

Accessibility Planning: a chimera?

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The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

This thesis investigates whether Accessibility Planning is a chimera. Is Accessibility Planning an illusion without reality, or is it a feasible planning concept? Are accessibility-based planning approaches not already included in mainstream transport planning practice? The objectives of the study are explored through literature reviews and primary research of planning practitioners and pedestrians. The literature reviews identify a number of potential barriers to Accessibility Planning through assessing research literature and collecting information on previously abandoned approaches that were similar in scope to Accessibility Planning. The potential barriers were rephrased into eight research propositions, divided into two groups, *culture* and *tools*. A further literature review and two surveys seek to answer the propositions. A survey of transport planners in British local authorities investigates difficulties in implementing Accessibility Planning and planners' attitudes to it. A second survey uses questionnaires and an innovative GIS-based analysis to examine pedestrian route choice. The evidence collected by the new GIS methodology assesses the reliability of 'local' accessibility indicators based solely on notional distance. This part of the study also presents new evidence on pedestrian route choice behaviour. Finally, the findings from the two surveys and the literature reviews are brought together and used to confirm or reject the propositions. The results of the study portray how British transport planning culture has changed to take up an accessibility-based planning approach and where the strengths and weaknesses of Accessibility Planning lie. The study concluded that Accessibility Planning is not a chimera and that the tools that have dominated transport planning do not incorporate an accessibility-based planning approach. It also found that there is a significant problem in specifying useful accessibility indicators, that this is an obstacle for effective Accessibility Planning, and that Accessibility Planning requires new skills and ways of working.

Table of contents

In brief

| | | |
|-------------|---|-----|
| Chapter 1. | Introduction | 1 |
| Chapter 2. | Accessibility planning definition | 5 |
| Chapter 3. | Review of literature on accessibility indicators | 17 |
| Chapter 4. | Applications in policy and planning | 40 |
| Chapter 5. | Review of factors influencing pedestrian behaviour | 67 |
| Chapter 6. | Research propositions | 103 |
| Chapter 7. | Consistency between tools that have dominated transport planning and those needed for Accessibility Planning | 111 |
| Chapter 8. | Local Authority survey | 129 |
| Chapter 9. | Pedestrian route choice study | 160 |
| Chapter 10. | Discussion | 208 |
| Chapter 11. | Conclusions | 221 |
| | References | 228 |

Table of contents

In full

| | |
|---|-----------|
| 1. Introduction | 1 |
| 1.1. Introduction | 1 |
| 1.2. Background | 1 |
| 1.3. Research methodology | 2 |
| 1.3.1. Research objectives and propositions | 2 |
| 1.3.2. Research activities | 3 |
| 1.4. Thesis outline | 3 |
| | |
| 2. Accessibility Planning definition | 5 |
| 2.1. Introduction | 5 |
| 2.2. Definitions of accessibility | 5 |
| 2.3. Definitions of mobility | 8 |
| 2.4. Accessibility as a planning concept | 9 |
| 2.4.1. ‘Planning for accessibility’ in literature | 9 |
| 2.4.2. ‘Planning for accessibility’, and mobility | 10 |
| 2.5. Discussion | 12 |
| 2.5.1. Use of the term accessibility | 12 |
| 2.5.2. Differences between accessibility and mobility planning | 13 |
| 2.5.3. Do accessibility-enhancing planning strategies make sense? | 15 |
| 2.6. Conclusions | 15 |
| 2.6.1. Definition of ‘Accessibility Planning’ | 15 |
| | |
| 3. Review of literature on accessibility indicators | 17 |
| 3.1. Introduction | 17 |
| 3.2. Use in transport research | 17 |
| 3.2.1. Many interpretations | 17 |
| 3.2.2. Scope of existing studies | 17 |
| 3.3. How accessibility is measured | 19 |
| 3.3.1. Categorisation and components | 19 |
| 3.3.2. Types of measures | 20 |
| 3.3.2.1. Cumulative opportunity measures | 22 |

| | |
|---|-----------|
| 3.3.2.2. Gravity-based measures | 22 |
| 3.3.2.3. Utility-based measures | 23 |
| 3.4. How to choose an appropriate indicator | 24 |
| 3.4.1. Frameworks for design | 24 |
| 3.4.2. Methodologies for calibration | 26 |
| 3.4.3. Behaviour and known errors | 28 |
| 3.5. Transport modes covered in previous studies | 29 |
| 3.5.1. Overview of studies covering different modes | 29 |
| 3.5.2. Development of 'local' indicators | 32 |
| 3.6. Discussion | 35 |
| 3.6.1. Key findings | 35 |
| 3.6.2. Gaps in knowledge | 37 |
| 3.6.3. Directions for further research | 38 |
| 3.7. Conclusions | 38 |
| | |
| 4. Applications in policy and planning | 40 |
| 4.1. Introduction | 40 |
| 4.2. British planning examples and concepts | 40 |
| 4.2.1. Overview | 40 |
| 4.2.2. Post-war new town planning in the UK | 40 |
| 4.2.2.1. General planning principles | 40 |
| 4.2.2.2. Specific examples | 41 |
| 4.2.2.3. Policy outcomes and abandonment | 43 |
| 4.2.3. British Structure Plans | 43 |
| 4.2.3.1. General planning principles | 43 |
| 4.2.3.2. Specific examples | 44 |
| 4.2.3.3. Policy outcomes and abandonment | 47 |
| 4.2.4. Use of Public Transport Accessibility Level indicators | 48 |
| 4.2.4.1. General planning principles | 48 |
| 4.2.4.2. Application and policy outcomes | 49 |
| 4.2.5. Use of accessibility profiles in Planning Policy Guidance 13 | 49 |
| 4.2.5.1. General planning principles | 49 |
| 4.2.5.2. Application and policy outcomes | 50 |

| | |
|--|-----------|
| 4.3. Recent developments in British transport policy | 50 |
| 4.3.1. Developments during the late 1990s | 50 |
| 4.3.2. Accessibility Planning | 51 |
| 4.3.3. Eddington study | 53 |
| 4.3.4. Sustainability, land use policy and eco-towns | 54 |
| 4.3.5. Towards a Sustainable Transport System | 55 |
| 4.4. Dutch transport and development planning 1988 -2001 | 56 |
| 4.4.1. General planning principles | 56 |
| 4.4.2. Policy outcomes and abandonment | 58 |
| 4.5. Discussion | 59 |
| 4.5.1. Use of accessibility indicators and standards | 59 |
| 4.5.2. How did the use of accessibility indicators come about? | 60 |
| 4.5.3. The role of planning culture | 61 |
| 4.5.4. Abandoned and surviving concepts | 62 |
| 4.5.5. Abandonment | 63 |
| 4.5.5.1. Reasons for the abandonment of accessibility indicators used in new town planning | 63 |
| 4.5.5.2. Reasons for the abandonment of accessibility indicators used in transport and land use structure plans | 64 |
| 4.5.5.3. Reasons for the abandonment of the A-B-C policy | 64 |
| 4.6. Conclusions | 65 |
| 5. Review of factors influencing pedestrian behaviour | 67 |
| 5.1. Introduction | 67 |
| 5.2. Study approach: accessibility needs vs. observed behaviour | 68 |
| 5.3. Factors important for walking propensity | 69 |
| 5.3.1. Overview of studies investigated | 69 |
| 5.3.2. Introduction to research on urban form, travel behaviour and pedestrians | 69 |
| 5.3.3. Findings in studies on non-specific routes | 70 |
| 5.3.4. Findings in studies on route and local area attributes | 77 |
| 5.4. Factors affecting pedestrian quality of travel | 83 |
| 5.4.1. Findings in studies on quality of travel | 83 |
| 5.5. Factors important for pedestrian route choice | 85 |

| | |
|--|------------|
| 5.5.1. Findings on pedestrian route choice | 85 |
| 5.6. Problems reported by pedestrians | 93 |
| 5.6.1. Findings in surveys on pedestrian problems | 93 |
| 5.6.2. Comment | 95 |
| 5.7. Discussion | 95 |
| 5.7.1. Summary of findings | 95 |
| 5.7.2. Relevance of findings for Accessibility Planning | 96 |
| 5.7.3. Critique of the evidence | 97 |
| 5.8. Conclusions | 101 |
| 5.8.1. Limitations of previous studies | 101 |
| 5.8.2. Indicators based solely on distance exclude many serious user problems | 101 |
| 5.8.3. Directions for further study | 102 |
| 6. Research propositions | 103 |
| 6.1. Introduction | 103 |
| 6.2. Motivations for research propositions | 103 |
| 6.2.1. Summary of findings in previous chapters | 103 |
| 6.2.2. Development of research propositions and study limitations | 104 |
| 6.2.3. Two overarching research propositions | 105 |
| 6.3. Propositions on planning culture | 106 |
| 6.4. Propositions on planning tools | 107 |
| 6.5. How the propositions are addressed | 108 |
| 6.5.1. Consideration of alternative data collection methodologies | 108 |
| 6.5.2. Selected approach to data collection | 109 |
| 7. Consistency between tools that have dominated transport planning and those needed for Accessibility Planning | 111 |
| 7.1. Introduction | 111 |
| 7.2. How four stage models and CBA handle local accessibility | 111 |
| 7.2.1. Tools used to appraise accessibility | 111 |
| 7.2.2. Four stage models and accessibility | 112 |
| 7.2.3. Cost-benefit analysis, NATA and accessibility | 113 |
| 7.2.4. Comment | 114 |

| | |
|--|------------|
| 7.3. Criticisms of transport appraisal methodology and its relevance for | |
| Accessibility Planning | 115 |
| 7.3.1. Four stage models | 115 |
| 7.3.1.1. Introduction | 115 |
| 7.3.1.2. Limitations in scope | 115 |
| 7.3.1.3. Limited prediction accuracy | 116 |
| 7.3.1.4. Concerns about lack of transparency | 117 |
| 7.3.1.5. Consequences for planning practice | 118 |
| 7.3.2. Cost-benefit analysis | 119 |
| 7.3.2.1. Introduction | 119 |
| 7.3.2.2. Treatment of equity aspects | 120 |
| 7.3.2.3. Handling of democratic and ethical values | 121 |
| 7.3.2.4. Use of cost-benefit analysis in a field where some policy | |
| instruments are not possible to quantify in monetary terms | 123 |
| 7.3.2.5. Consequences for planning practice | 123 |
| 7.4. Discussion | 124 |
| 7.4.1. How four stage models may have held back Accessibility Planning | 124 |
| 7.4.2. Equity, CBA and Accessibility Planning objectives | 126 |
| 7.5. Conclusions | 127 |
| 8. Local Authority Survey | 129 |
| 8.1. Introduction | 129 |
| 8.2. Methodology | 129 |
| 8.2.1. Timing | 129 |
| 8.2.2. Questionnaire design | 129 |
| 8.2.3. Sample selection | 131 |
| 8.2.4. Survey distribution | 131 |
| 8.2.5. Response rate | 132 |
| 8.2.6. Potential biases | 132 |
| 8.3. Selected findings | 133 |
| 8.3.1. Accessibility Planning and transport planning culture | 134 |
| 8.3.1.1. Association with transport planning | 134 |
| 8.3.1.2. Helpfulness at different stages of a planning process | 135 |
| 8.3.1.3. How the issue has been dealt with before | 136 |

| | |
|---|------------|
| 8.3.1.4. Expected outcomes | 138 |
| 8.3.2. Usefulness of accessibility indicators in transport planning | 141 |
| 8.3.2.1. Advantages of Accessibility Planning | 141 |
| 8.3.3. Planners' perception of the reliability of local accessibility indicators | 142 |
| 8.3.3.1. Reliability of walking and cycling indicators | 142 |
| 8.3.4. Accessibility Planning and economic objectives | 143 |
| 8.3.4.1. Policy synergies and conflicts | 143 |
| 8.3.5. Accessibility Planning, skills and ways of working | 145 |
| 8.3.5.1. Working in partnerships | 145 |
| 8.3.6. Accessibility Planning and traditional transport models | 148 |
| 8.3.6.1. Making use of Accessibility Planning outputs | 148 |
| 8.3.7. Availability of data on local accessibility | 150 |
| 8.3.7.1. Data availability, resolution and conversion | 150 |
| 8.4. Discussion | 151 |
| 8.4.1. Identifying needs | 152 |
| 8.4.2. Integrating land use and transport planning | 154 |
| 8.4.3. Achieving the right balance between building infrastructure and investing in measures that enhance local accessibility | 155 |
| 8.4.4. Addressing negative changes in commercial service patterns | 156 |
| 8.5. Conclusions | 157 |
| 9. Pedestrian route choice study | 160 |
| 9.1. Introduction | 160 |
| 9.1.1. Scope | 160 |
| 9.1.2. Background | 160 |
| 9.1.3. Why study route choice? | 161 |
| 9.2. Methodology | 161 |
| 9.2.1. Survey design | 161 |
| 9.2.2.1. Route choice workshop | 162 |
| 9.2.2.2. Consideration of alternative survey techniques | 162 |
| 9.2.2.3. Preliminary design of questionnaire | 162 |
| 9.2.2.4. Pilot study | 163 |
| 9.2.2.5. Final questionnaire design | 164 |

| | |
|---|-----|
| 9.2.2.6. Selection of survey area | 165 |
| 9.2.3. Model of study network | 167 |
| 9.2.4. Environmental attributes | 167 |
| 9.2.5. Network analysis | 168 |
| 9.3. Key findings | 170 |
| 9.3.1. Sample | 170 |
| 9.3.2. Response bias | 170 |
| 9.3.3. Walking to Arndale Centre | 171 |
| 9.3.4. Reasons for not walking to a particular place | 172 |
| 9.3.5. Improvements to make more journeys possible | 174 |
| 9.4. Modelling results: walking propensity | 176 |
| 9.4.1. The role of distance | 176 |
| 9.4.2. The role of differences in elevation | 176 |
| 9.4.3. The role of continuous high quality routes | 178 |
| 9.5. Modelling results: pedestrian route choice | 180 |
| 9.5.1 Route choice during daytime and when dark | 180 |
| 9.5.2. Proportion not choosing to take the shortest route | 181 |
| 9.5.3. Route choice and gender | 181 |
| 9.5.4. Route choice and age | 182 |
| 9.5.5. Route choice and walking frequency | 183 |
| 9.5.6. Reasons for taking an alternative route | 184 |
| 9.5.7. Reasons for taking a longer route | 185 |
| 9.5.8. Route quality and route choice | 187 |
| 9.6. Three illustrative examples of walking behaviour | 191 |
| 9.6.1. Selection of locations to be investigated | 191 |
| 9.6.2. Beckett Park footpath | 192 |
| 9.6.3. The Ginnel | 194 |
| 9.6.4. Headingley Mount/ Ash Road junction | 196 |
| 9.7. Discussion | 199 |
| 9.7.1. Findings on walking propensity in this and other studies | 199 |
| 9.7.2. Findings on pedestrian route choice in this study | 200 |
| 9.7.2.1. General facts on route choice | 200 |
| 9.7.2.2. Explaining route choice behaviour | 200 |

| | |
|---|------------|
| 9.7.3. Findings on route choice in previous studies | 201 |
| 9.7.4. Assessing the strength of the evidence | 201 |
| 9.7.5. Relevance for Accessibility Planning | 203 |
| 9.7.6. Implications of the findings for the specification of indicators | 204 |
| 9.8. Conclusions | 205 |
| 9.8.1. Overly simple indicators hamper Accessibility Planning | 205 |
| 9.8.2. Recommendations on pedestrian accessibility indicators | 206 |
| 9.8.3. Further analysis and research | 206 |
| 10. Discussion | 208 |
| 10.1. Introduction | 208 |
| 10.2. Culture as a barrier | 208 |
| 10.2.1. Potential tensions between Accessibility Planning and transport planning | 208 |
| 10.2.1.1. Key findings | 208 |
| 10.2.1.2. Assessment | 209 |
| 10.2.2. Do planners perceive accessibility indicators sceptically? | 210 |
| 10.2.2.1. Key findings | 210 |
| 10.2.2.2. Assessment | 210 |
| 10.2.3. Potential conflict with economic objectives | 211 |
| 10.2.3.1. Key findings | 211 |
| 10.2.3.2. Assessment | 211 |
| 10.2.4. Skills and ways of working | 212 |
| 10.2.4.1. Key findings | 212 |
| 10.2.4.2. Assessment | 213 |
| 10.3. Tools as a barrier | 214 |
| 10.3.1. The role of four stage transport models | 214 |
| 10.3.1.1. Key findings | 214 |
| 10.3.1.2. Assessment | 215 |
| 10.3.2. Specification of indicators | 215 |
| 10.3.2.1. Key findings | 215 |
| 10.3.2.2. Assessment | 216 |
| 10.3.3. Availability of data | 216 |
| 10.3.3.1. Key findings | 216 |

| | |
|---|------------|
| 10.3.3.2. Assessment | 217 |
| 10.3.4. Equity and appraisal techniques | 218 |
| 10.3.4.1. Key findings | 218 |
| 10.3.4.2. Assessment | 219 |
| 10.4. Summary of results | 219 |
| | |
| 11. Conclusions | 221 |
| 11.1. Introduction | 221 |
| 11.2. A chimera or not? | 221 |
| 11.3. Difficulties and barriers | 222 |
| 11.4. Is Accessibility Planning worthwhile? | 223 |
| 11.5. Recommendations for policy | 225 |
| 11.6. Summary of achievements | 225 |
| 11.7. Future research | 226 |
| | |
| References | 228 |
| | |
| Appendices | |
| Appendix 1. Overview of the planning approach used in the West Yorkshire Transportation Study | 250 |
| Appendix 2. Overview of planning approaches used in the South Yorkshire Structure Plan | 260 |
| Appendix 3. Local Authority survey questionnaire | 268 |
| Appendix 4. Do transport planners think that Accessibility Planning fits into the culture and context of transport planning? | 276 |
| Appendix 5. Route choice survey questionnaire | 279 |
| Appendix 6. Environmental attributes priority list | 288 |
| Appendix 7. Further results of the network model | 290 |
| | |
| Figures | |
| Figure 2.1. Principal relationship between Accessibility Planning and Accessibility-enhancing planning strategies | 16 |
| Figure 3.1. Examples of distance decay functions | 27 |

