Habitual (i.e. always travelled that way)		
Reliability		
Other (Please Specify) ____________		

10. Have you changed your usual main mode of travel to your work or place of study since the 1st Jan 2010?
If you have changed more than once tell us about the most recent.

Yes ☐ No ☐ Don't Know ☐

If 'no' or 'don't know' please go to question 15

11. Do you know the Year of this change?

2010 ☐ 2011 ☐ 2012 ☐ 2013 ☐ 2014 ☐ 2015 ☐ 2016 ☐ Don't Know ☐

12. Do you know the Month of this change?

Jan	Feb	Mar	Apr	May	Jun
☐	☐	☐	☐	☐	☐
Jul	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
☐	☐	☐	☐	☐	☐

Don't Know ☐

13. What was your previous usual main mode of travel to your work or place of study?

Tick one box only

Unless Park and Ride, tick the box for the longest part, by distance, of your usual journey to work

Park and Ride - Bus	
Park and Ride - Tram	
Park and Ride - Other	
Bus	
Car, on your own	
Car sharing with other/s	
On foot	
Motorbike / Moped	
Tram	
Train	

14. Thinking about why you made the decision to change your usual mode of travel to bike, please indicate how important each of the following reasons were in making that decision by giving it a score of 1 to 5 with 5 being very important and 1 being of no importance. Please indicate if the reason is not applicable (NA) to you.

Very Important ← Not important

	5	4	3	2	1	NA
Change of workplace						
Change of home address						
Employer removed access to parking at work						
Increase in cost of parking at work						
Deterioration in bus service						
Deterioration in rail service						
Improved cycle facilities/lanes/storage						
Wanted to do more exercise						
Change in family circumstances						
Shorter journey time						
More reliable option						
Other – please specify ____________________ ____________________ ____________________						

15. Do you have any general comments about your journey by bike today?

16. Are you?

Male ☐ Female ☐

17. Are you?

Under 18	
18-25	
25-34	
35-44	
45-59	
60 or over	
Prefer not to say	

18. Do you consider yourself disabled?

Yes	
No	
Prefer not to say	

19. To which of these ethnic groups do you belong?

White	
Black	
Asian	
Mixed	
Chinese	
Other Ethnic Group (please specify below)	
Prefer not to say	

Other ethnic group

To be entered into the FREE prize draw with a chance to win a £20 Victoria Centre Shopping Voucher please provide the following contact information. The winner will be drawn w/c 17/10/2016 and will be notified by 28/10/2016.

NB: This information will only be used for the stated purpose and will not be passed onto a third party.

Name

Contact Telephone Number

Contact Email Address

Thank you for taking the time to complete this survey.

Enumerator

Traveller Survey- NET Line 1

Nottingham City Council is trying to find out more about why people choose to travel in Nottingham by Tram. It would be great if you could find the time to take part in this survey. There will be prize draw for all respondents for £20 of shopping vouchers for Victoria or Broadmarsh Shopping Centre.

Date: ☐ AM Peak ☐ Off Peak ☐ PM Peak ☐

Tram stop: ☐

1. What is the FULL post code of the place where you started your journey (Address if not known)?

2. What is the FULL post code of your destination (Address if not known)?

3. Have you used a park and ride site today to park your car?

   Yes ☐ No ☐

4. What is the purpose of your journey?

Commuting to work or education	
Commuting from work or education	
Business Travel	
Going shopping (non- food or food shopping)	
Accessing healthcare facilities	
Accessing sport, leisure and recreation facilities	
Visiting friends / relatives	
Other reason (Please Specify) ____	

If the answer to the above is Commuting please ask the following, if not commuting go to Q8.