| | | |
|--------------|--|-----|
| Figure 8.1. | Usefulness of Accessibility Planning to local authorities | 135 |
| Figure 8.2. | Do the outputs of accessibility planning increase the ability to communicate the transport problems faced by residents to local policy makers? | 136 |
| Figure 8.3. | Is the concept of Accessibility Planning new to your local authority? | 137 |
| Figure 8.4. | Documents where Accessibility Planning issues have been addressed before | 138 |
| Figure 8.5. | Expected change in the level of accessibility for user groups | 139 |
| Figure 8.6. | Expected change in the level of accessibility for user groups in LTP authorities | 139 |
| Figure 8.7. | Expected change in the level of accessibility for user groups in non-LTP authorities | 140 |
| Figure 8.8. | Reliability of walking and cycling indicators | 143 |
| Figure 8.9. | Consistency between objectives of Accessibility Planning and local policies | 144 |
| Figure 8.10. | Do outputs of Accessibility Planning allow a meaningful comparison with other transport problems? | 149 |
| Figure 8.11. | Do outputs of Accessibility Planning allow a meaningful comparison with traditional transport models such as SATURN? | 149 |
| Figure 8.12. | Responses on data availability and tools | 150 |
| Figure 8.13. | Stages in the Accessibility Planning process | 153 |
| Figure 9.1. | Map of survey area and the location of the Arndale Centre | 165 |
| Figure 9.2. | Respondents' reasons for avoid walking to a particular local shop, service or bus stop | 173 |
| Figure 9.3. | Improvements that would make more local journeys on foot possible | 174 |
| Figure 9.4. | Proportion of trips where route distance is greater than shortest path | 180 |
| Figure 9.5. | Proportion of trips for women and men where route distance is greater than shortest path | 182 |
| Figure 9.6. | Proportion of trips where route distance is greater than shortest path by age group | 182 |

| | | |
|---------------|--|-----|
| Figure 9.7. | Proportion of trips where route distance is greater than shortest path by walking frequency to the Arndale Centre during daytime | 183 |
| Figure 9.8. | Proportion of trips where route distance is greater than shortest path by walking frequency to the Arndale Centre when dark | 183 |
| Figure 9.9. | Proportion of respondents indicating that they sometimes take another route than their preferred one to the Arndale Centre | 184 |
| Figure 9.10. | Location of Beckett Park, the Ginnel and Headingley Mount | 192 |
| Figure 9.11. | Beckett Park footpath due west | 193 |
| Figure 9.12. | Plan of Beckett Park footpath | 193 |
| Figure 9.13. | Respondents using Beckett Park footpath | 194 |
| Figure 9.14. | The Ginnel footpath due north | 195 |
| Figure 9.15. | Plan of the Ginnel | 195 |
| Figure 9.16. | Respondents using the Ginnel | 196 |
| Figure 9.17. | Headingley Mount – Ash Road junction looking west along Ash Road | 197 |
| Figure 9.18. | Plan of Headingley Mount/ Ash Road junction | 197 |
| Figure 9.19. | Respondents crossing Headingley Mount at Ash Road junction | 198 |
| | | |
| Tables | | |
| Table 3.1. | Scope of selected studies on accessibility | 18 |
| Table 3.2. | Terminology for accessibility measures in selected studies | 21 |
| Table 3.3. | Impedance factors and modes in selected studies | 30 |
| Table 4.1. | Selected accessibility standards in British new towns | 41 |
| Table 4.2. | Personal accessibility indicators in the West Yorkshire Transportation Study | 45 |
| Table 4.3. | Accessibility indicators in the South Yorkshire Structure Plan | 47 |
| Table 4.4. | Matching principles for mobility and accessibility profiles | 57 |
| Table 4.5. | Examples of business classifications | 57 |
| Table 4.6. | Reasons for using planning methodologies based on accessibility indicators | 60 |
| Table 5.1. | Findings on urban form and walking propensity: selected studies on non-specific routes | 72 |
| Table 5.2. | Findings on urban form and walking propensity: selected studies on route and local area attributes | 80 |

| | | |
|--------------|--|-----|
| Table 5.3. | Findings in selected studies on pedestrian route choice | 91 |
| Table 5.4. | Proportion of pedestrians reporting problems | 94 |
| Table 6.1. | Relevance of remaining research activities for research propositions | 110 |
| Table 7.1. | Typical zone sizes in four stage models | 113 |
| Table 8.1. | Comparison between authorities responding to the questionnaire and those on the send list | 133 |
| Table 8.2. | Main advantages of Accessibility Planning | 141 |
| Table 8.3. | Main difficulties and disadvantages | 146 |
| Table 9.1. | Environmental attributes included in the network model | 168 |
| Table 9.2. | Respondents' characteristics compared with local Census data | 170 |
| Table 9.3. | Characteristics for respondents walking to the Arndale Centre | 172 |
| Table 9.4. | Propensity to walk and distance | 176 |
| Table 9.5. | Walking propensity and change in elevation | 177 |
| Table 9.6. | Walking propensity and average gradient | 177 |
| Table 9.7. | Walking propensity for those with high quality routes | 178 |
| Table 9.8. | Proportion of respondents whose routes qualify as high-quality on two or more criteria | 179 |
| Table 9.9. | Respondents' detours during daytime and when dark | 181 |
| Table 9.10. | Proportion of respondents giving different reasons for sometimes taking another route | 185 |
| Table 9.11. | Proportion of respondents stating 'very important' reasons for choosing their daytime walking routes | 186 |
| Table 9.12. | Proportion of respondents stating 'very important' reason for choosing their walking routes when dark | 187 |
| Table 9.13. | Results for networks achieving high overall prediction rates | 189 |
| Table 9.14. | Accessibility issues at three specific locations | 191 |
| Table A.1.1. | Outline of personal accessibility measures used for urban areas in the West Yorkshire Transportation Study | 251 |
| Table A.2.1. | Outline of accessibility measures used in the South Yorkshire Structure Plan | 261 |
| Table A.2.2. | Weights assigned to accessibility related objectives for Industrial Development | 265 |

| | |
|---|-----|
| Table A.2.3. Weights assigned to accessibility related objectives for Housing Development | 265 |
| Table A.2.4. Weights assigned to accessibility related objectives for Countryside Recreation Development | 265 |
| Table A.6.1. Environmental attributes priority list | 288 |
| Table A.7.1. Results for networks with different levels of natural surveillance | 290 |
| Table A.7.2. Results for networks with different levels of vehicle flow | 291 |
| Table A.7.3. Results for networks with different levels of lighting or surfacing | 292 |
| Table A.7.4. Results for selected networks with multiple attributes including vehicle flow | 293 |
| Table A.7.5. Results for selected networks with multiple attributes including lighting | 294 |
| Table A.7.6. Respondents using a route for which some links are omitted | 295 |

Chapter 1

Introduction

1.1. Introduction

This thesis investigates whether Accessibility Planning is a chimera. Are accessibility-based planning approaches not already included in mainstream transport planning practice? Is Accessibility Planning simply an illusion without reality, or is it a theoretically feasible planning concept but difficult to implement? Perhaps it is a likeable planning concept that when implemented brings negative consequences or conflicts. Or is it simply a way of planning transport networks and land use more effectively?

1.2. Background

A recent change in British transport policy (DfT 2004a, DfT 2006a) requires English local transport authorities to develop ‘accessibility strategies’. The concept of developing the strategies is known as *Accessibility Planning*¹ and includes setting targets and implementing measures to improve access to basic services for socially excluded groups. Draft accessibility strategies were to be integrated in each authority’s Local Transport Plan (LTP) by March 2006 at the latest.

When Accessibility Planning was implemented, an initiative called ‘planning for accessibility’ had been expected for some time. Such a planning initiative had already been pledged at the start of Tony Blair’s and New Labour’s first term in power (DETR 1998a, p.123). However, it was not until five years later that the principal framework for such an approach was outlined in a governmental report on transport and social exclusion (SEU 2003). Guidance for the new planning concept followed (DfT 2004a, DfT 2004b). However, the idea of planning for accessibility is, in fact, not new. Planning methodologies based on accessibility indicators have been tested at local and national levels (see for example Wytconsult 1977a), but several of these early initiatives were abandoned

¹ The concept is more fully defined and discussed in Chapter 2.

relatively quickly (see Chapter 4). In addition, many of the measures for alleviating social exclusion promoted in the Social Exclusion Unit's report (SEU 2003), i.e. improving walking, cycling and public transport networks, have for a long time been part of transport plans.

During consultation on the new Accessibility Planning guidance concerns were raised about how to interpret the core indicators put forward by the DfT and the appropriateness of the information produced (Davis 2004). In particular, the appropriateness of indicators proposed for walking and cycling was questioned (Chiaradia 2004). There was also concern expressed that local authorities would treat Accessibility Planning as a separate task related to the planning of certain deprived areas and would not mainstream the approach (Headicar 2004). Considering all the above, it seemed fair to say that some apprehension surrounded the launch of Accessibility Planning.

1.3. Research methodology

1.3.1. Research objectives and propositions

As previously mentioned, the main research question was to investigate if Accessibility Planning is a chimera. To answer this, four main research objectives were formulated:

- To investigate the empirical foundation of 'local' accessibility indicators,
- To examine why planning methodologies using accessibility indicators, developed between 1970s and 1990s, did not succeed,
- To survey the role of potential barriers to Accessibility Planning, and
- To analyse how practical planning tools for measuring accessibility could best be improved.

The study formulated two overarching research propositions for why planning methodologies using accessibility indicators *had not previously succeeded*. The first proposition studied cultural barriers to Accessibility Planning (exploring potential conflicts between Accessibility Planning and the dominant transport planning culture). A second proposition investigated whether lack of planning tools was a barrier to Accessibility Planning (examining the availability of tools

needed to assess accessibility). Each overarching proposition was further subdivided into a number of underlying research propositions (see Chapter 6).

1.3.2. Research activities

Literature reviews were used to identify gaps in previous research and to develop research propositions surrounding barriers to Accessibility Planning. A further literature review examined tools used for transport planning and compared them to those needed for Accessibility Planning. Two surveys were then designed to answer the research propositions. A survey of local authorities collected data on local implementation barriers and the perceptions of Accessibility Planning amongst transport planners. Results from this survey and from the literature reviews steered the scope of a second survey which explored how accessibility levels varied depending on the design of an accessibility indicator's impedance function when travelling on foot. This survey, reported in Chapter 9, includes a novel approach to analysing pedestrian route choices. Further details of the methodologies applied in the surveys are presented in Chapters 8 and 9.

1.4. Thesis outline

The thesis is written largely in the order the research was carried out. The first part of the thesis (Chapters 2-6) examines the differences between 'planning for accessibility' and 'planning for mobility', how accessibility can be measured and how accessibility indicators have been used in planning practice.

Chapter 2 investigates how the notion of accessibility has been defined in transport literature. It distinguishes between 'Accessibility Planning', and 'accessibility-enhancing' planning strategies, and 'local' and 'regional' accessibility. Chapter 3 examines the use and development of accessibility indicators in transport research and methodologies for designing appropriate accessibility measures. Chapter 4 reviews how accessibility indicators have been used in transport policy and planning practice as well as reasons for the abandonment of earlier planning methodologies based on accessibility indicators. Given its importance for 'local' accessibility, Chapter 5 examines how accessibility on foot can best be measured and what knowledge exists about pedestrian propensity and route choice from transport research. Chapter 6

summarises the first part of the thesis. The research propositions on potential barriers to Accessibility Planning are also presented here.

The second part of the thesis, Chapters 7-11, presents the analysis of the surveys, discusses the results and draws conclusions. Chapter 7 examines how different aspects of accessibility are dealt with in dominant transport planning tools and appraisal methodologies. Chapter 8 reports on the survey of local authorities. Chapter 9 analyses pedestrian route choices. Chapter 10 examines each of the research propositions based on key findings from previous chapters, and Chapter 11 summarises the strengths and weaknesses of Accessibility Planning, answers the main research question and provides recommendations for further research.

Chapter 2

Accessibility Planning definition

2.1. Introduction

This chapter establishes a definition of Accessibility Planning for this thesis. Any definition of accessibility planning needs to rest on a firm understanding of the notion of accessibility as well as that of mobility. This is because the two concepts have often been confused and used interchangeably (Hodge 1997, p.33, Salomon et al. 1998, p.130). The structure of the chapter follows on from this. First, various definitions of accessibility and mobility are presented. This is followed by a section exploring earlier definitions of accessibility as a planning concept. The use of accessibility in transport planning is then discussed. This section also looks at differences and similarities between accessibility-enhancing and mobility-enhancing strategies. Finally, the chapter concludes with the definition of Accessibility Planning adopted in this thesis.

2.2. Definitions of accessibility

Definitions of accessibility used in everyday language tend to focus on physical access. The Oxford Advanced Learner's Dictionary (2000) defines 'accessible' as "that can be reached, entered, used, seen, etc." and is exemplified by: "The remote desert area is accessible only by helicopter". In a similar vein, the Cambridge Advanced Learner's Dictionary (2003) defines 'accessible' as able to be reached or easily obtained. Accessibility is exemplified by: "Two new roads are being built to increase accessibility to the town centre." Consequently, accessibility is generally used to refer to the effort, means, or modes, with which a destination can be reached.

In transport planning, accessibility has been defined in several different ways. Hansen (1959) translated accessibility as the 'potential for interaction' taking into account the distance between an origin and a destination as well as the value of, or number of, opportunities available at a destination. Similarly, Breheny (1974) defined accessibility as 'spatial opportunity'. These accessibility definitions

typically included two elements: an impedance factor describing transport networks and a factor for the activity or opportunity available at a location. Quite differently, *Traffic in Towns* (Buchanan et al. 1963, p. 55) defined accessibility as the ability to move from one part of town to another and beyond in safety and with “reasonable speed, directness and aesthetic pleasantness for the drivers” and to “penetrate without delay and stop without restriction in the vicinity” of the destination. A shorter interpretation of accessibility was taken as “the degree of freedom for vehicles to circulate and to penetrate individual destinations and to stop on arrival” (Ibid, Glossary of terms).

Hägerstrand (1970) developed an accessibility concept called the time-geography prism. His concept took people’s different abilities to make a journey throughout the day into account, in addition to transport network impedance and opportunities at locations. For example, in a household with two working adults and one car, the two adults often have very different levels of accessibility depending on who was in charge of the car (if for example their work places were not located together).

Ingram (1971) distinguished between ‘relative’ accessibility and ‘integral’ accessibility. ‘Relative’ accessibility was taken as the physical separation between two locations while ‘integral’ accessibility was defined as how one location related to all other locations in a given area. Ingram’s definitions of ‘relative’ and ‘integral’ accessibility excluded the value of opportunity. For example, a destination with many work places was valued the same as one with few. This was deliberate in order not to confuse variations in transport network performance (distance, time, costs) and variations in the value of opportunity at destinations.

Jones (1981) reviewed a number of transport studies in order to formulate his definition of accessibility. Within these studies the use of accessibility was aimed mainly at understanding travel behaviour, car ownership and residential location. The studies employed the following broad notions of accessibility:

- Spatial separation (point to point or one point to all other points),
- Travel cost of observed or expected trips,
- The opportunity which an individual at a given location possesses to take part in a particular activity or set of activities, and

- Average opportunity of the population resident in an area to take part in a particular activity or set of activities.

Jones (1981, p.22) concluded that accessibility was concerned with the opportunity that an “individual or type of person at a given location possessed to take part in a particular activity or set of activities”.

Handy (1993, p.60) distinguished between ‘local’ and ‘regional’ accessibility for non-work trips. Local accessibility was defined as dependent on “proximity to locally oriented centers of activity” such as supermarkets, pharmacies and other convenience services. Regional accessibility was defined with respect to larger city centres and commercial areas associated with less frequent trips.

Johnston et al. (1994, p.2) suggested that accessibility in its “simplest” form can be defined as the ease with which one place can be reached from another. According to Johnston, more wide-ranging accessibility definitions typically incorporate at least three elements: the location or function from where accessibility is measured, the transport system and the location of activities to which access is being measured.

Accessibility is also frequently used to describe street usability and transport needs specific for the disabled and the elderly (HMSO 1995, Folkesson 2002). For example, dropped kerbs and low-floor vehicles are referred to as accessibility improvements. In this context, accessibility typically denotes disabled users’ ability to travel independently.

IHT (1997, p.32) defined accessibility as the ease of reaching services. They stressed that accessibility is “what movement has actually achieved”, not more, easier and faster movement per se. Comparable definitions have been used by May (2001) and SEU (2003). May (2001, p. 48) suggested that accessibility is the “ease of reaching” and continues that it is different types of facilities that are understood to be reached, not places in general. Similarly, SEU (2003, p.1.) defined accessibility as people’s ability to get to “key services at reasonable cost, in reasonable time and with reasonable ease” Accessibility levels were said to

depend on many things, including transport networks, information about transport services, personal security and the reliability of transport services. To sum up, key distinctions in more recent definitions of accessibility in transport planning, such as those presented by IHT (1997), May (2001) and SEU (2003), are accessibility as an attribute of people and of places (accessibility to and accessibility from).

2.3. Definitions of mobility

Cambridge Advanced Learner's Dictionary (2003) defines 'mobile' as 'able to move, able to move freely or be easily moved'. Oxford Advanced Learner's Dictionary (2000) describes mobility as the ability to move or travel around, easily exemplified by: "*an electric wheelchair has given her greater mobility*" and "*mobility training for the blind*". Consequently, mobility in everyday language often means that a person has the ability to travel. However, there are several other interpretations too.

Hansen (1959) defined mobility as the potential for movement, the ability to get from one *place* to another, an interpretation close to the general meaning of accessibility (see Section 2.2). Mobility as used in human geography is connected to migration, i.e. the number of people moving residency from one area to another (see Johnston et al. 1994). In transport planning, Salomon et al. (1998, pp. 130-31) identified that mobility was referred to in three ways: as the amount of travel a person carried out, as an aggregate measure of transport network performance and as a more "perceptual" measure of choices and ability to travel. Mobility, as accessibility, is also often mentioned in relation to disabled persons' ability to use transport services and buildings. In addition, mobility is frequently used in the context of 'sustainable mobility', implying that the desired amount of movement depends on its environmental, social and economic impacts (see e.g. Banister & Åkerman 2000).

To sum up, the concepts of accessibility and mobility are similar and the level of accessibility one has is generally dependent on ones mobility (ability to move). However, the two concepts are distinct in that they refer to rather different qualities of life, e.g. the ability to spend little time travelling versus the ability to

travel a lot. The two notions may therefore represent quite different strategies for how to improve the performance of the combined land use and transport system.

2.4. Accessibility as a planning concept

2.4.1. 'Planning for accessibility' in literature

The first explicit mentioning of the term 'accessibility planning' found through review was in work by Cervero (1996). The concept of planning for accessibility has thereafter been employed in several different ways. Nonetheless, the idea of 'accessibility' as a planning concept is far from new. Planning methodologies during the 1970s used accessibility indicators to investigate joint performance of transport networks and land uses (e.g. Wytconsult 1977a). These studies did not label themselves as 'planning for accessibility' or 'accessibility planning'. Dallal (1980) was another early example putting forward a planning methodology based around the concept of measuring 'accessibility'. Further details of the abovementioned planning concepts will be presented in Chapter 4.

Cervero (2001) expanded on his 1996 definition of 'accessibility planning' describing it as an approach that competed with and complemented the traditional focus of transport planning on mobility and effortless movement. A key difference between planning for mobility versus accessibility, he suggested, was between planning for cars versus planning for people and places. A key rationale for 'accessibility planning' was, according to Cervero (2001), negative environmental impacts of too much traffic, but also that people would like to spend more time at their destinations and shorter time moving around. Cervero's definition appears to suggest two things. Firstly, that people desired to reside in a place where their wanted everyday functions could be reached without long journeys, and secondly, that people often lacked opportunities in choosing such a location.

The 1998 Transport White Paper (DETR 1998a) championed a strategy of increased opportunities to reach services and work places by walking, cycling and public transport. This approach of giving "greater emphasis to accessibility, in the sense of access to jobs, leisure and services by public transport, walking and cycling, in the land use planning process" was called "planning for accessibility"

(p.123). Planning for accessibility, the strategy pointed out, meant a strong focus on careful assessment of land use policies and the use of parking standards in order to improve modal choice.

SEU (2003) developed much of the framework for the approach to the current English and Welsh approach to Accessibility Planning (DfT 2004a). SEU (2003, p. 60) defined the concept as a framework for a transport-oriented planning process that “will ensure that there is clear responsibility and accountability for identifying accessibility problems and deciding how to tackle them. This process will enable local authorities and other agencies to assess more systematically whether people facing social exclusion can get to key activities, and to work more effectively together on implementing solutions.” A similar definition was used by the DfT (2004a), *Guidance on Accessibility Planning in Local Transport Plans*.

All the planning concepts mentioned above make use of accessibility indicators in one way or another. The indicators are typically defined by setting up some form of accessibility standards. Sometimes the importance of such standards for the planning concept is rather implicit (DETR 1998a, Cervero 2001). In other cases it is a well articulated part of the planning methodology (see e.g. Wytconsult 1977a and SEU 2003). Accessibility standards can for example describe the level of accessibility attributed to a person or a location that is considered adequate, for example, a maximum desirable travel time to a particular type of facilities (see e.g. Wytconsult 1977a). However, accessibility standards do not just have to consist of a fixed distance, cost or time. They can also be based on a distribution or a score. For example, X% of a particular group of households should be within Y minutes of their local surgery. From this follows that accessibility indicators can be designed to target certain needs of certain groups, i.e. those worst of in terms of accessibility (see e.g. SEU 2003).

2.4.2. ‘Planning for accessibility’, and mobility

A fairly common theme in texts that critique transport policies is that accessibility and mobility are balancing or rival concepts, even if few authors have examined the differences between the two planning concepts in detail. For example, the Independent Commission on Transport (ICoT 1974, p.260) suggested that goals

based on the notion of accessibility were preferred to the ones based on mobility, but did not describe how the new accessibility goals could or should be formulated. Ross (2000) described accessibility and mobility as the yin and yang of transport planning. Vigar (2002, p.220) suggested, similarly to the Independent Commission on Transport, that policy makers should focus on “issues of accessibility rather than mobility”. Gudmundsson (2005, p.123) concluded, similarly to the study by Ross (2000) and the one by Cervero (2001), that accessibility and mobility were complementary concepts that must both be taken into account in transport planning.

Those that have set out to more clearly describe what planning for accessibility means have typically done so by comparing accessibility-enhancing and mobility-enhancing planning strategies (Salomon et al. 1998, Handy 2002, Levine & Garb 2002). One focus in these studies has been the type and quality of local destinations, such as shops, available by public transport, walking and cycling versus the demand for improvements of network capacity in general. Another theme has been the relationship between transport networks and land use development.

Salomon et al. (1998) defined mobility as the activity programme, or amount of travel, an individual engages in. With this definition, mobility relates to the functions that are actually reached. If this perspective was applied *and* the destinations are viewed as fixed in space, each mobility gain is automatically translated into an accessibility improvement as costs per destination are reduced. If the destinations were not viewed as fixed in space a paradox arises (Levine & Garb 2002). Levine & Garb (2002, p.187) and Handy (2002, p.9.) indicated, independently, that increased ability to move, in the short term, improves accessibility, but that this is not necessarily true in the longer term. Both continued, again independently, that mobility, the amount of movement, was neither a sufficient nor a necessary condition for good accessibility. This, they explained, was because long and costly trips were also an indicator of poor accessibility. It was possible to have good accessibility with poor mobility, they claimed, as long as the main facilities desired are located in the proximity.

However, the circumstances in which increased mobility, potential for movement, did *not* improve accessibility were not fully discussed in the literature.

Levine & Garb (2002, p. 180), suggested that a problem in transport planning was that increased transportation capacity, ability for movement, may induce destinations to move further away from each other and that this may lead to a situation where increased mobility, potential for movement, is associated with “more time and money spent in travel, rather than less.” Handy (2002) suggested that policies to increase mobility, the ability to move, will, in general, also increase accessibility by making it easier to reach destinations. Levine & Garb (2002, p. 187) concluded that, because transport was viewed as a derived demand, improved mobility, potential for movement, is desired only to the extent that it furthers accessibility. An important issue here is the differences between short term effects (where increased mobility means increased accessibility) and longer term impacts where an indirect, counter effect may dominate.

2.5. Discussion

2.5.1. Use of the term accessibility

As shown in Section 2.2, many different interpretations of accessibility have been used within transport planning. Increased use of the term ‘accessibility’ in transport planning during recent years has not, as it seems, lead to a more uniform or generally accepted definition. Accessibility has been, and still is, used differently in three main parallel streams of thought. This may make the term difficult to utilise, unless one explains what one actually means when applying it. Firstly, ‘Accessibility’ as applied in ‘Accessibility Planning’, ‘planning for accessibility’ and ‘accessibility-enhancing’ transport strategies is essentially a measure aimed at analysing how well the combined transport networks and land use pattern serves users (see e.g. Cervero 1996, Levine & Garb 2002, DfT 2004a). This is the broad interpretation used in this thesis. Secondly, accessibility has been promoted as a concept or measure of how well a transport network performs (see e.g. Buchanan et al. 1963, Ingram 1971, Dallal 1980). This stream of work excludes differences in values of opportunity derived at different destinations and hence it could be labelled as mobility-oriented. Thirdly, accessibility has been used specifically in relation to disabled users’ ability to use all parts of transport

networks (see e.g. HMSO 1995), again, often with little consideration to disabled users' overall ability to reach services needed.

2.5.2. Differences between accessibility and mobility planning

There are many similarities between planning for accessibility and planning for mobility. For example, both concepts may take account of people's varying transport abilities (e.g. the ability to drive a car). But there are some distinctive differences too. The key differences between planning for accessibility and planning for mobility can, it is suggested here, be summarised in three main points:

- Different points of reference for valuation of activities taking place at destinations,
- Differences in how changes in land use are taken into account, and
- The extent to which each planning concept incorporates the fact that accessibility can be fulfilled without physical transport.

The first difference between planning for mobility and planning for accessibility is the explicit and implicit valuation made of any activity taking place at a destination. Planning for mobility makes little distinction between 'wants' to reach a destination and 'needs' to do so. A typical definition of mobility, the ease to reach *any* location, does not explicitly acknowledge the value that could be derived from taking part in an activity at an 'available' destination. From this follows a classical justification for accessibility as a policy objective. Namely, that a high level of movement is no guarantee for good accessibility (see e.g. Independent Commission on Transport 1974). However, this apparent logic may correspond poorly with travel behaviour where destinations further away are preferred because of their higher perceived attractiveness. So, in the dominant paradigm for transport planning, the utility of each destination available is a result of how far and often people chose to travel there, i.e. their mobility. If many choose to travel far, and at great cost, then the value of the activity carried out at these locations must at least be in proportion with their travel costs (this is the consumer surplus approach). Planning for accessibility is, on the other hand, typically based on normative frameworks. The normative frameworks typically consist of accessibility standards based on accessibility indicators (see Section

2.4.1). This means that decision makers have pre-selected a set of functions (type of facilities) considered important (see e.g. SEU 2003). In fact, only if one defines the meaning of accessibility as something that can and ought to be ably reached, does accessibility mean something other than mobility, the potential for movement. Thus, a key difference between planning for accessibility and the dominant transport planning culture is that the former is essentially normative in identifying a set of activities which ought to be easy to reach.

A second difference between the two concepts lies in how accessibility and mobility respond to land use changes (Handy 2002, Levine & Garb 2002). Authors who favour accessibility over mobility as a policy objective typically define accessibility to take in any land use changes, in particular any induced long-term land use responses that require individuals to travel further away because others are able to do so (see Levine & Garb 2002). For example, if one's local supermarket closed down, *ceteris paribus*, this would lead to a loss of accessibility and probably an increase in mobility, the amount of movement, in order to shop at a store further away. Changes to land use patterns, and in particular those that can be more directly attributed to transport network improvements, e.g. transit-oriented developments (T-O-Ds), are thus one important focus in accessibility-enhancing planning concepts (see e.g. Cervero 2001). However, T-O-Ds can also be consistent with mobility-enhancing strategies. The difference is that land use strategies can play a relatively diminutive role in planning approaches that centre on mobility (i.e. ease of movement) without deducting from its objectives, while in a accessibility-enhancing planning policy land use strategies such as T-O-Ds have a vital function for the policy's effectiveness.

A third key difference is that, as pointed out by Jones (1987), accessibility does not strictly need to include any form of physical transport. This distinction may grow in importance as the number and quality of services that can be reached without being mobile increase. One example of such a service is internet banking. However, this thread seems hitherto little explored in relation to accessibility as a planning concept (see Section 2.4.2).

2.5.3. Do accessibility-enhancing planning strategies make sense?

The extent to which accessibility-enhancing planning strategies have a role to play depends on many things, e.g. our ability to measure the notion. However, from a transport policy point of view it makes sense to include accessibility objectives. One reason for this is that mobility levels do not necessarily correspond to the extent to which local accessibility needs are satisfied (see Section 2.5.2). That said, the level of local accessibility that users have or perceive do not necessarily correspond to mobility levels (the amount of movement) and therefore there is a need to examine the transport system from this point of view too.

2.6. Conclusions

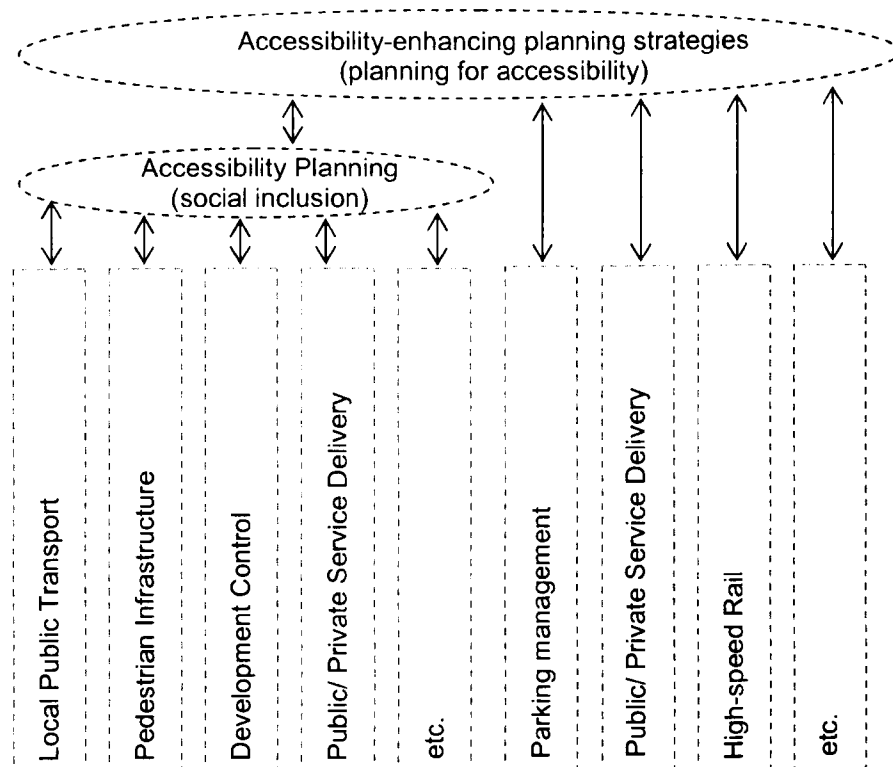
2.6.1. Definition of ‘Accessibility Planning’

Planning for accessibility (‘Accessibility Planning’ and ‘accessibility-enhancing planning strategies’) is a process that allows for mobility as well as non-mobility improvements to be implemented as a solution to insufficient accessibility. The planning concept tends to focus on what Handy (1993) called ‘local’ accessibility (see e.g. Wytconsult 1977a, SEU 2003). However, there is no reason why an accessibility-enhancing planning strategy should not, in principal, focus on regional accessibility. Accessibility as a planning concept tends to be used as a normative notion, where *needs* to reach certain locations, typically defined as essential services, are seen as a class higher than *desire* to reach any other type of destinations (see Section 2.5.2). For example, accessibility-enhancing strategies may focus on needs for groups with limited potential for movement across all available modes (see e.g. DETR 1998a). Hence three criteria could be established for what Accessibility Planning as well as accessibility-enhancing planning strategies include. These are:

- A reasonably clear description of mobility profiles, the ability for movement, of those that should benefit (the most) from the planning initiative,
- A specification of what type of destinations that are considered to be of a greater importance than others, and
- A process for reviewing positive and negative impacts of changes to transport networks and land use (incl. service provision) using accessibility indicators.

Accessibility Planning and accessibility-enhancing planning strategies both make use of accessibility indicators (see Section 2.4.1) but the two concepts differ in terms of whose needs are targeted, with Accessibility Planning being an approach focusing on the requirements of socially excluded groups. Figure 2.1 outlines the relationship between the two concepts. Note that measures (e.g. service delivery) to some extent can be carried out in a way that benefits many people but not socially excluded groups. One example of this may be a push for internet banking and closure of local branches (if socially excluded groups do not have access to a computer or do not know how to use one).

Figure 2.1. Principal relationship between Accessibility Planning and Accessibility-enhancing planning strategies.



Finally, accessibility-enhancing planning strategies typically differ from the dominant transport planning paradigm in how it treats changes in land use, how activities at destinations are valued, and how 'accessibility' problems are defined and measured (see Section 2.5.2).

Chapter 3

Review of literature on accessibility indicators

3.1 Introduction

This chapter identifies the main components of accessibility and examines why there is no standard approach to measuring it. The chapter includes: an overview of the literature from the field; findings from the literature on how accessibility best could be measured; a description of different types of accessibility indicators; advice on how to choose an appropriate accessibility measure; and a discussion of the role of the findings for Accessibility Planning.

3.2. Use in transport research

3.2.1. Many interpretations

Accessibility may be measured in many ways (Pirie 1979, Morris et al. 1979a, Jones 1981, Handy and Niemeier 1997). Pirie (1979) suggested that how accessibility should be measured depended on one's conception of it and the question to be raised. Morris et al. (1979b) concluded that there was no single best indicator of accessibility. They also indicated that each measure involves a trade-off between ease of operation and behavioural veracity. Jones (1981) and Handy & Niemeier (1997) drew similar conclusions. According to Jones (1981) the choice of measure depends on the type of problem being studied and the resources available. Handy & Niemeier (1997, p.1181) suggested that different situations and purposes demanded different approaches.

3.2.2. Scope of existing studies

Table 3.1 presents an overview of the content of frequently referenced reviews of accessibility measures. A general objective of most studies was to investigate the performance of the land use and transport system. Many of the studies met their objectives by developing new accessibility measures. For example, Geurs et al. (2001) reviewed and applied measures of accessibility to evaluate impacts of land-use transport scenarios. Their study included an extensive overview of different types of

accessibility measures used and type of destinations covered in a hundred or so previous studies (Ibid p.69).