5. Do you normally work/study?

Out of Hours (Within the period 20:00 - 07:00within 8pm to 7am)	
Normal Working Day (Within the period 07:00 – 20:007am to 8pm)	
Other	

6. Is your work/study? **Tick all that apply**

Part Time	
Full Time	
Temporary/Casual Staff	

7. Which of the following best describes the level of skill related to your job/study?

Professional/ Managerial	
Office	
Qualified Manual Work	
Non-Qualified Manual Work	
Student	

8. How far is your journey today?

Up to 1 mile	
Over 1 mile and up to 2 miles	
Over 2 miles and up to 4 miles	
Over 4 miles and up to 10 miles	
Over 10 miles and up to 20 miles	
Over 20 miles	

9. How long do you expect your journey to take?

0 - 15 minutes	
16 - 30 minutes	
31 - 45 minutes	
46 - 60 minutes	
Longer than 60 minutes	

10. What is your main reason for travelling by tram? Tick one 'main' reason in the first column and up to three of the other reasons that are applicable in the second column.

Reason	Main Reason	Other Reasons
Cost		
Can't drive / no car access		
Lack of parking availability		
Capability – e.g. restricted for a disability/impairment		
Confidence – I feel safe/confident travelling this		
Convenient / easier / less hassle		
Avoids traffic congestion		
Environmental reasons		
Direct Service		
Frequency of service		
Highest quality journey option		
Quick journey time		
Reliability		
Routine/Habitual (i.e. always travelled that way)		
Weather conditions		
Other (Please Specify) ______________________________		

11. Have you changed your usual main mode of travel for journeys within Nottingham like the one you are undertaking today since the 1st January 2010? **If you have changed more than once tell us about the most recent.**

Yes ☐ Don't Know ☐

No ☐ **If No or Don't Know go to question 16**

12. Do you know the Year of this change?

2010	2011	2012	2013	2014	2015	2016	Don't Know
☐	☐	☐	☐	☐	☐	☐	☐

13. Do you know the Month of this change?

Jan	Feb	Mar	Apr	May	Jun
☐	☐	☐	☐	☐	☐
Jul	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
☐	☐	☐	☐	☐	☐

Don't Know ☐

14. What was your previous usual main mode of travel for journeys within Nottingham like the one you are undertaking today?
Tick one box only.
Unless park and ride, tick the box for the longest part, by distance, of your usual journey to work.

	Usual choice
Park and Ride - Bus	
Park and Ride - Tram	
Park and Ride - Other	
Bus	
Bicycle	
Car, on your own	
Car, Share with others	
Foot	
Motorbike / Moped	

15. Thinking about why you made the decision to change your usual mode of travel for journeys within Nottingham like the one you are undertaking today to the tram, please indicate how important each of the following reasons were in making that decision by giving it a score of 1 to 5 with 5 being very important and 1 being of no importance. Please indicate if the reason is not applicable (NA) to you.

Very Important ← Not important

	5	4	3	2	1	NA
Change of workplace						
Change of home address						
Employer removed access to parking at work						
Increase in cost of parking at work						
Deterioration in the bus service						
New tram line opened						
Deterioration in the quality of cycle lanes/storage/facilities						
Deterioration in rail service						
Change in family circumstances/Health issues						
Shorter journey time						
More reliable option						
Other – please specify ____________________ ____________________ ____________________						

16. If you have changed your place of work since 2010, did the NET tram line influence that decision?

Not applicable, I haven't changed workplace	
The change of workplace would not have been practical without the NET tram	
The tramline made it easier to change workplace but I would still have done so without it.	
The tram line had no impact on the decision to change workplace.	

17. Do you have any general comments about your journey by tram today?

18. Are you?

Male ☐ Female ☐

19. Are you?

Under 18	
18-25	
25-34	
35-44	
45-59	
60 or over	
Prefer not to say	

20. Do you consider yourself disabled?

Yes	
No	
Prefer not to say	

21. To which of these ethnic groups do you belong?

White	
Black	
Asian	
Mixed	
Chinese	
Other Ethnic Group (please specify below)	
Prefer not to say	

To be entered into the FREE prize draw with a chance to win a £20 Victoria Centre Shopping Voucher please provide the following contact information. The winner will be drawn w/c 12/12/2016 and will be notified by 23/12/2016.

NB: This information will only be used for the stated purpose and will not be passed onto a third party.

Name

Contact Telephone Number

Contact Email Address

Thank you for taking the time to complete this survey.