Table 3.1. Scope of selected studies on accessibility

| Author (year) | Country | Scope |
|---------------------------|-----------------|--|
| Hansen (1959) | U.S.A | How data on changes in accessibility levels and vacant plot availability can be used to predict future land use patterns. |
| Ingram (1971) | Canada | Assessment of different distance decay functions using survey data on trip time frequencies. |
| Wachs & Kumagai (1973) | U.S.A | How accessibility indicators can be used as a social indicator and a measure of equality of opportunity. |
| Dodgson (1974) | UK | Use of accessibility indicators to estimate regional economic growth effects of the M62 motorway. |
| Martin & Dalvi (1976a, b) | UK | Comparison of accessibility by public and private transport. |
| Morris et al. (1979a, b) | Australia | Review of accessibility concepts, accessibility indicators and their relevance to transport planning. |
| Pirie (1979) | South Africa | Review of limitations and strengths of distance, topological, gravity and cumulative-opportunity measures. |
| Leake et al. (1979, 1980) | UK, Egypt | Assessment of the explanatory power of various accessibility measures on trip generation. |
| Koenig (1980) | France | Review of theories behind various accessibility indicators with focus on travel behaviour. |
| Jones (1981) | UK | Review of accessibility measures proposed in literature and applied in practical planning studies. |
| Rutherford (1994) | U.S.A | Review of how accessibility indicators can be used to integrate transport plans, land use and environmental strategies with focus on methods for evaluation of multimodal passenger transport. |
| Handy & Niemeier (1997) | U.S.A | Review of accessibility measures and two case studies of how accessibility measures can be used in local and regional planning. |
| Makri et al. (1999) | Sweden | Review of accessibility measures to identify suitable accessibility measures for a case study of local accessibility. |
| Halden et al. (2000) | UK | The need, suitability and practicality for accessibility analysis in integrated land use and transport appraisal. |
| Geurs et al. (2001) | The Netherlands | Review of activity- and utility-based accessibility measures, their theoretical base, data needs and usability for assessment of transport and land use changes. |
| Geurs & van Wee (2004) | The Netherlands | Accessibility measures' usability in evaluations of land use and transport strategies with focus on economic impacts and interpretability. Identification of further research needs. |

The majority of studies examined by Geurs et al. (2001) looked at accessibility to work places and to population, e.g. the number of jobs that could be reached using certain distance decay functions (within a given time).

Within the studies in Table 3.1 three groups of research were identified. A first group was primarily concerned with how accessibility indicators can be used as a tool to integrate transport and land use planning. Hansen (1959), an early contributor in this field, suggested that accessibility (measured as travel time by car to shopping, employment and residential population) could be used by planners to predict where new urban development would take place. Morris et al. (1979a, b) continued this tradition and reviewed different types of accessibility measures and their relevance to transport planning. Jones (1981), Rutherford (1994) and Handy and Niemeier (1997) amongst others added to this stream of work.

A second group of research was concerned with economic valuations of changes to transport networks. Dodgson (1974) pioneered this field with a study of the potential economic impact of the M62 motorway near Manchester. Linneker & Spence's (1992, 1994, 1996) studies of the M25 London orbital motorway were later examples using accessibility indicators to capture economic impacts.

Wachs & Kumagai (1973) were early contributors to a third stream of work. They used accessibility as an indicator of urban quality of living and to examine social impacts of transport planning. Their accessibility indicators were designed to evaluate equality of opportunity and social impacts of transport networks (the study measured access to health services and employment opportunities in Los Angeles). Cervero et al. (1995), Folkesson (2002) and Jopson et al. (2007) are other examples of studies in this field. Jopson et al. (2007) presented a number of British case studies including two on access to good quality education and primary healthcare.

3.3. How accessibility is measured

3.3.1. Categorisation and components

There are several ways to categorise different components of accessibility (Martin & Dalvi 1976, Geurs et al. 2001). For example, Martin & Dalvi (1976a, p.19) identified

three dimensions of equal importance in modelling accessibility: the representation of individuals' preferences and choice sets, the representation of opportunities available and the level-of-service the transport system provides in overcoming distances. Handy & Niemeier (1997) recognised four main components of accessibility measures; the degree and type of disaggregation, the definition of origins and destinations, the measurement of travel impedance and the measurement of attractiveness. Reneland (1998) characterised different types of accessibility indicators by asking four questions about: modes available, origins and destinations, time of day and the type of user (age, sex, disability, type of business). Geurs et al. (2001) considered accessibility in terms of transport, land use, temporal and individual components.

The categorisation used in the four studies above have many things in common. Both Geurs et al. (2001) and Martin & Dalvi (1976a) divided accessibility into transport, land use and individual components and both included destination attractiveness as a part of the individual component. However, there are differences too. Handy & Niemeier (1997) broke out destination attractiveness into its own component. Geurs et al. (2001) and Reneland (1998) separated temporal components. Consequently, different classifications put emphasis on different aspects of accessibility.

3.3.2. Types of measures

As shown in Table 3.2, there is no consistent terminology for describing different types of accessibility measures. For example, the indicator that Hansen (1959, p.73) called a "measurement of accessibility" was in later studies known as a gravity-based one. Pirie (1979) reviewed the notion of accessibility in terms of distance, topological, gravity, cumulative opportunity and time-space measures. Koenig (1980) recognised two main types of measures: isochronal measures (the number of opportunities that could be reached within a given time) and opportunities weighted by impedance (e.g. gravity-based measures).

Handy & Niemeier (1997) organised accessibility measures into three types: cumulative opportunity measures, gravity-based measures and utility-based measures.

Table 3.2. Terminology for accessibility measures in selected studies.

| Author | Cumulative opportunity | Gravity-based measures | Utility-based measures | Other measures |
|-------------------------|-----------------------------------|--|--|---|
| Hansen (1959) | n/a | 'Measurement of accessibility' | n/a | |
| Ingram (1971) | n/a | Integral accessibility | n/a | Relative accessibility |
| Koenig (1980) | Isochronic definition of measures | Opportunities weighed by impedance / 'Hansen-type' | Utility approach | |
| Jones (1981) | Contour measures | Gravity-based measures | Hedonic value measures/ consumer surplus | Network measures, measures of travel |
| Handy & Niemeier (1997) | Cumulative opportunity | Gravity-based measures | Utility-based measures | |
| Halden et al. (2000) | Simple measures | Opportunity measures | Value measures | |
| Geurs & van Wee (2004) | Contour measures | Potential accessibility measures | Utility-based measures | Infrastructure-, location-, & person-based measures |

Halden et al (2000) used three terms to describe the practical application of different accessibility measures; simple indicators, opportunity measures and value measures. The simplest indicators used thresholds (e.g. time required to reach a given number of opportunities) to give a basic measure of transport and/or opportunity. The term opportunity measure was used for measures that “*sum all the available opportunities and weight them by a measure of deterrence based upon how easily the opportunities can be reached*” (Halden et al. 2000, p. 9). The term ‘value measure’ was used for a measure that seeks to define the attractiveness of the available opportunities to represent their value as a transport choice.

Geurs & van Wee (2004) distinguished between infrastructure-based, activity-based and utility-based accessibility measures. The activity-based measures were further split into distance measures, contour, potential accessibility, and space-time measures.

The schemas described above were similar in that they distinguished between accessibility indicators depending on how network impedance was calculated. For example, Koenig (1980), Handy & Niemeier (1997) as well as Geurs et al. (2004) all

made a distinction between measures which treated all destinations within a specified interval equally (cumulative opportunity) and measures which gradually reduced the value of destinations further away (gravity-based). Most studies also broke out measures based on utility theory and included variations of destination attractiveness. Handy & Niemeier's categorisation is one of the most frequently referenced and has therefore been used to structure the rest of this section.

3.3.2.1. Cumulative opportunity measures

Cumulative opportunity measures typically describe the number of opportunities that can be reached within a certain time or distance. For example, the number of jobs within 30 minutes travel time from a residential area by certain modes. There are three main types of cumulative opportunity measures: fixed costs, fixed opportunities and fixed population (Breheny 1978). Fixed costs described the number of opportunities within a certain cost limit. Fixed opportunities expressed the average or total impedance (measured in cost, time or distance units) required to access a specified number of opportunities while fixed population described the average (over the population) of the number of opportunities available within various fixed travel costs. Cumulative opportunity is sometimes used as a measure of equality of opportunity. For example, a cumulative opportunity indicator could be used to investigate the proportion of citizens that have a post office within a given travel time. A potentially strong point of cumulative opportunity measures is that it is relatively easy to interpret and understand, and it can easily be applied to different modes. A potential weakness is that opportunities, say, 29 minutes away are counted as equal to ones one minute away.

3.3.2.2. Gravity-based measures

Gravity-based accessibility measures use a distance decay function to describe the diminishing influence of distant opportunities. The closer the opportunity is located to the origin, the more it contributes towards accessibility levels. In comparison to cumulative opportunity measures it is not only the number of opportunities but also their exact locations relative to the origin that contribute towards the level of accessibility. Hansen (1959) was one of the first authors to make use of a gravity measure within the field of transport. A key issue for later studies was how to calibrate an adequate network impedance function. For example, Ingram (1971) concluded that

a Gaussian curve distance decay function provided the best fit with trip frequency data over trip length in minutes. The Gaussian curve has a slow rate of decline close to the trip origin. This in turn meant that there would be little difference in the level of accessibility for a destination, say 5 minutes away, and one 15 minutes away. Many later studies have invested a lot of time on creating more elaborate impedance functions and several different impedance functions have been used in different studies (Geurs et al. 2001).

An advantage of gravity-based measures is that they take into account the diminishing role of distant opportunities (without artificial thresholds). A potential drawback is that it may be difficult to establish a 'true' impedance function.

3.3.2.3. Utility-based measures

Utility-based measures take into account the attributes of each choice and the socio-economic characteristics of the individual or household (in addition to the opportunities available at different destinations and the travel cost of reaching them). Koenig (1980) presented an early example of how to calculate utility-based accessibility indicators. Utility-based measures assume that an individual assigns a utility to each destination in a choice set and selects the alternative which maximises his or her utility. As it is not possible to evaluate all factors affecting the utility associated with each alternative by a given individual, this utility is assumed to be best represented as the sum of a deterministic component and a random (stochastic) component. An advantage of individual utility measures is that they have a theoretical basis in economic theory (Neuburger 1971). A disadvantage is that the measure may be difficult to interpret (see Geurs et al. 2001).

3.4. How to choose an appropriate indicator

3.4.1. Frameworks for design

Several studies have discussed how to design, or specify, an appropriate accessibility indicator for a study (e.g. Morris et al 1979a, b, Koenig 1980, Cervero et al. 1995, Handy & Niemeier 1997 & Halden et al. 2000).

Morris et al. (1979a, b) created a loose framework for how to design accessibility indicators for transport planning. Their structure used four general dimensions: the element of spatial separation (impedance), behavioural foundations, technical feasibility and ease of interpretation. The level of aggregation of population and activities, and the emphasis put on the ease of interpretation of a measure were identified as especially important.

Koenig (1980) and Handy & Niemeier (1997) amongst others preferred indicators that were easily intelligible to decision makers and laymen. Koenig (1980, p.170) pointed out that an important strength with the type of accessibility measures he argued for were that they were suitable for a “dialogue” with “authorities”, “the public” and “non-specialists”. Similarly, Handy & Niemeier (1997) suggested that ease of interpretability was an important factor for choosing a particular accessibility indicator. No data was found in any of the studies on how easily interpretable decision makers and members of the public really found the different types of accessibility measures used.

Cervero et al. (1995) paid great attention to the disaggregation of accessibility measures. A good measure of accessibility, they suggested, did not only portray opportunities as a lump sum but it did also, for example, reflect skills available among residents compared to those needed for jobs nearby. For this reason they argued that gravity-based and other measures needed to be balanced with indicators that took socio-economic aspects into greater consideration, i.e. that a set of accessibility indicators were needed to provide an adequate representation of accessibility. Cervero et al. (1995, p.17) concluded that an *“important step in operationalizing accessibility as a performance measure will be a clearer articulation of objectives, framed not only in terms of movement efficiencies but with regards to sustainability and social equity.”*

Taking different abilities, e.g. skills or level of mobility, into account could naturally provide quite different pictures of accessibility.

Handy and Niemeier (1997) set out to provide a clearer framework for how to choose the right accessibility measure for a study. They argued that “*an accessibility measure is only appropriate as a performance measure if it is consistent with how residents perceive and evaluate their community*” (p. 1176). This, it was said, would guarantee that the measure mirrored the most important issues for the people in a particular area (not the average in a region). The quality and price of products and services could be such a factor that residents perceived differently in different areas. Handy and Niemeier included the price and quality of products into the attractiveness parameter. However, they pointed out that including price and quality of products in an accessibility measure would make it even more difficult to specify and calibrate.

Reneland (1998) focused his efforts on practical information needs for transport planning and the social dimension of accessibility (equality of opportunity). His study distinguished between accessibility by different modes. A per mode approach has the potential benefit of better catering for the practical needs of transport planning. Transport planning is often project-based with the main purpose to improve facilities for one particular mode, for example public transport network planning.

Halden et al. (2000, p. 13) identified six types of indicators that they suggested corresponded to existing “appraisal needs” in transport planning: accessibility to local facilities by walking and cycling; to public transport services; accessibility to opportunities such as jobs & shops by all modes; ratios comparing accessibility for different mobility groups; accessibility for freight and economic appraisal using utility measures. Halden et al. suggested that the needs of a “particular situation” decided the appropriate classification of destinations, deterrence functions and the sizes of the zones to be considered (see p.9) and concluded that detailed planning guidance was needed if new tools to assess accessibility should become a distinctive part of planning decisions. They built this conclusion on interviews with 29 stakeholders.

To sum up, several authors aimed to provide a framework for the design of accessibility indicators. They pointed at a number of considerations that were needed

to create a sound measure. However, different studies also provided somewhat different advice on how to achieve this.

3.4.2. Methodologies for calibration

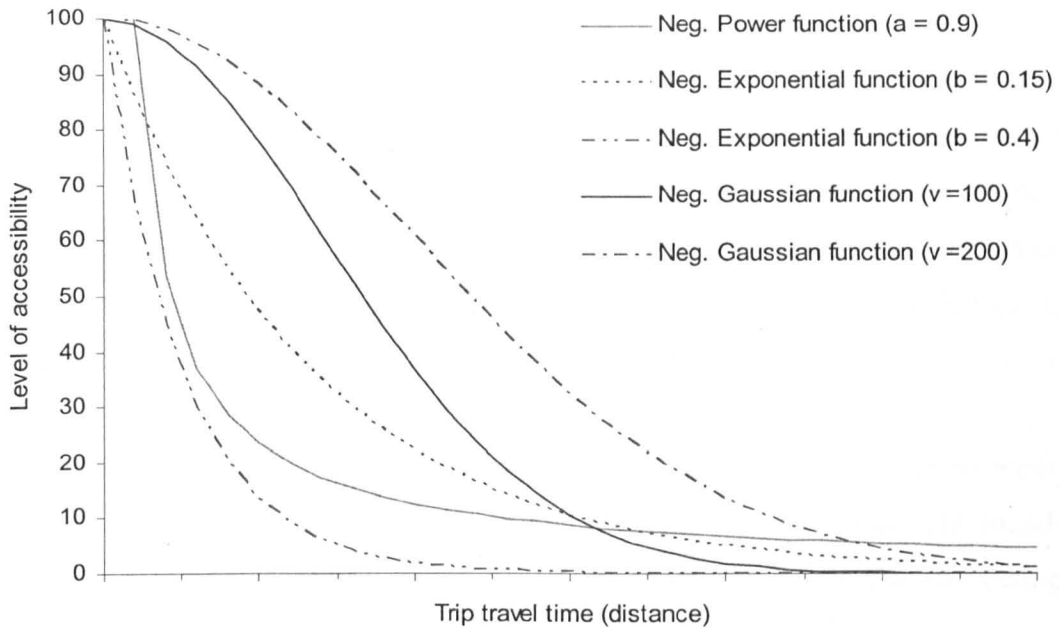
All types of accessibility measures need calibration. Cumulative opportunity measures need to be calibrated so that the cut-off distances they use correspond to the purpose of the indicator. Gravity-based and utility-based indicators need to be calibrated using an appropriate distance decay function. Also the attractiveness component of many measures needs to be calibrated.

Most studies have suggested that accessibility measures principally should be calibrated to reflect revealed travel behaviour (Ingram 1971, Geurs et al. 2001). However, some authors suggested alternative principles for calibration. For example, Morris et al. (1979a, b) suggested that the practical value of an indicator depended upon the extent to which it reflected travel behaviour *and* perception. Similarly, Handy & Niemeier (1997, p.1180) suggested that one should aim to calibrate accessibility indicators so that they reflected how individuals “perceive” travel choices. Handy & Niemeier pointed out that calibration methodologies based on actual travel behaviour have limitations as they do not take into consideration the fact that revealed behaviour does not necessarily reflect preferred behaviour. Exactly to what extent accessibility measures should reflect ‘wanted’ or perceived travel behaviour in comparison to revealed travel behaviour was somewhat unclear in the studies above. No clear calibration methodologies for travel perception were described in any detail. Consequently, travel statistics were the most common, if not only, calibration methodology used in the literature.

Cut-off distances for cumulative opportunity measures seem to have been chosen, rather arbitrarily, to correspond with planners’ or decision makers’ perception of accessibility (see for example Geurs et al. 2001, p.51-52). Gravity-based indicators and utility-based measures were typically calibrated using trip frequency (Ingram 1971, Geurs et al. 2001). For example, Ingram (1971) examined three functions for calibrating distance decay (reciprocal, negative exponential & Gaussian) and came to the conclusion that a Gaussian function was preferred because it corresponded to local

data on trip length in minutes vs. trip frequency. Figure 3.1 illustrates different types of distance decay functions.

Figure 3.1. Examples of distance decay functions.



According to Handy & Niemeier (1997) the negative exponential form was used more frequently than others in accessibility studies and was the most closely tied to travel behaviour. Geurs et al. (2001) identified four key types of distance decay functions in transport literature: a negative power or reciprocal function, a negative exponential function, a modified version of the Gaussian function and a modified log function. They found that a 'log-logistic' impedance function corresponded best to empirical data from the Dutch National Travel Survey (data on trip frequency vs. travel time for all trip purposes and modes together). The log-logistic curve used was slightly less steep for trips shorter than 10 minutes than a negative exponential curve. As earlier mentioned, the attractiveness component of gravity-based measures needs to be calibrated too. Geurs et al. (2001, 2004) provided a good overview of how this could be done for measures on a regional level, e.g. using data on retail floor space and the number of employment opportunities at each location and taking competition factors into account.

The different impedance functions used in the studies above seemed to depend not only on characteristics of households and trip purposes included in them (their purpose), but also to some extent on the span of trip lengths included in the calibration process ('local' vs. 'regional' accessibility) and the availability and quality of empirical data.

3.4.3. Behaviour and known errors

Existing literature reveals some interesting findings on the behaviour of accessibility models and differences that arise from different designs and calculation principles. For example, Guy (1983) and Spence and Linneker (1992) showed how important the design of measures was for the outcome. Hewko et al. (2002) reported on errors related to different levels of data aggregation.

Guy (1983) compared the outcomes of measures with different attractiveness and impedance functions for 'local' accessibility to shops and services. He found that different accessibility indices resulted in different levels of accessibility (using the same impedance factor, crow-flies distance, across all indices). The measures not only gave different results, they changed the rankings between areas as well as provided somewhat different pictures of how accessibility had developed over time. Guy (p.236) concluded that the results were "significantly affected by the choice of method adopted." The study also highlighted how calculations of accessibility were distorted in areas near a boundary beyond which no data was provided. Further details of the indicators used by Guy (1983) are provided in section 3.5.2.

Spence and Linneker (1992) registered similar ambiguous tendencies of indicators as those described by Guy (1983), but at a regional level. They compared a market potential measure (access to employment using a gravity measure) with a measure of access costs to all British regions for HGVs in Britain (cumulative opportunity). The two indicators were designed to measure the regional economic impact of changed accessibility levels of the M25 London Orbital Motorway. The best and worst accessibility impacts were registered in different areas with the two indices. Spence & Linneker (1994, p.1153) concluded that accessibility differed "substantially" between areas depending upon which form of accessibility measure that was used. Spence & Linneker (1994) attributed one source of the unexpected results to assumptions made

on route choices in the accessibility model. They also pointed out that the outcomes of the two different indicators were comparable in an earlier study with similar objectives. The study by Dodgson (1974) that they referred to investigated accessibility impacts of the M62.

Hewko et al. (2002) calculated accessibility levels to 312 playgrounds, 132 community halls and 19 leisure centres in Edmonton using the distance from the centre points of zones to the facilities. Calculations based on 199 neighbourhood zones were compared to those for 18,000 smaller post code areas using different principles to determine each zone's centroid. The results showed that the average distance for all neighbourhoods together to the nearest playground was 24% lower when calculations were based on larger zones (311m compared to 408m). The differences in aggregation levels changed the rank of zones. Also, calculations based on fewer zones inflated the differences between neighbourhoods. The errors arose from the fact that neighbourhoods were represented by a single point, e.g. at the centre of an area. Aggregation errors were particularly problematic when calculating accessibility to nearest facility and were there were many facilities to one zone. Hewko et al. recommended that aggregation errors were best tackled by reducing the size of zones where possible and by better representation of the distribution of populations within neighbourhoods.

As seen above, alternative designs of accessibility measures and aggregation errors may have great influence on the outcomes of accessibility calculations and rank of areas.

3.5. Transport modes covered in previous studies

3.5.1. Overview of studies covering different modes

As earlier mentioned, a key point in research on accessibility indicators was how network impedance best could be measured. Table 3.3 describes in some detail how impedance factors for different modes of transport were included in selected larger studies. The table shows what impedance factors were used in the studies and to what extent the limited range of walking and cycling were considered.

Table 3.3. Impedance factors and modes in selected studies

| Author | Location | Scale | Type | Impedance factor | | | | Mode specific indicators | | | | |
|----------------------------|---------------------------|-------|----------------|-------------------|-----------|---------------|-------|--------------------------|----------------|------------------|-----|-------------------|
| | | | | Generalised costs | Time only | Distance only | Other | Walk | Cycle | Public transport | Car | No specified mode |
| Hansen (1959) | Washington, USA | R | g | | x | | | | | | x | |
| Ingram (1971) | City of Hamilton, Canada | C | c/g | | | x | x | | | | | x |
| Wachs et al. (1973) | Los Angeles, USA | L/R | c | | x | | | | | x | x | |
| Weibull (1976) | Stockholm, Sweden | C/R | c/g | | x | | | | | x | x | |
| Wytconsult (1977a,b) | West Yorkshire, UK | L/C/R | n/c/o | x | | | | x | | x | x | |
| Koenig (1980) | Le Mans, France | C | u | x | | | | | | | | x |
| Dallal (1980) | Fulham, UK | C | o ³ | | x | | | | | x | | |
| Guy (1983) | Reading, UK | L | n/c/g | | | x | | x | | | | |
| Jones (1986) | Newcastle, UK | C/R | c | | x | | | | | x | | |
| Linneker et al. (1992, 96) | Greater London, UK | R/N | c/g | x | | | | | | | x | |
| Hillmann et al. (1997) | Croydon, UK | C | o ³ | | x | | | | | x | | |
| Reneland (1998) | 45 towns & cities, Sweden | C | n/c | | | x | | x | x | | | x |
| Cervero et al. (1999) | San Francisco, USA | R | g | | | x | | | | | | x |
| Gutierrez et al. (1999) | Madrid, Spain | R | c/g | | x | | | | | | x | |
| Handy & Clifton (2000) | 7 areas in Austin, USA | L | c | | | x | | x | x | | | x |
| van Wee et al. (2001) | The Netherlands | R/N | c/o | | x | | | | | | x | |
| Geurs et al. (2001) | The Netherlands | R/N | c/g/u | | x | | | | | x | x | |
| Envall et al. (2002a, b) | Växjö, Sweden. | C | c | | x | | | | x | x | x | |
| Frölich et al. (2002) | Switzerland | R/N | g | | x | | | | | | x | |
| Lovett et al. (2002) | East Anglia, UK | L/R | n | | x | | | | | x | x | |
| Folkesson (2002) | Karlshamn, Sweden | L/C | n/c | | | x | | x | x | | | x |
| Halden (2002) | Edinburgh, UK | C/R | g/u | x | | | | | | x | x | |
| Webber & Foster (2002) | Development sites, UK | L/C | c | | x | | | x | x | x | x | |
| Wu & Hine (2003) | Belfast, UK | C/R | c/o | | x | | | | | x | | |
| Reneland et al. (2004) | 6 towns & cities, Sweden | L/C | n/c | | | x | x | x | x ⁴ | x | x | |
| Zhu & Liu (2004) | Singapore | R | g | | x | | | | | x | | |

¹ (L) Local, (C) City, (R) Regional, (N) National² (n) nearest, (c) cumulative, (g) gravity-based, (u) utility-based, (o) other (e.g. incl. competition).³ Access to public transport networks only.⁴ On-road cycle routes excluded (routes with motor vehicle traffic) unless within 30km/h zones.

The column called 'impedance factor' indicates the main component of impedance in a study, e.g. distance. The column called 'mode specific indicators' indicates to what extent a study included one or more indicators that took into account the limited range of non-motorised modes or included frequency of public transport services. If a study took into consideration travel speed by car it was marked down as including car-specific indicators. If a study used road network distance without consideration of travel speed or the limited range of non-motorised modes it was marked as 'no specified mode'.

The column called 'scale' in the table indicates the size of the area each study covered. Local level (L) means that a study covered one or several neighbourhoods. City level (C) indicates that a study included one or more towns or cities. Regional level (R) indicates that a study covered a region or metropolitan area. National Level (N) means that the study included two or more adjoining regions or covered a whole country.

The studies investigated applied different types of indicators, e.g. nearest facility, cumulative opportunity etcetera. This is shown in the column called 'type'. It should be said that it was not always straightforward to identify the role of different components of accessibility in a study. For example, Hansen (1959, p.75) used off-peak travel time by car plus 5-8 minutes terminal time* to represent impedance. However, the study did not clearly describe how differences in terminal times were estimated and what data underpinned the calculation of travel speeds. That said, as shown in Table 3.3, many studies investigated accessibility solely by public transport and private car, or by using generalised costs across several modes between zone pairs (with little detail provided on the size of zones). Several studies of public transport included impedance for walk time to bus stops (e.g. Wachs et al. 1973). Note that only two of the studies used indicators with specific impedance measures for all four main modes of road transport (fully taking the limited range of walking and cycling into account). These were the studies by Webber & Foster (2002) and Reneland et al. (2004). Some of studies presented in the table are further discussed below.

* Time to reach car park, start the car etc.

3.5.2. Development of 'local' indicators

Accessibility Planning is mainly about 'local' accessibility, e.g. what facilities important for everyday life could or could not be reached by different modes (see Chapter 2). Early studies in the field such as Hansen (1959) focused on accessibility on a regional level. Wachs & Kumagai (1973) was perhaps the first study to investigate differences in local accessibility. Other studies that explored this field include Wytconsult (1977a), Dallal (1980), Guy (1983) and Handy & Clifton (2000).

Wachs & Kumagai's (1973) study included indicators of accessibility to health care facilities in Los Angeles (see also Section 3.2.2). The indicators examined the number of doctor's surgeries (general practitioners) and hospitals that were accessible within 15 and 30 minutes travel time by car and public transport respectively. Furthermore, the study investigated how the accessibility of each area related to income levels, hence how accessibility was distributed. Car travel times used off-peak travel speed for major streets in the area. Public transport travel time was calculated including walking from a health care facility to a bus stop (3 mph). Time for transfers between services was included where needed. Waiting time at the bus stop was excluded from the analysis as was frequency of services (time for transfers were based on that travellers boarded the first bus available after noon on a weekday).

Wytconsult (1977a) calculated a number of indicators of local accessibility including 12 types of facilities and 5 types of work categories using 1,300 zones covering a population of 2 million in West Yorkshire. The study included accessibility measures for local shops, shopping centres and major shopping centres as well as 5 different measures for doctor's surgeries, health care facilities, major hospitals and post offices. Indicators were calculated for accessibility by car, public transport (incl. walk time) and for walking. However, for any type of facilities that were located within the origin zone the travel cost was set to zero with all modes (Cooper et al. 1979, Table II). The travel cost component of public transport was divided into walking time to access bus stop, waiting time, travel time and fare costs. The generalised cost for car was based on travel time and distance-based costs for fuel etc. (running costs represented about 70% of total costs). For shopping, education and healthcare the cost of access to the *nearest* of each of the facilities was used as it was used to firstly assess the need for basic requirements and not the choice of people travelling to facilities further away

(Wytconsult 1977b, pp. 25-27). Standards were applied to each of the different type of destinations in order to assess accessibility levels. For example, an acceptable trip cost to the nearest shopping centre was assigned to be 30 generalised cost minutes while the standard was 16 generalised cost minutes for the nearest group of local shops. Further details on how the measures calculated by Wytconsult (1977b) were used in planning practice are provided in Chapter 4 and Appendix 1.

Dallal (1980) broke new ground with his study of Public Transport Accessibility Levels (PTAL) in Fulham & Hammersmith. The PTAL measure included walking access to several alternative bus stops and headway (frequency of service) and was therefore more sophisticated than the measures used by Wachs & Kumagai (1973). PTAL was an indicator designed for practical planning, both in terms of planning public transport networks as well as development planning (e.g. parking standards). Strictly speaking PTAL was however not a proper measure of accessibility as it did not explicitly take into account what type of destinations or the amount of opportunities that could be reached within a certain time. PTAL was a measure of accessibility *to* public transport services, and it assumed that public transport services went where people wanted to go. As such the PTAL measure reduced the data needed and simplified calculations compared to earlier methodologies.

Guy (1983) pioneered the use of accessibility models to describe accessibility on foot measuring accessibility to local shops in part of Reading, Berkshire. The study applied four different types of accessibility measures: a composite index of total travel distance for reaching 12 different types of goods; a cumulative opportunity measure (number of shops within 1km) and two gravity measures (based on number of shops). The composite measure required that each retail unit in the area was categories into one of 20 types (e.g. supermarket, greengrocer etc.). Each type of shop was then assumed to provide one or several of the 12 types of goods and services. The distance to reach a certain type of goods was weighted by the national average expenditure for the particular group of items. All indicators used crow-fly distances as the impedance factor. This was deemed necessary to simplify calculations. Guy used exact locations of shops and a sample of households. The study was therefore more sophisticated than Wytconsult (1977a), that used rather large zones and considered all facilities within the zone equally reachable.

Handy & Clifton (2000) explored ways that planners could evaluate neighbourhood accessibility using existing data sources. They applied accessibility measures of retail intensity, retail diversity and retail choice in seven neighbourhoods in Austin, Texas. Cumulative opportunity measures were used counting the facilities available within the neighbourhood and 1/4, 1/2, one and two miles from its boundary. Retail intensity was defined as the total number of shops in a neighbourhood. Diversity was taken as the number of different types of shops and services provided within an area. Choice was defined as the number of shops of a certain type, for example food shops or restaurants. Crow-fly distances were used as the impedance factor. Handy & Clifton found that lack of data on the characteristics of the transport network, especially for non-car modes, limited the scope of their analysis.

Folkesson's study (2002) was one of the first studies of local accessibility to use shortest network path as the impedance factor. She used two accessibility indicators to assess changes in accessibility to local shopping facilities 1980-1998 in Karlshamn and Ronneby. One indicator measured the distance to the nearest food shop with a 'wide range of produce'. A second indicator measured cumulative opportunity to 20-80% of the total shop turnover in different market segments (e.g. clothes, furniture). In addition, the distance to the nearest petrol stations was measured. This was as many petrol stations in the study area sold essential groceries such as bread and milk. The proportion of households with their closest food shop within 'walking distance' (defined as 400m along the shortest route) decreased in both cities during the 18 years studied. The proportion of people having a petrol station selling basic groceries within reach by walking decreased as well. Folkesson (2002, p. 99) found, similarly to Handy & Clifton (2000), that lack of data on the quality of walking and cycling routes in her study area limited the usefulness of indicators.

The study by Webber & Foster (2002) explored the relationship between accessibility and adequate parking policies for new developments. Accessibility indicators were used to explore the relationship between accessibility on foot, by public transport, parking provision and travel behaviour. Webber & Foster (p.19) used resident population within 15 minutes by walking and 30 minutes by cycling to represent access levels by these modes. The walking and cycling indicators were based on a

notional travel speed and therefore, in practice, distance (1,250m for walking, 6,500m for cycling) was used as the impedance factor. It is unclear if straight-line or network distances were used.

Reneland et al. (2004) aimed to develop a methodology to measure local accessibility considering safety, security and route quality for children, adults and disabled when travelling by foot, cycle, bus and car. Their objective was to give planners adequate information so that they could identify the most important instruments for a given transport policy. A wide range of different accessibility indicators were used. Some of these measured what often is called 'level of service'. One example of such a measure was the proportion of children with walking routes to their school that met specified safety levels (e.g. no need to cross heavily trafficked roads at places without 'adequate' pedestrian crossing facilities). Also other measures were designed to meet decision makers' and users' anticipated aspirations. For example, for safety reasons the measure developed to capture cyclists' accessibility only allowed cyclists to use off-road links and streets in areas that had traffic calming features.

As mentioned above, early studies looked into local accessibility by car and public transport as well as on foot to the nearest facility. Later studies simplified the public transport component and added more sophisticated methodologies for how to value attractiveness and choice of facilities. Neither the studies by Guy (1983), Reneland (1998), Handy & Clifton (2000), Folkesson (2002) nor the one by Webber & Foster (2002) made any allowance for the type of cycle or walking facilities or level of hilliness of an area. Guy (1983) used crow-fly distances and not actual walking distances in his study. Consequently, variations in accessibility on foot and by bicycle related to the quality of transport networks were not included in the studies investigated.

3.6. Discussion

3.6.1. Key findings

The review highlighted many unsolved issues of how accessibility could best be measured and how to design an appropriate set of accessibility indicators. No single best approach for measuring accessibility has yet emerged (Morris et al. 1979b, Handy

& Niemeier 1997). Consequently, no firm framework for how one should identify an appropriate set of accessibility indicators was found. The way accessibility was measured in a particular study depended mainly on how it was defined (Jones 1981) and the study's objective (Cervero et al. 1995).

Most authors suggested that interpretability (who should understand the output), data costs, the level of aggregation and a high level of correlation with travel behaviour were important factors to consider in the design of indicators (Section 3.4.1). Other important distinctions for the design of indicators are whether they should deal with one mode or several, one or several types of destinations, and accessibility to or from a location. In other respects different authors stressed different factors as being important. For example, Koenig (1980) preferred accessibility indicators based on the individual to ones based on particular modes of transport. Reneland et al. (2004) took the opposite position probably because a modal perspective was found useful in planning practice. More comprehensive accessibility studies typically used several complementary measures (e.g. Cervero et al. 1995). This implies that one should use a combination of different types of accessibility indicators, for example, gravity-based measures and cumulative opportunity measures in order to capture a comprehensive picture of accessibility.