Enumerator

Traveller Survey- NET Line 2 and 3

Nottingham City Council is trying to find out more about why people choose to travel in Nottingham by Tram. It would be great if you could find the time to take part in this survey. There will be prize draw for all respondents for £20 of shopping vouchers for Victoria or Broadmarsh Shopping Centre.

Date: AM Peak Off Peak PM Peak

Tram stop:

1. What is the FULL post code of the place where you started your journey (Address if not known)?

2. What is the FULL post code of your destination (Address if not known)?

3. Have you used a park and ride site to day to park your car?

   Yes No

4. What is the purpose of your journey?

Commuting to work or education	
Commuting from work or education	
Business Travel	
Going shopping (non- food or food shopping)	
Accessing healthcare facilities	
Accessing sport, leisure and recreation facilities	
Visiting friends / relatives	
Other reason (Please Specify) ________________________________	

If the answer to the above is Commuting please ask the following, if not commuting go to Q8.

5. Do you normally work/study?

Out of Hours (Within the period 20:00 - 07:00within 8pm to 7am)	
Normal Working Day (Within the period 07:00 – 20:007am to 8pm)	
Other	

6. Is your work/study? **Tick all that apply**

Part Time	
Full Time	
Temporary/Casual Staff	

7. Which of the following best describes the level of skill related to your job/study?

Professional/ Managerial	
Office	
Qualified Manual Work	
Non-Qualified Manual Work	
Student	

8. How far is your journey today?

Up to 1 mile	
Over 1 mile and up to 2 miles	
Over 2 miles and up to 4 miles	
Over 4 miles and up to 10 miles	
Over 10 miles and up to 20 miles	
Over 20 miles	

9. How long do you expect your journey to take?

0 - 15 minutes	
16 - 30 minutes	
31 - 45 minutes	
46 - 60 minutes	
Longer than 60 minutes	

10. What is your main reason for travelling by tram? Tick one 'main' reason in the first column and up to three of the other reasons that are applicable in the second column.

Reason	Main Reason	Other Reasons
Cost		
Can't drive / no car access		
Lack of parking availability		
Capability – e.g. restricted for a disability/impairment		
Confidence – I feel safe/confident travelling this		
Convenient / easier / less hassle		
Avoids traffic congestion		
Environmental reasons		
Direct Service		
Frequency of service		
Highest quality journey option		
Quick journey time		
Reliability		
Routine/Habitual (i.e. always travelled that way)		
Weather conditions		
Other (Please Specify) ____________________		

11. What was your previous usual main mode of travel for journeys within Nottingham like the one you are undertaking today before this tram line opened?

Tick one box only

Unless Park and Ride, tick the box for the longest part, by distance, of your usual journey to work

	Usual choice
Park and Ride - Bus	
Park and Ride (Hucknall, Pheonix Park, Wilkinson Street or The Forest)	
Park and Ride - Other	
Bike	
Car, on your own	
Car sharing, Share with others	
On foot	
Motorbike / Moped	
Bus	
Train	

12. Thinking about why you made the decision to change your usual mode of travel for journeys within Nottingham like the one you are undertaking today to the tram, please indicate how important each of the following reasons were in making that decision by giving it a score of 1 to 5 with 5 being very important and 1 being of no importance. Please indicate if the reason is not applicable (NA) to you.

Very Important ← Not important

	5	4	3	2	1	NA
Change of workplace						
Change of home address						
Employer removed access to parking at work						
Increase in cost of parking at work						
<u>Deterioration</u> in the bus service						
<u>New tram line opened</u>						
<u>Deterioration</u> in the quality of cycle lanes/storage/facilities						
<u>Deterioration</u> in rail service						
Change in family circumstances/Health issues						
Shorter journey time						
More reliable option						
Other – please specify ____________________ ____________________ ____________________						

13. If you have changed your place of work since 2010, how did the new tram line influence that decision?

Not applicable, I haven’t changed workplace	
The change of workplace would not have been practical without the new tram line.	
The new tram line made it easier to change workplace but I would still have done so without it.	
The new tram line had no impact on the decision to change workplace.	