An interesting point for discussion is to what extent an accessibility indicator needs to resemble actual travel behaviour in order to be useful. Accessibility Planning leans towards equality of opportunities and perception of travel choices available (SEU 2003). However, most of the studies reviewed took the perspective that accessibility was a measure that should resemble travel behaviour and could best be calibrated using actual travel data (see Section 3.4.2). An exception here was Reneland et al. (2004) whose accessibility indicators for walking and cycling aimed to examine how well the transport network fulfilled user aspirations rather than resemble actual travel behaviour. As pointed out by Handy and Niemeier (1997, p.1181) actual behaviour is "*not necessarily the same as preferred behaviour*". This in turn has implications for how accessibility indicators should be designed and for how they are calibrated. A weak point of many accessibility indicators applied in literature was that their resemblance to how people actually perceive their accessibility was largely unproven. To sum up, a key question to consider when measuring accessibility is whether an

indicator used for a study should resemble actual travel behaviour, preferred travel behaviour or whether it should be a measure of equality of opportunities (see Section 3.2.2).

3.6.2. Gaps in knowledge

The review identified several research gaps, areas where accessibility indicators could be further developed. Four of these were:

- better knowledge on how people perceive accessibility and decision makers' interpretation of different accessibility indicators (sections 3.4.1 - 3.4.2).
- development of measures that take into account opportunities for trip chaining, temporal and competition effects (3.4.2),
- the size and sources of calculation errors (3.4.3), and
- development of adequate indicators for accessibility by non-motorised modes (Sections 3.5.1 - 3.5.2).

Koenig (1980) and Handy & Niemeier (1997) amongst others preferred indicators that were easily intelligible to the layman. However, no data was found in the literature on how decision makers perceived different indicators. Indeed, Koenig (1980) and Handy & Niemeier (1997) had different views on what interpretable indicators looked like. Incorporation of temporal aspects in accessibility indicators was another largely remaining challenge (Geurs & van Wee 2004). For example, in a two person household with one car, allocation of that car could have very significant impact on each individual's potential for movement at different times of the day and hence on their accessibility. Furthermore, most accessibility measures say little about how different destinations are grouped together and the possibility this may provide for trip chaining. The phenomenon of calculation errors was relatively well reported in the reviewed literature (see Section 3.4.3). However, relatively little seems to be known about the size of errors in different contexts and the role of including different factors (e.g. route qualities) in the impedance function. Most previous studies did not include a specific impedance factor for accessibility on foot or by bicycle that took into account these modes' limited range and the studies that did used distance only (Table 3.3). Few, if any, of the studies reviewed here looked in any detail at the character of the first 15 minutes of travel and the role different characteristics within this time may have for the perception of accessibility. Where indicators that took into account the

limited range of walking and cycling were included these were rather simplistic (Section 3.5.2).

3.6.3. Directions for further research

A useful addition to the evidence on ‘local’ indicators would be to know more about the extent to which different impedance factors and functions for local accessibility (e.g. on foot) could change the overall accessibility rank between areas (see Guy 1983, Hewko et al.2002). The importance of this gap can be underlined by the fact that walking represents around a quarter of all trips (a higher proportion than for bus, coach and rail together) and that 76% of trips shorter than one mile are made on foot (DfT 2007a). In addition most public transport journeys involve two walking segments.

3.7. Conclusions

This chapter aimed to clarify how the notion of accessibility could best be measured. Initially, it was assumed that existing literature on ‘accessibility indicators’ in the transport field would have a strong link with the concept of ‘planning for accessibility’ described in Chapter 2. It was thought that a better understanding of how accessibility had been measured in existing literature would provide many insights on the extent to which Accessibility Planning would work or not. One might easily believe that a strong link would exist between studies of accessibility indicators and ‘planning for accessibility’. However, this proved to be wrong. The literature on accessibility indicators has as much to do with ‘planning for mobility’ as it has with ‘planning for accessibility’. One reason for this is that most of the accessibility studies reviewed relied on revealed behaviour with little concern for how accessibility impacts were distributed amongst different groups and for inhibited trips (trips not carried out). Furthermore, most studies did not adequately take into account the limited range and other requirements of non-motorised modes (Section 3.5.2).

That said, the review found out that accessibility measures can be categorised in relation to three dimensions (see Section 3.2.2). First, how they correspond to revealed travel behaviour. Secondly, to what extent they measure aspirations. Thirdly to what extent they capture equality of opportunities. The review also identified that we do not seem to know very much about deficiencies in accessibility and how the inclusion of equity and different aspirations affect it.

Because transport research into accessibility indicators seemed to maintain only a weak link to 'planning for accessibility' a different approach from that initially anticipated was needed in order to understand potential barriers to the planning concept. At this point it was therefore decided to examine how accessibility indicators were used in planning practice and why previous planning methodologies using accessibility indicators had failed.

Chapter 4

Applications in policy and planning

4.1. Introduction

Planning for local accessibility is not new. Accessibility planning methodologies were trialled in the UK during the 60s and 70s and in the Netherlands in the 1990s (see Chapter 1). For reasons largely not investigated at the time, these earlier planning efforts proved to be futile in the longer term. This chapter investigates how the notion of accessibility has been used in a number of high-profile planning examples, and in British transport policy. It also examines what is known about why the use of accessibility indicators was abandoned.

4.2. British planning examples and concepts

4.2.1. Overview

This section presents experiences from a number of cases where the notion of accessibility has played a significant part of a transport planning process in planning methodology or rhetoric. The first sub-section explores the use of accessibility indicators in new town planning. The following sections analyse accessibility indicators used in structure plans during the 1970s and public transport planning during the 1980s.

4.2.2. Post-war British new towns

4.2.2.1. General planning principles

Post-war British new towns were to house overflow population from the large cities. A first generation of 14 towns was designated between 1946 and 1950. A second and third generation of new settlements took the total number of new towns to 26 in the early 1970s. These 26 settlements had at that time a total population of about 1.3 million people (Schaffer 1972). Many new towns were built with the ambition that they would be self-sufficient in terms of local work places and services for residents (Cullingworth 1999). Most towns were based on the idea of local accessibility, with local shops located in neighbourhood centres easily reachable on foot (Dupree 1987, p. 175). As

shown in Table 4.1, accessibility standards were an important part in the designs (also in the second and third generation new towns that catered for ‘full’ car ownership). The table also illustrates that modal emphasis was different between the different towns.

Table 4.1. Selected accessibility standards in British New Towns (RDC 1967, MKDC 1970a, Osborn et al. 1977, Dupree 1987)

| Town (Design. year) | Target population | Type of facility | Usage/ accessibility standards |
|-------------------------|----------------------|-----------------------------------|---|
| Cumbernauld (1955) | 50,000 | Food shop | One local food shop per 400 houses (within a short walking distance) |
| Redditch (1964) | 84,000 | Priority bus route | All but a few houses within 8 minutes walk/ 500m of a centrally located high-frequency ring route. |
| Runcorn (1964) | 90,000 | High-speed busway/ local shops | Less than 500 yards/ 5 minute walk to nearest high-frequency bus stop and everyday shopping facilities. |
| Irvine (1966) | 80,000 | Community centre | All houses within 5-7 minute walk/ 500m from a general shop and a primary school. |
| Peterborough (1967) | 160,000 | Bus stop | All dwellings within 800m of bus stop with a direct service to centre (most within 400m) |
| Milton Keynes (1967) | 250,000 | Local centre | Less than 500m walking distance to local centre (shops, pub, schools and bus stop). |

4.2.2.2. Specific examples

Cumbernauld

Cumbernauld, 13 miles north of Glasgow, was the first of a second phase new towns in Britain. Accessibility standards played an important part in the town’s design. Cumbernauld’s planners placed emphasis on making it possible to walk from every part of the town to the centre without crossing any major road. The target was to locate all dwellings within $\frac{3}{4}$ of a mile of the town centre and $\frac{2}{3}$ within $\frac{1}{3}$ of a mile (Hillman & Potter 1975). A locally positioned food shop in each area of 400 houses was considered essential (EFP & CDC 1970). All further necessary civic amenities were placed in a central shopping centre, within 20 minutes walk from anywhere in town. Weight was

put on the child pedestrian safety. The footpaths were perhaps the most radical feature of Cumbernauld. *“No one ever needs to cross a road. People are channelled under and over the motorways. It is engineering for pedestrians.”* (EFP & CDC 1970). Private cars were also extensively catered for. A novelty for most British towns at the time was that houses were built with their own garage and that there were streets exclusively for motor cars.

Runcorn

The new town of Runcorn, 14 miles east of Liverpool, was organised around a maximum walking time of five minutes to local centres from where a rapid transit bus route was to provide access to the town centre. The purpose of the design was to meet everyday social and shopping needs within easy walking distance (RDC 1967). 500 yards was found to represent an accurate estimate of the distance covered in 5 minutes on foot in most areas. The exception was a few hilly parts where walking distances were reduced accordingly. The chosen walking distance was input into the design of housing density and other space. Each local centre was designed to cater for around 8,000 people. The centrally located rapid transit bus mainly used its own segregated ‘high-speed’ busway. The busway was a key instrument to achieve a “balance” between private and public transport (RDC 1967, p. 18).

Milton Keynes

Transport became the primary determinant of Milton Keynes urban form (Potter 1976, p.121, White 1976, p.95) and accessibility was one of the overall planning goals (MKDC 1970a p.13). Accessibility was also one of seven transportation objectives (MKDC 1970b p.279). The Milton Keynes plan was highly ambitious in terms of local accessibility. Around 200 potential locations for local centres were provided containing bus stops, shops, pubs and one school per 1,250 inhabitants. The local centres were to be located where the main pedestrian routes cross the main roads ensuring that everyone would live within 500 metres walking distance from at least one such local centre (the plan anticipated that the centres would have somewhat different types of facilities). Provision of a good public transport system was given “*highest priority*” (MKDC 1970a, p.35). The transport and land use system was designed to give “*equality of accessibility, by public and private transport, to all parts of the city*” (MKDC 1970a, p.33). A dispersed pattern of employment was delivered with work sites located fairly

evenly around the perimeter of the city. The plan for Milton Keynes analysed public transport demand, cost and revenues and found that with commonly accepted fares the revenue would support a public transport frequency of service at least “*twice as good*” as in comparable cities (MKDC 1970a, p.34). The explicit reason for this excellent level of service was a high capacity road transport system in the new town that would allow buses to move freely without congestion at a lower cost. It was suggested, for example, that the grid road network of the town would allow the public transport network to have flexible routings while the dispersed employment locations were anticipated to give even loadings in all directions improving efficiency. The summary of the transport analysis concluded that the plan had provided “*no transport constraint on where those without a car might live*” (MKDC 1970b, p.299). This bold statement was underpinned by little empirical analysis of accessibility needs and will be briefly discussed in the next section.

4.2.2.3. Policy outcomes and abandonment

In new-towns such as Cumbernauld and Runcorn, the use of accessibility standards had significant impact on the urban form. In later new towns such as Milton Keynes the ambitions to meet local accessibility objectives had less obvious impacts on the design (Osborn et al. 1977). In hindsight, the policy path chosen in Milton Keynes, e.g. low density housing and employment sites spread around the periphery of the town, did not seem to be very effective in meeting the plan’s local accessibility nor public transport objectives (White 1976, p.96, Bishop 1986, Mitchell 2000) and the claim that those without a car could live anywhere without transport constraints today seems exaggerated, as does the plan’s assertion public transport service levels twice those observed. The last British new town, an extension to Lancaster called Central Lancashire, was designated in 1970 (Dupree 1987) and hence the use of accessibility standards in this context was forsaken.

4.2.3. British Structure Plans

4.2.3.1. General planning principles

The Structure Plan initiative established by the 1968 *Town and Country Planning Act* required transport plans to be a part of development plans, as recommended by *Traffic*

in Towns (see Cullingworth et al. 2006, p.401). The broad purpose of the plans was to outline policies for economic planning and development of a region as a whole.

Structure plans developed during the late 1970s were contemporary to some significant changes in the rhetoric of British transport policy. For example, DoT (1977) promoted the idea that transport planning needed to consider the costs for different groups so that they could access essential services as well as decreasing the length of journeys. *“In the past, plans have often assumed an increasing supply of relatively cheap transport. Housing and employment have become increasingly separated. Larger hospitals, schools, offices and shops to serve wider areas have meant longer and often more difficult journeys. The expectations for the longer-term are different now”* DoT (1977, p.7). Perhaps as a consequence of this the preparation of some structure plans came to include the use of extensive regional and local accessibility models.

4.2.3.2. Specific examples

West Yorkshire Transport Studies

The main purposes of the *West Yorkshire Transportation Studies* (WYTS) was to contribute towards the transport element of the county-wide Structure Plan, as well as preparation of annual transport policies and programmes and the preparation of a public transport plan.

The accessibility models developed as part of WYTS covered an area of approximately 2 million inhabitants (Wytconsult 1977a,b,c,d) and were one of the largest and most sophisticated of their time. As shown in Table 4.2, a large number of ‘personal’ accessibility indicators were used for the study covering both regional and local accessibility. Accessibility was expressed as the degree of opportunity available to people, both as individuals and as commercial operators, to undertake specified activities. A key part of the planning approach was to assess the accessibility problems against standards (Wytconsult 1977c, pp. 6, 31). The accessibility standards were set using a Delphi technique within the study team and the “severity of an accessibility problem was defined as the cost in excess of the standard” (Cooper et al. p. 30).

An accessibility problem was defined as the total costs or cost per person in a particular zone for trips that exceeded the generalised cost standard for an indicator. Generalised costs included travel time and vehicle running costs/ public transport fares. Access costs for facilities within the origin zone were set to zero.

Different standards were applied to each of the 12 facilities while the five categories of jobs were split into two groups, e.g. an acceptable trip cost to a shopping centre was assigned to be 30 generalised cost minutes while the standard was 16 generalised cost minutes for local shops. Professional/ managerial jobs were applied a cost standard of cost of 97 generalised cost minutes per return trip equalling 45 min travel time with public transport or 29 minutes by car. The standard for the other four job categories was set to 73 cost minutes equalling 35 minutes by public transport and 22 minutes by car (Cooper et al. p. 30). Excess access costs for work trips were only calculated for car drivers and public transport and not in terms of walking as the walk mode was not included in the Strategic Model used for the access to work calculations (Wytconsult 1977b, p.56).

Table 4.2. Personal accessibility indicators in the West Yorkshire Transportation Study (urban areas)

| Type of measure | No. of zones | Modes | Attractiveness classification | Usage |
|---|--------------|---------------------------------|---|--|
| Access to work | 19 | Public transport Car | 5 categories (no. of jobs in zone per employment category) | Analyse transport networks and impacts of new links/ services on different groups |
| Access to education (nearest facility) | ~1,300 | Public transport Car Walk | 4 types (local, middle, upper and higher education) | Analyse transport networks and identify areas with poor local facilities |
| Access to shops (nearest facility) | ~1,300 | Public transport Car Walk | 4 groups (local shops, shopping centres and major shopping centres) | Analyse transport networks and identify areas with poor local facilities |
| Access to facilities (nearest facility) | ~1,300 | Public transport Car Walk | 5 types (doctor's surgery, health care, hospital, post office & social security office) | Identify areas with poor local facilities (problems normally only arose for public transport users). |

The study recognised that conventional transport modelling processes were designed to quantify travel demand and economic impacts of changes in the transport system. It was therefore suggested that transport models provided little information on the extent to which the land use and transport system really served peoples' activity requirements and how the impacts were distributed in relation to the population. The study advocated that personal accessibility was “*quite distinct from the characteristics of actual travellers and traffic flows for whose benefit improvements in travel speeds have often (erroneously) been equated with improvements in accessibility.*” (Wytconsult 1977b, p.1). In order to describe accessibility, data other than that for “conventional modelling” was needed (Cooper et al. 1979, p. 28). WYTS included models of pedestrian access to local services and schools and public transport and private car access to work places, local towns and regional centres. Cycling, motorcycling and taxis were not included in the study in order to reduce the work load (Wytconsult 1977b, pp.29-30). Appendix 1 presents further details of the planning approach used in the West Yorkshire Transportation Study.

South Yorkshire Structure Plan

The *South Yorkshire Structure Plan* (SYSP) covered a population of 1.3 million and included two main analyses of accessibility in the context of land use planning (Mallet et al. 1977a, b, c). An overview of indicators in SYSP is presented in Table 4.3. Mallet et al. (1977a) identified areas poorly served by recreational areas and indoor sport centres and studied their public transport accessibility. Another major study (Mallet et al. 1977b) produced alternative location strategies for housing, industry and recreational developments. This study included an assessment of the suitability of various committed or proposed developments and the priorities amongst them using both ‘regional’ and ‘local’ accessibility indicators. As shown in Table 4.3, accessibility by car and *to* and *by* public transport played a significant part of the planning methodology. The SYSP also included a study of the proportion of the population dependent on public transport in different areas, i.e. households not owning a car and people other than heads of households in households owning one car (for 230 zones). This data as well as the accessibility indicators were presented on a number of zone and grid maps.

Table 4.3. Accessibility indicators in the South Yorkshire Structure Plan

| Type of measure | No. of zones | Modes | Attractiveness classification | Usage |
|--|--------------|-------------------------|---|--|
| Job accessibility (gravity model) | ~1,500 | Public transport Car | Number of jobs | Identify areas where the maximum choice of jobs could be offered to the workforce of new residential sites |
| Market accessibility (cumulative) | ~1,500 | Public transport Car | Population within 1 hour travel time | Describe locations where employer's choice of markets and supplies could be maximised (included parts of Manchester, West Yorkshire etc.) |
| Shopping (gravity) | ~1,500 | Unclear | Shopping centre floor space | Identify locations where new residential locations could benefit from existing shopping centres |
| Labour accessibility (gravity) | ~1,500 | Public transport Car | 'Economically active' residents | Identify locations that would maximise the choice of labour for employers (the plan identified this as one of the most critical factors for new & re-locating firms) |
| Recreational areas & sport centres (composite) | 230 | Public transport Car | 'Major facilities' | Analyse potential locations for new facilities (combination of three indicators including access by direct bus service) |
| Access to public transport (coverage) | ~1,500 | Public transport | Proportion of zones covered by bus corridor | Identify locations covered by existing public transport services (minimum two services per hour, corridor represented 10-15 minutes walk on either side of route) |

For most indicators (jobs, population, and labour) public transport network impedance was only measured as "travel distance" (Mallett et al. 1977b, p.15, p.16, p.18, p.20). In the preparation of the plan accessibility indicators were used as an input to a multi criteria analysis using three different sets of weights representing the values of conservationists, developers and planning officers (Mallett et al. 1977b). Appendix 2 presents further details of the planning approach used in the South Yorkshire Structure Plan.

4.2.3.3. Policy outcomes and abandonment

In WYTS, the accessibility indicators were generally used to identify areas with poor accessibility, mainly within urban areas. The general idea was that the indicator data should feed into a wider analysis of transport problems and possible remedies. Today, West Yorkshire still experiences problems with poor local access and social exclusion (WYPTE 2000, pp. 71-75). It is also clear that the planning methodology applied in WYTS did not last. For example, no local accessibility indicators were presented in the

2001 Local Transport Plan for West Yorkshire (WYPTE 2000). In SYSP accessibility indicators played a significant role in analysing optional planning strategies and were used as inputs to stakeholder and expert consultations. The impact of accessibility indicators on the chosen solutions in WYTS and SYSP were less clear than in new towns such as Cumbernauld and Runcorn and it was not always easy to follow how the outputs of accessibility indicators were linked to proposed policy instruments and investments (see e.g. Wytconsult 1977b, d). We will return to discuss the abandonment of accessibility indicators as a planning tool in Section 4.5.5.

4.2.4. Use of Public Transport Accessibility Level indicators

4.2.4.1. General planning principles

The Public Transport Accessibility Level (PTAL) indicator was originally developed by the London Borough of Hammersmith and Fulham (Dallal 1980, Hillman & Pool 1997). The purpose of measuring accessibility in this context was to find “*an objective means of evaluating the competing transport requirements of different areas and sectors of community*” (Dallal 1980, p. 494). The PTAL indicator itself was essentially a sophisticated continuation of the methodologies applied in public transport network planning in new towns such as Runcorn and Redditch, incorporating headway and walking distances. PTAL indicators are based on the assumption that accessibility levels are proportionate to the number of bus services available, not what type or amount of facilities that can be reached. PTAL is therefore principally a measure of access *to* public transport services. PTAL only indirectly covers facilities available at the other end of the journey. For example, Dallal (1980) judged a regular service right outside the door of 3 buses per hour equivalent to a frequency of 10 buses per hour at a bus stop 4 minutes walk away (it was found that the waiting time for high frequency buses in London was equal to the average interval due to irregular running). Thus, the total access time for the stop further away would be 10 minutes (6 minutes waiting time + 4 minutes walk) and equal the average waiting time for a doorstep service every 20 minutes. The fact that many more destinations likely to be within reach at a location with 10 bus services an hour was ignored.

4.2.4.2. Application and policy outcomes

PTAL was increasingly used throughout the UK during the 1980s and 90s (Webber & Foster 2002, Wu & Hine 2003). The London Borough of Hammersmith & Fulham (2003) has made use of the concept for more than twenty years.

In the mid-1990s software was created to assist PTAL calculations. The software, ACCMAP supported the use of the PTAL indicator in development control, as encouraged by Planning Policy Guidance 13 (Hillman & Pool 1997). ACCMAP applies a weighting system called Equivalent Doorstep Frequency (EDF) related to the walking distance to the available bus stop(s) and bus frequency was applied (Hillman & Pool 1997). PTAL has increasingly been used for many different purposes since the new software was developed, including transport assessments of new developments, to give guidance when deciding development plot ratios/ density, when defining maximum parking standards, when identifying areas of deficiency in transport services and when assessing specific user groups' level of service (Dallal 1980, Hillman & Pool 1997, Hampshire County Council 2002, London Borough of Hammersmith & Fulham 2003). During the mid-1990s: London Borough of Croydon, GMPTE, Surrey County Council and Northern Ireland DOE started to use the PTAL approach (Hillman & Pool 1997). More recently Bristol City Council (2001), Hounslow Borough (2003), the Greater London Authority (2002) and London Borough of Merton (2001) have started to adopt the approach. In 2000 the Royal Town Planning Institute (RTPI) accepted the PTAL approach as good planning practice for integrating land use and transport in a consultation paper (RTPI 2000).

4.2.5. Use of accessibility profiles in Planning Policy Guidance 13

4.2.5.1. General planning principles

During the 1990s, the importance of accessibility by public transport, walking and cycling grew significantly in British transport policy and project appraisal (e.g. DoE & DfT 1994, DoE & DoT 1995, DETR 1998a, b, c, d, DfT 2000a & b, ODPM 2001). New planning guidelines, e.g. Planning Policy Guidance 13 (DoE & DfT 1994) recommended local authorities to establish *accessibility profiles* for public transport to determine sites which could meet policy goals. The accessibility profiles should “relate both to access to public transport from housing and access from public transport to

employment and other destinations” (DoE & DoT 1994, p.10). Key aims of Planning Policy Guidance 13 were to ensure that local authorities undertook land use policies and transport programmes in ways which helped to:

- Reduce growth in the length and number of motorised journeys,
- Encourage alternative means of travel which have less environmental impact, and
- Reduce reliance on the private car.

A revised planning note was published in 2001 (ODPM 2001). The new advice strengthened the required infrastructure provision for non-car modes (McClintock et al. 2002).

4.2.5.2. Application and policy outcomes

PPG 13 brought an increased use of travel plans and accessibility profiles in development planning. Accessibility profiles are used to decide when travel plans are required and what type of measures that they need to include (see e.g. Southampton City Council 2006). The accessibility profiles are often established using PTAL software (see Section 4.2.4.2). Accessibility profiles may also be used for establishing an appropriate level for developer’s contributions. The contributions paid by developers are in turn used for different transport improvements.

4.3. Recent developments in British transport policy

4.3.1. Developments during the late 1990s

The 1998 Transport White Paper (DETR 1998a) promised a new planning approach, focusing on accessibility, which would give greater emphasis to accessing jobs, leisure and services by public transport, as well as walking and cycling in land use planning. A key aim according to the rhetoric of the white paper, was to increase personal choice by improving the alternatives to the private car. Amongst other things it meant that a new method for appraisal of trunk roads was established (DETR 1998b). The new appraisal included an ‘accessibility’ assessment and all existing trunk road proposals were reassessed. The result of the review was a targeted programme of trunk road improvements with the aim of increasing accessibility by improving the operating conditions for public transport and by reducing severance. 20 of the schemes in the

revised programme were expected to "significantly improve accessibility, encouraging greater use of public transport, cycling and walking" (DETR 1998b, p.53). However, it has later been suggested that the investment programme failed in meeting its objectives to encourage public transport, cycling and walking (Shaw & Walton 2001, Walton 2003).

4.3.2. Accessibility Planning

Following this burgeoning interest in the role of accessibility in transport policy, a report examining the links between social exclusion, transport and the location of services was presented in 2003 (SEU 2003). It focused on access to opportunities that had the greatest impact on 'life-chances', such as work, learning and healthcare. SEU identified lack of accessibility as a major part of the problems experienced by people facing social exclusion. The term accessibility was defined as that people should be able to reach to "key services at reasonable costs, in reasonable time and with reasonable ease" (SEU 2003, p.1). Key services were in turn described as jobs, schools, healthcare facilities and food shops. The extent to which people could reach these facilities was said to depend on many things including location of services, cost of transport, availability of transport services, safety and security when travelling and people's knowledge of travel opportunities. The report highlighted two main ways to improve accessibility: improved transport (transport planning) and improving location and delivery of key activities (land use planning, public and private service delivery). It advocated that 'Accessibility Planning' should be built into the forthcoming round of Local Transport Plans. The purpose of Accessibility Planning was to ensure that there was a clear and systematic process and responsibility for identifying groups or areas with accessibility problems and improve information on barriers to accessibility and the areas where accessibility was poorest.

Following the publication of the Social Exclusion Unit's report (SEU 2003) and the earlier Transport White Paper (DETR 1998a), a draft guidance on Accessibility Planning was published by the DfT in August 2004 (DfT 2004a). Revised versions of the guidance were published in December 2004 (DfT 2004c) and January 2006 (DfT 2006a). There were only small and mainly editorial differences between the two full versions of the guidance (DfT 2004c, DfT 2006a), with the most significant difference being that the latter version excluded information on non-transport funding streams

such as those relevant for land use planning and the health sector (see DfT 2004c, p. 54-58 and DfT 2006a, p. 51). In addition, changes were made as to how the core accessibility indicators were calculated. These changes were implemented in order to simplify the calculations of the core indicators and included, amongst other things, the use of a notional crow-flies distance rather than walking network distances (see DfT 2005b).

According to the DfT (2004a, p.7) a primary focus of the second round of LTPs was to “improve access to jobs and services, particularly for those most in need” and that accessibility strategies were “mainstreamed” within planning of local transport. The Accessibility Planning Guidance (DfT 2004c, DfT 2006a) recommended local authorities to use a methodology comprising five stages; strategic accessibility assessment, local accessibility assessment, option appraisal, accessibility plan preparation and monitoring. The first main stage was a strategic area-wide strategic assessment and mapping audit, the purpose of which was to identify ‘priority areas/groups’. The term ‘priority area’ was not explicitly defined in the guidance but seems to imply that local accessibility problems for low mobility groups may be worse for those living in certain neighbourhoods.

The strategic assessment made use of six core accessibility indicators, outlined below, which were to be considered in conjunction with local level of deprivation (DfT 2004c, p.69, DfT 2006a, p.60):

- % of a) pupils of compulsory school age; b) pupils of compulsory school age in receipt of free school meals within 15 and 30 minutes of a primary school and 20 and 40 minutes of a secondary school by public transport,
- % of 16-19 year olds within 30 and 60 minutes of a further education establishment by public transport,
- % of a) people of working age; b) people in receipt of Jobseekers' allowance within 20 and 40 minutes of work by public transport,
- % of a) households b) households without access to a car within 30 and 60 minutes of a hospital by public transport,
- % of a) households b) households without access to a car within 15 and 30 minutes of a GP by public transport, and

- % of a) households; b) households without access to a car within 15 and 30 minutes of a major centre by public transport.

The second main stage of the methodology involved a detailed mapping audit for previously identified priority areas. For this stage local authorities were free to use more detailed and locally selected accessibility indicators.

Obviously, the abovementioned national planning framework should be considered vital to the implementation of Accessibility Planning, not the least because the guidance (DfT 2004a, DfT 2006a) put in place a general procedure for identification of accessibility problems. The earlier report by the Social Exclusion Unit (SEU 2003) had played an instrumental role in explaining and informing decision makers about accessibility problems of low-mobility groups and by means of this won acceptance for the benefits of Accessibility Planning. The process of Accessibility Planning, its different stages and the accessibility indicators used, will be further discussed in Chapter 8, particularly in Sections 8.3 and 8.4.

4.3.3. Eddington study

The Eddington study (Eddington 2006) reviewed the transport system's role in sustaining UK's productivity and economic competitiveness. The study majors on accessibility to work places and should therefore be relevant for Accessibility Planning. One of the study's key conclusions was that there is a need to improve traffic flows in dense (congested) urban areas and to provide 'deep' labour markets in large UK cities in order to strengthen transport planning's contribution to economic growth. This may indicate that there is a tension between planning transport for increased economic productivity and achieving the objectives of Accessibility Planning, particularly in rural areas. However, the report also highlights the fact that small transport improvement schemes often offer higher returns than what is achieved by very large transport projects. The Eddington study therefore suggests caution regarding the economic benefits of major transport schemes in general (p. 16, p. 38). The report also highlights the fact that many walking and cycling network improvements are amongst the transport schemes with the highest economic returns (p. 44). This may mean that the focus put on economic productivity in the Eddington study is, or at least can be, largely

consistent with Accessibility Planning objectives (this issue will be further discussed in Chapter 8, Section 8.3.4).

A weakness of the Eddington study is perhaps the fact that the report does not include any consideration of the role land use policies have for transport system's ability to contribute to gains in economic productivity and competitiveness other than to stress that significant new developments need to develop transport and land use "together" (p.45). Hence, the study gives little guidance on the value of developing transport and land use patterns that can support particular aspects of accessibility (e.g. by particular modes of transport).

4.3.4. Sustainability, land use policy and eco-towns

In May 2007 the Government presented a white paper dealing with sustainability issues, land use planning and increased need for new housing (HM Government 2007). The paper built on the findings of an independent review of the system for land use planning in England known as the Barker review (Barker et al. 2006). Soon after that the white paper *Planning for a sustainable future* was released, a prospectus for eco-towns was published by the Department for Communities and Local Government (DCLG 2007). This pamphlet presented outcome targets for new settlements designed to meet demand for new (affordable) housing as well as being test-beds for new environment technology, e.g. the potential for meeting zero carbon emission standards.

Planning for a sustainable future as well as the eco-town prospectus identified a number of things that would be important in order to meet the requirements of a low-carbon future. Some of these have direct bearing on Accessibility Planning. For example, the white paper stresses that the challenge of climate change requires that new developments are located and designed to reduce the need to travel (HM Government 2007, p. 11). In order to achieve this, the Government expects that the "carbon ambitions" of development plans are tested including their ability to help "secure the fullest possible use of sustainable transport and, overall, reduce the need to travel" (HM Government 2007, p. 105). Changes to national planning policy in this and other respects are under consideration and a new framework is announced to be completed by summer 2009 (HM Government 2007, p. 118). In the same vein, the eco-town paper declares that each new eco-town should include a "good range of facilities within the

town including a secondary school, shopping, business space and leisure” and that an “essential requirement” is that each town provides “an area-wide travel plan” with “local targets setting out how it intends to achieve a significantly higher proportion of journeys on foot, by cycle and by public transport than comparable sized cities” (DCLG 2007, p. 12, p.15).

Consequently, *Planning for a sustainable future* as well as the eco-town prospectus include several policies increasing the momentum for Accessibility Planning objectives, e.g. the target that eco-towns should have a significantly higher proportion of trips on foot, by bicycle and by public transport than comparable sized settlements (DCLG 2007, p. 15). However, there are also proposals in these documents, perhaps in particular in the Barker review, that potentially may weaken or even undercut the successfulness of Accessibility Planning, e.g. the fact that relatively few concrete proposals are put forward for how to reduce the need to travel while the paper spends considerable time and effort in order to explain how to streamline the planning process of major new transport infrastructure (see e.g. HM Government 2007, pp. 59-76).

On a more positive note, *Planning for a sustainable future* as well as the Barker review recommended that land use planning should “promote a positive planning culture within the plan-led system” (see e.g. Barker 2007, p.6) and this is consistent with the spirit of Accessibility Planning.

4.3.5. Towards a Sustainable Transport System

In October 2007 Ruth Kelly, Secretary of State for Transport presented a white paper called *Towards a Sustainable Transport System* (DfT 2007d). The paper was a response to two previous government-initiated reviews, the Eddington review on economic impacts of transport (see Section 4.3.3) and a report on the costs of climate change (Stern 2007). The process of Accessibility Planning does not feature highly in the paper (the concept is mentioned only once, on page 59). However, the paper sets out five new high-level and long-term transport policy objectives and the objective that Accessibility Planning aims to achieve (i.e. equality of opportunities through e.g. integration of land use and transport planning) is one of them.

The white paper acknowledges many of the measures and principles promoted in Accessibility Planning, e.g. the importance of good walking and cycling conditions, improved public transport, adequate personal security and availability of local services that can be reached on foot and by bicycle (see e.g. pages 40-41 and 50). The white paper also stresses the importance of an improved option generation process, building on the ideas of the Eddington study (Eddington 2006). As discussed earlier in Chapter 2, a wide-ranging option generation process is a key feature of accessibility-based planning strategies (as accessibility-based planning strategies include land use planning, service delivery as well as changes to transport systems within their scope, see e.g. DfT 2006a, p. 48). The white paper also identifies a need to consult with transport users “much earlier” than occurred in the past (DfT 2007d, p. 78). This is also in line with a key idea promoted in Accessibility Planning, i.e. the need to confer with residents about their accessibility needs as well as proposed changes to transport systems.

4.4. Dutch transport and development planning 1988 - 2001

4.4.1. General planning principles

It has been suggested that the Netherlands pioneered an approach which gives equal emphasis to accessibility and mobility in transport planning (Tolley & Turton 1995). In 1988, the Netherlands adopted a policy aimed at increasing accessibility by public transport. It was called the A-B-C Location Policy and matched mobility needs with the accessibility profiles of locations. The policy sought to concentrate employment-intensive land use around public transport nodes, and was a reaction against an increase in the number of offices located along the trunk road network giving rise to increased congestion as well as increased car usage and environmental deterioration (van Wee et al. 1996, NEA 2000). The policy was designed to reduce the growth rate of car traffic and revitalise city centres (Martens et al. 1999). The A-B-C concept was also known as ‘*the right business at the right place*’. When a company relocated or built new premises their mobility profiles were matched with the accessibility profiles of different parts of the town to find the most suitable location. The policy was integrated in the Dutch national transport plan, and included in the mandatory land use plans set up by local authorities. It was complemented by ‘compact city’, mixed-use and in-town retail planning policies (Schwanen et al. 2004).

Tables 4.4 and 4.5 summarise the planning concept. The principal criteria for mobility profiles were labour intensity, employees' transport needs, visitor frequency and road haulage (Verroen et al. 1990). Labour intensity was measured as the number of employees per floor space, employees transport needs were taken as dependence on car for business transport, and visitor frequency related to floor space. The accessibility profiles divided urban locations into four groups A, B, C and R. A-areas were those with a very high accessibility to public transport, B-areas with adequate access to public transport, C-areas car-oriented and R-areas areas with poor accessibility by public transport and road. A detailed description of the A-B-C concept can be found in VROM (1991).