14. Do you have any general comments about your journey by tram today?

15. Are you?

Male ☐ Female ☐

16. Are you?

Under 18	
18-25	
25-34	
35-44	
45-59	
60 or over	
Prefer not to say	

17. Do you consider yourself disabled?

Yes	
No	
Prefer not to say	

18. To which of these ethnic groups do you belong?

White	
Black	
Asian	
Mixed	
Chinese	
Other Ethnic Group (please specify below)	
Prefer not to say	

To be entered into the FREE prize draw with a chance to win a £20 Victoria Centre Shopping Voucher please provide the following contact information. The winner will be drawn w/c 12/12/2016 and will be notified by 23/12/2016.

NB: This information will only be used for the stated purpose and will not be passed onto a third party.

Name

Contact Telephone Number

Contact Email Address

Thank you for taking the time to complete this survey.

Nottingham City Council

Enumerator | |

Commuter Survey- Train Commuters.

Nottingham City Council is trying to find out more about why people choose to travel by train to and from work in Nottingham. It would be great if you could find the time to take part in this survey. There will be a prize draw for all respondents for £20 of shopping vouchers for Victoria or Broadmarsh Shopping Centre.

Date: ____________ PM X

1. What is the purpose of your journey?

Commuting to work or education	
Commuting from work or education	
Business Travel	
Going shopping (non- food or food shopping)	
Accessing healthcare facilities	
Accessing sport, leisure and recreation facilities	
Visiting friends / relatives	
Other reason (Please Specify) ________________________________	

<u>If to or from work/education go to question 2 otherwise go to question 15</u>

2. What is the <u>FULL</u> post code of the place where you started your journey (Address if not known)?

3. What is the FULL post code of your destination (Address if not known)?

4. Do you normally work/study?

Out of Hours (Within the period 20:00 - 07:00within 8pm to 7am)	
Normal Working Day (Within the period 07:00 – 20:007am to 8pm)	
Other	

5. Is your work/study? **Tick all that apply**

Part Time	
Full Time	
Temporary/Casual Staff	

6. Which of the following best describes the level of skill related to your job/study?

Professional/ Managerial	
Office	
Qualified Manual Work	
Non-Qualified Manual Work	
Student	

7. How far do you normally travel to your work or place of study?

Up to 1 mile	
Over 1 mile and up to 2 miles	
Over 2 miles and up to 4 miles	
Over 4 miles and up to 10 miles	
Over 10 miles and up to 20 miles	
Over 20 miles	

8. How long does it normally take you to get to your work or place of study?

0 - 15 minutes	
16 - 30 minutes	
31 - 45 minutes	
46 - 60 minutes	
Longer than 60 minutes	

9. What is your main reason for travelling by train? Tick one 'main' reason in the first column and up to three of the other reasons that are applicable in the second column.

Reason	Main Reason	Other Reasons
Cost		
Can't drive / no car access		
Capability – e.g. restricted for a disability/impairment		
Confidence – I feel safe/confident travelling this		
Convenient / easier / less hassle		
Environmental reasons		
Direct service		
Frequency of service		
Highest quality journey option		
Quick journey time		
Avoids traffic congestion		
Reliability		
Routine/Habitual (i.e. always travelled that way)		
Weather conditions		
Other (Please Specify) ________		

10. Have you changed your usual main mode of travel to your work or place of study since the 1st Jan 2010?
If you have changed more than once tell us about the most recent.

Yes ☐ No ☐ Don't Know ☐

If 'no' or 'don't know' please go to question 15

11. Do you know the Year of this change?

2010 ☐ 2011 ☐ 2012 ☐ 2013 ☐ 2014 ☐ 2015 ☐ 2016 ☐ Don't Know ☐

12. Do you know the Month of this change?

Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐

Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Don't Know ☐

13. What was your previous usual main mode of travel to your work or place of study?

Tick one box only

Unless Park and Ride, tick the box for the longest part, by distance, of your usual journey to work.

	Usual choice
Park and Ride - Bus	
Park and Ride - Tram	
Park and Ride - Other	
Bus	
Bike	
Car, on your own	
Car sharing, Share with others	
On foot	
Motorbike / Moped	
Tram	

14. Thinking about why you made the decision to change your usual mode of travel to the train, please indicate how important each of the following reasons were in making that decision by giving it a score of 1 to 5 with 5 being very important and 1 being of no importance. Please indicate if the reason is not applicable (NA) to you.

Very Important ← Not important

	5	**4**	**3**	**2**	**1**	**NA**
Change of workplace						
Change of home address						
Employer removed access to parking at work						
Increase in cost of parking at work						
Improved rail service						
Improved bus service						
Deterioration in the bus service						
New tram line opened						
Deterioration in the quality of cycle lanes/storage/facilities						
Change in family circumstances/Health issues						
Shorter journey time						
More reliable option						
Other – please specify ____________________ ____________________ ____________________						

15. Do you have any general comments about your journey by train today?

16. Are you?

Male ☐ Female ☐

17. Are you?

Under 18	
18-25	
25-34	
35-44	
45-59	
60 or over	
Prefer not to say	

18. Do you consider yourself disabled?

Yes	
No	
Prefer not to say	

19. To which of these ethnic groups do you belong?

White	
Black	
Asian	
Mixed	
Chinese	
Other Ethnic Group (please specify below)	
Prefer not to say	

Other ethnic group

To be entered into the FREE prize draw with a chance to win a £20 Victoria Centre Shopping Voucher please provide the following contact information. The winner will be drawn w/c 12/12/2016 and will be notified by 23/12/2016.

NB: This information will only be used for the stated purpose and will not be passed onto a third party.

Name

Contact Telephone Number

Contact Email Address

Survey Location
(business park and firm
`

Commuter Survey

How do you travel to and from work?

Nottingham City Council is trying to find out more about how people choose to travel to and from work in Nottingham. It would be great if you could find the time to take part in this survey. There will be a prize draw for all respondents for £20 of shopping vouchers for Victoria or Broadmarsh Shopping Centre.

Please answer the following questions about your main mode of transport to and from work:

1. What is your FULL home post code (Address if they don't know it)

2. Do you normally work?

Out of Hours (within 20:00 to 07:00)	
Normal Working Day (Within 07:00 to 20:00)	
Other	

3. Is your work? **Tick all that apply**

Part Time	
Full Time	
Temporary/Casual Staff	

4. Which of the following best describes the level of skill related to your job?

Professional/ Managerial	
Office	
Qualified Manual Work	
Non-Qualified Manual Work	
Other	

5. How far do you normally travel to work?

Up to 1 mile	
Over 1 mile and up to 2 miles	
Over 2 miles and up to 4 miles	
Over 4 miles and up to 10 miles	
Over 10 miles and up to 20 miles	
Over 20 miles	

6. How long does it normally take you to get to work?

0 - 15 minutes	
16 - 30 minutes	
31 - 45 minutes	
46 - 60 minutes	
Longer than 60 minutes	

7. How do you usually travel to work?

Tick one box only

Unless park and ride, tick the box for the longest part, by distance, of your usual journey to work

Park and Ride - Bus	
Park and Ride - Tram	
Park and Ride - Other	
Bus	
Bicycle	
Car, on your own	
Car sharing with other/s	
On foot	
Motorbike / Moped	
Tram	
Train	

8. What is your main reason for usually travelling this way? **Tick one 'main' reason**

Reason	Main Reason
Cost	
Cleanliness / comfort	
Can't drive / no car access	
Capability – e.g. restricted for a disability/impairment	
Confidence – I feel safe/confident travelling this	
Convenient / easier / less hassle	
Environment reasons	
Direct service	
Frequency of service	
Have to drop children off at school	
Health and well-being	
Highest quality journey option	
Quick journey time	
Reliability	
Routine/Habitual (i.e. always travelled that way)	
Less traffic congestion	
Weather conditions	
Other (Please Specify)	

9. What other reason(s) do you have for travelling this way? **Tick up to three reasons.**

Reason	**Other Reasons**
Cost	
Cleanliness / comfort	
Can't drive / no car access	
Capability – e.g. restricted for a disability/impairment	
Confidence – I feel safe/confident travelling this	
Convenient / easier / less hassle	
Environment reasons	
Direct service	
Frequency of service	
Have to drop children off at school	
Health and well-being	
Highest quality journey option	
Quick journey time	
Reliability	
Routine/Habitual (i.e. always travelled that way)	
Less traffic congestion	
Weather conditions	
Other (Please Specify)	

10. Have you changed your usual main mode of travel to work since the 1st January 2010? **If you have changed more than once tell us about the most recent.**

Yes ☐ Don't Know ☐

No ☐ **If No go to question 15**

11. Do you know the Year of this change?

2010	2011	2012	2013	2014	2015	2016	Don't Know
☐	☐	☐	☐	☐	☐	☐	☐

12. Do you know the Month of this change?

Jan	Feb	Mar	Apr	May	Jun
☐	☐	☐	☐	☐	☐

Jul	Aug	Sep	Oct	Nov	Dec	Don't Know
☐	☐	☐	☐	☐	☐	☐

13. What was your previous usual main mode of travel to work?

Tick one box only.

Unless park and ride, tick the box for the longest part, by distance, of your usual journey to work.

	Usual choice
Park and Ride - Bus	
Park and Ride - Tram	
Park and Ride - Other	
Bus	
Bicycle	
Car, on your own	
Car, Share with others	
Foot	
Motorbike / Moped	
Tram	
Train	

14. Thinking about why you made the decision to change your usual mode of travel, Please indicate how important each of the following reasons were in making that decision by giving it a score of 1 to 5 with 5 being very important and 1 being of no importance. Please indicate if the reason is not applicable to you (NA).

Very Important ← Not important

	5	**4**	**3**	**2**	**1**	**NA**
Change of workplace						
Change home address						
Employer removed access to parking at work						
Increase in cost of parking at work						
Improved bus service						
Deterioration in bus service						
New Tram Line opened						
Improvement in quality of cycle lanes/storage/facilities						
Deterioration in quality of cycle lanes/storage/facilities						
Improvement in rail service						
Deterioration in rail service						
Travel incentives/discounts						
Employer acts to make mode of travel more convenient						
Attended a Totally Transport Event sponsored by Nottingham City Council						
Wanted to do more exercise						
Change in family circumstances/Health Issues						
Shorter journey time						
More reliable option						
Other – please specify						

15. Are you aware of the **Totally Transport** initiative whereby your employer has been encouraged to participate in workplace transport events or to develop a workplace travel plan which promotes the use of Public Transport, walking and cycling?

Yes ☐ No ☐

If No Go to Question 17

16. Please say to what extent you agree with the following statements:

	Strongly Agree	Agree	Neither Agree nor Disagree	disagree	Strongly disagree
Totally Transport has contributed to a better quality of life for employees working on this business park					
Totally Transport has made it easier to get a parking space					
Totally Transport has contributed to a reduction of car use for commuting to work in this business Park					

17. Please say to what extent you agree with the following statements:

	Strongly Agree	Agree	Neither Agree nor Disagree	disagree	Strongly disagree
I think it is important to constrain the growth of car use in this area even when it might result in additional costs for car users and/or employers					
All revenue generated from the Workplace Parking Levy should be reinvested to finance measures to encourage the use of public transport, cycling or walking					

18. Do you have any general comments about your commute to and from work?

19. Are you?

Male ☐ Female ☐

20. Are you?

Under 18	
18-25	
25-34	
35-44	
45-59	
60 or over	
Prefer not to say	

21. Do you consider yourself disabled?

Yes	
No	
Prefer not to say	

22. To which of these ethnic groups do you belong?

White	
Black	
Asian	
Mixed	
Chinese	
Other Ethnic Group (please specify below)	
Prefer not to say	

Other ethnic group

To be entered into the FREE prize draw with a chance to win a £50 Victoria Centre Shopping Voucher please provide the following contact information. The winner will be drawn w/c 17/10/2016 and will be notified by 28/10/2016.

NB: This information will only be used for the stated purpose and will not be passed onto a third party.

Name

Contact Telephone Number

Contact Email Address

Thank you for taking the time to complete this survey.