Table 4.4. Matching principles for mobility and accessibility profiles (VROM 1991)

| Criteria | A -locations | B-locations | C-locations |
|--------------------------------|--------------|-------------|-------------|
| Labour intensity | High | Average | Low |
| Visitor intensity | High | Average | Low |
| Dependence on car for business | Low | Average | High |
| Road haulage/ goods | Low | Average | High |

Table 4.5. Examples of business classifications (VROM 1991).

| A -locations | B-locations | C-locations |
|---|--|---|
| Offices, shops, regional and local authorities, regional education, hospitals, culture facilities | Car-oriented commercial services, clothing industry, graphical industry, rental firms, sport centres | Petroleum industry, furniture manufacturing, car dependent service industry |

To enhance the outcome in terms of reducing congestion and environmental impacts the policy pushed for parking standards for A- and B-locations. For example A-locations had a parking standard of one space per 10 employees in the Randstad (the metropolitan area of Amsterdam, Rotterdam and The Hague) while B-locations had 1 space per 5 employees. C-locations had no recommended maximum parking standards.

4.4.2. Policy outcomes and abandonment

The A-B-C Policy was in practice for more than a decade and has been assessed from three different perspectives: impacts on congestion, impacts on the environment and ease of implementation (e.g. van Wee et al. 1996, Martens et al. 1999, VROM 2001). Van Wee et al. (1996, p.85) estimated that the A-B-C policy could be expected to reduce travelled car kilometres by 5-8%. Furthermore, as the policy focused on employment, it could be expected to have a significant impact on controlling the increase in road congestion on certain parts of the network, measured as peak hour car travel. However, later studies suggested that congestion was continuing to increase despite the existence of the A-B-C policy (VROM 2001, Schwanen et al. 2004). One reason for this may have been that the A-B-C policy had been applied to not more than a third of all new business relocations (VROM 2001).

In 2001, the A-B-C policy was weakened and removed as a free-standing concept. *The Fifth National Policy Document on Spatial Planning* replaced it with a less rigid planning framework for local authorities, and indicated that the A-B-C policy had been difficult to implement (VROM 2001). The main criticism of the A-B-C policy put forward by local authorities was that the policy had been too restrictive (van Wee et al. 1996, Martens et al. 1999). Some key elements of the A-B-C policy (e.g. control of development in peripheral areas and promotion of mixed use) survived the change.

After being abandoned, Schwanen et al. (2004, p.597) assessed the policy's impact on modal split and travel distance. They concluded that the policy had led to an increase in public transport trips and that it had been successful in protecting greenfield land and revitalising cities but that it had had little effect on modal split or total distance or time travelled by car.

No evaluations were found on the A-B-C policy's impact on accessibility by different modes or its role for low mobility groups. However, it may be argued that the policy brought accessibility benefits for low mobility groups. For example, the A-B-C policy ought to have made it easier for those without a car to reach services located in new developments than that would have been the case without it.

4.5. Discussion

What were the reasons for implementation and later abandonment of strict accessibility standards for new developments in the UK, of accessibility analyses in UK structure plans and of the Dutch A-B-C policy? What, if anything, can we learn from earlier planning examples? And why has PTAL survived? These are some of the questions this section attempts to address.

4.5.1. Use of accessibility indicators and standards

The concept of 'local' accessibility was probably most important for the planning outcome where land use and transport planning was closely integrated (e.g. new towns) and where 'firm' accessibility standards were applied (e.g. the A-B-C policy). Post-war New Town planning often applied rather strict standards for maximum travel distance or time to local facilities, tied to the neighbourhood unit idea and primarily used to determine the size, density and shape of residential areas and local retail outlets within or nearby each 'residential zone' or 'environmental area' (see Table 4.1). The use of accessibility indicators in the planning process was more blurred in later British planning examples. WYTS focused on transport planning needs, in particular assessing car and public transport networks and calculated a set of highly elaborate indicators (see Table 4.2). Accessibility standards were used to investigate the distribution of opportunities focusing on the nearest facility, but the role of the indicators for the planning outcome and formulation of policy options was not always very clear. However, a general role of the indicators was to identify areas with low accessibility (mainly within urban areas). The indicators applied in SYSP paid more attention to development planning needs than those in the West Yorkshire study did. SYSP used less detailed accessibility indicators than WYTS. The SYSP indicators were however put to a more sophisticated use. They were used to initiate optional solutions and a debate about the appropriate value to be attached to different aspects of accessibility (Mallett et al. 1977b). So, the SYSP indicators were used to broaden the debate about how different aspects of accessibility and whose accessibility that should be given priority in different contexts. This is quite different from how accessibility indicators were employed in WYTS. WYTS aimed more clearly to calculate the best possible definition of accessibility using solely quantitative data and with little explicit input from external experts, stakeholders and elected leaders.

PTAL and PPG 13, although useful in many ways, did not really take into consideration which facilities could actually be reached by different groups of the population. PTAL focused on access *to* public transport and when used within the PPG 13 framework it included access to *new* developments only. PTAL used for development planning did therefore take into account only a very limited part of an individual's accessibility.

The methodology adopted in the A-B-C policy, based on 'firm' accessibility standards in development planning was similar to that used in post-war New Town planning. A key difference between New Town planning and the A-B-C policy was that the later dealt with employment sites not residential areas and promoted mixed use not residential zoning.

4.5.2. How did the use of accessibility indicators come about?

As shown in Table 4.6, accessibility indicators have been used in several different contexts and for many different reasons.

Table 4.6. Reasons for using planning methodologies based on accessibility indicators.

| Context of use | Main objectives |
|---|--|
| New Town planning (e.g. Cumbernauld) | The economic value of local facilities (planning for certain life styles/ family structures). |
| Land use and transport structure plans (WYTS, SYSP) | Probably that planned improvements should benefit all groups in society. |
| Business relocations/ development planning (A-B-C policy) | Congestion reduction, improved quality of life in regenerated urban areas and protection of greenfield land. |
| Development planning (PPG 13, PTAL) | Protection of greenfield land, congestion reduction, and access by public transport to new developments. |

A desire to cater explicitly for certain groups of households, i.e. those with housewives, was a generally accepted design objective in New Town planning (Osborn et al. 1977). Good quality shops within walking distance were also an important argument in marketing of new towns such as Cumbernauld (EFP & CDC 1970). New town planning was a clean sheet of paper and therefore applying accessibility standards was probably

fairly straightforward. For example, there was no need to discuss how the accessibility standards applied fitted with the perception of local residents as there were none.

Little is known about how accessibility-based planning approaches got their opportunity to be practiced in land use and structure plans during the 1970s. Perhaps the most likely reason was an ambition that transport investments should benefit all. The perception that fuel was going to get more expensive in the future may also have helped (see DoT 1977, Section 4.2.3.1).

Congestion and concerns for the environment, in particularly the protection of greenfield land, were important reasons in the UK for implementing PPG 13. Congestion reduction was also an important reason underlying the rhetoric of the A-B-C policy (see e.g. van Wee 1996, NEA 2000). Other aims of the A-B-C policy were to improve urban neighbourhoods, attract investment into certain areas and protect greenfield land (Schwanen et al. 2004).

4.5.3. The role of planning culture

The previous section highlighted that accessibility planning methodologies have many applications and potential benefits. So, why was Accessibility Planning then only applied in relatively few cases and not mainstreamed? Why did so few research resources seem to go into developing tools for it, if it was such a good idea? One explanation may be that British planning culture was negatively biased towards accessibility planning methodologies, and there is ample of suggestions in the literature supporting that view (see e.g. Tetlow & Goss 1968, Schaffer 1972, Wistrich 1983). Planning for mobility by car was described with words such as “scientific”, “realistic” (Tetlow & Goss 1968, p. 99-100) and “objective” (Buchanan et al. 1963, p. 76) and considered as an axiom for economic growth. Mobility planning helped the transport planning profession to ‘loosen the government’s purse-string’ on transport (Schaffer 1972, p.75). Planning for accessibility on the other hand was based “upon intuition” (Buchanan et al. 1963, p.76), was considered to “seem fair” (Buchanan et al. 1980), “hostile” to car use and a “philosophy” (Wistrich 1983, p.69, p.70). Wistrich (1983, p.69) suggested that “dissident professionals” helped to open up the grounds for a pro-accessibility transport policy. Evidence from elsewhere suggests transport planners considered accessibility-enhancing planning strategies to conflict with economic

objectives and that this may be one reason that the approach was abandoned (Buchanan et al. 1980, SIKA 2001). Buchanan et al. (1980, p.35) advocated that planning for accessibility was not cost-efficient. They accepted the fact that no firm evidence of the cost-effectiveness of accessibility standards existed at the time. However, they came to the conclusion that planning for accessibility standards was “unlikely” to lead to the most cost-effective solutions being considered. Instead they suggested that transport planning should focus on catering for increased mobility. The reason suggested by Buchanan was that Londoners had “to a large extent” already “adapted to the existing pattern of accessibility” and that those who chose to live in inaccessible areas do so because of offsetting advantages such as housing availability, housing costs and better environment. The evidence suggested for this was that if people would be better off elsewhere they would have moved house/ job already (Buchanan et al. 1980, p.35). SIKA (2001), a Swedish Governmental Agency for transport analysis, criticised a planning process focusing on basic needs with similar assertions about the housing market as those that Buchanan et al (1980) had expressed earlier. SIKA (2000, 2001) held on to this view even when national policy makers persistently suggested that basic needs and therefore local accessibility should be included in high-level transport appraisal and monitoring (Regeringen 1998, Regeringen 2003, p. 10). So did other publicly controlled transport agencies (Vägverket 1998). “Transport improvements lead, in general, to accessibility improvements for all groups of transport consumers and in relation to all destinations. It seems, therefore that there is no point in quantifying targets for such improvements” (SIKA 2001, p.38). SIKA continued; “there are reasons to warn against a transport policy focusing on *basic* transport needs only” as this, if basic needs were possible to determine, would not capture the general welfare benefits (SIKA 2001, p.38).

4.5.4. Abandoned and surviving concepts

The accessibility planning methodologies described in Sections 4.2 - 4.4 were all to a large extent abandoned, the exception being PTAL (the newly implemented Accessibility Planning initiative excluded). There might be several reasons that the PTAL approach has survived. As mentioned earlier, however, PTAL is not a ‘true’ measure of accessibility, it is a measure of access *to* public transport. PTAL is therefore simpler to compute than accessibility measures that include data on where different

types of services are located. Neither does PTAL require a judgement on the extent to which some facilities are more important than others (see Chapter 2, Section 2.6.1).

4.5.5. Abandonment

4.5.5.1. Reasons for the abandonment of accessibility indicators used in new town planning

As the demand and ambition to build new towns in the UK dried up the accessibility planning methodologies around which many of them were designed seem to have been forgotten. Also other reasons are likely to have contributed to the fact that this stream of planning for accessibility died out. The reasons seem to have more to do with overall changes in society than deficiencies in the planning methodologies per se. One such change was the waning of the neighbourhood idea, increased concerns over air pollution and noise in dense cities, and the rise of a new planning paradigm; that places for work, places to shop and places to live ought to be clearly and increasingly separated to improve quality of life when motorised modes successively became cheaper and widely available to people (see e.g. MKDC 1970a & b for one version of this idea). For example, why would one (mainly) use local services if commuting by car or bus and passing many other shops on one's way home? It should also be said that the accessibility standards stipulated in town plans such as that of Cumbernauld were perhaps not always met and in hindsight the commercial viability of shops in many local centres was probably relatively low (not the least because of their location, often away from main thoroughfares).

The difficulties of specifying accessibility needs and adequate indicators, discussed in Chapter 3, may also have contributed to the abandonment of accessibility indicators in transport planning. For example, the development of the plan for Irvine saw several changes to the facilities that were to be located locally (Osborn et al. 1977, pp. 439-445). Perhaps more importantly, those facilities that were to be provided locally differed significantly between different new towns, as did what was seen as an acceptable walking distance. For example, in Cumbernauld it was a 'foodshop', in Runcorn a 'local centre' and in Milton Keynes a bus stop, shops, a pub and schools.

4.5.5.2. Reasons for the abandonment of accessibility indicators used in transport and land use structure plans

In WYTS and SYSP (Section 4.2.3) the reasons for abandoning the use of accessibility indicators were unclear and one can merely speculate on the causes of it. However, it seems relatively clear that three high-level issues contributed to abandoning of the use of accessibility indicators in structure plans:

- Resource implications, lack of data and lack of adequate tools to analyse data,
- A change in planning culture and how local accessibility needs were viewed, and
- Problems of how to specify accessibility indicators (see Section 4.5.4.1).

WYTS was granted rather extensive resources for surveys and methodology development. Altogether the study contained more than 100 reports. Despite a relatively generous budget it was found that resources limited the accessibility analysis. For example, WYTS was not able to develop an accessibility measure for cycling despite it being a significant transport mode at the time (Wytconsult 1977b, pp. 29-30). Neither was walking accessibility included in the work place assessment. Furthermore, the accessibility analysis was disadvantaged by the lack of modern computer facilities which meant that the WYTS used zones rather than real walking distances to the nearest facilities. This had implications for the accuracy of outputs (see Chapter 3). Similarly, the methodologies used in the SYSP were hampered by a lack of adequate data and tools to analyse travel time by public transport, a likely reason for the fact that several of the indicators used did not include public transport headway (Mallett et al. 1977b).

4.5.5.3. Reasons for the abandonment of the A-B-C policy

The A-B-C policy was abandoned because the accessibility standards for new developments that underpinned the A-B-C policy were considered too rigid by local authorities (VROM 2001). It was also well recognised that the A-B-C policy had failed in meeting anticipated reductions in road congestion (see e.g. Martens et al. 1999). Interestingly, at the time of the abandonment the policy's effects in terms of social impacts (incl. local accessibility) and protection of greenfield land had been relatively poorly examined. Neither of the main transport evaluations of the Dutch A-B-C policy (van Wee et al. 1996, Schwanen et al. 2004) attempted to include an analysis of the A-

B-C policy's impact on local accessibility despite it being a potentially important outcome of the initiative. Schwanen et al. (2004) discussed the A-B-C policy's role for 'stimulation of cycling and walking' but this was measured as the policy's impact on modal choice and not its role for social inclusion or non-car accessibility. They found that the policy had 'little' effect in this respect. However, the logic of the methodology applied in their evaluation meant that the potential benefits of shorter travel time and increased choice on foot and by bicycle were excluded from the analysis.

4.6. Conclusions

As shown in Sections 4.2 - 4.4, Accessibility Planning (DfT 2004c, DfT 2006a) builds on the planning traditions of New Town planning and that of WYTS and is based around a need for some groups to reach facilities 'locally' using non-car modes. During this period of time (from New Town planning and to today) the scope of accessibility planning methodologies has changed, and the most recently implemented British policy initiative (DfT 2004a, DfT 2006a) focuses on improving social inclusion for low mobility groups. Previous British accessibility planning methodologies (e.g. WYTS, SYSP) probably failed for a number of reasons including the costs for measuring accessibility and a lack of data. A lack of understanding of the concept of accessibility among planners and decision makers may also have contributed to the abandonment. In addition, a change in the political climate in the UK may have reduced the incentive for planners to examine equity impacts of transport schemes. The transport planning culture also seemed to show a growing tendency to rank transport options depending on their economic efficiency (i.e. time gains based on increases in link speeds). Several other issues may also have contributed to the abandonment, including lack of adequate planning tools, changes to how the planning culture viewed accessibility needs (see Section 4.5.5.1) as well as unresolved policy conflicts. It is difficult to say if a change in transport planning culture contributed to the abandonment of accessibility indicators in the land use and structure plans studied (SYSP and WYTS, see Section 4.2.3.2) or if it simply was a re-assertion of the dominant culture. Perhaps more importantly, it seems that land use planning culture at this time changed to embrace so called modernistic planning principles and zoning (functional separation of work places, shops and homes) together with planning principles that promoted car use. The fact that accessibility-based planning approaches still got an opportunity to be applied in some land use and structure plans may perhaps be attributed to concerns that transport in the future would

stop to get successively cheaper (DoT 1977, see also Section 4.2.3.1). The Dutch A-B-C-policy was the only non-New Town accessibility planning methodology to be implemented over a longer period of time. The impacts of the A-B-C policy on 'local' accessibility, i.e. travel time on foot and by bicycle including travel choice by these modes and public transport, is not well known and these effects were, to our best knowledge, not studied before the policy was abandoned, or thereafter.

Chapter 5

Review of factors influencing pedestrian behaviour

5.1. Introduction

This chapter aims to bring clarity to the robustness of distance-only walking indicators and how impedance for pedestrian networks could best be measured.

Previous chapters found that little was known about how to design adequate local accessibility measures that could capture travel behaviour and/ or accessibility values (Chapter 3, e.g. Sections 3.6.2.-3.6.3). It was suggested that the reliance on accessibility indicators has been a significant hurdle to accessibility-enhancing planning strategies, not the least because different indicators may lead to significantly different rankings of accessibility for areas (see e.g. Section 3.6.3) and the fact that extensive resources are needed for their calculation (see Chapter 4, Section 4.2.3 & Appendix 1). Nevertheless, the recent governmental Accessibility Planning initiative (see SEU 2003, DfT 2004a, b & DfT 2006a) suggests the use of local accessibility indicators similar to the ones applied in several abandoned planning approaches. For example, a walking segment is incorporated in all six new accessibility indicators (see Section 4.3.2) and accessibility on foot is derived from a notional distance between origins and destinations (i.e. distance multiplied by a yardstick walking speed). So, the treatment of accessibility on foot is similar to, not more advanced than, that used in earlier accessibility-enhanced planning strategies. In fact, when the new Accessibility Planning initiative was developed (SEU 2003) little explicit thought seems to have been paid to the extent to which an indicator based solely on distance actually corresponds to the behaviour of pedestrians, pedestrian perceptions or an accessibility concept based around equality of opportunities (see also Sections 3.6.1- 3.6.3). This may certainly deserve some thought and this chapter aims to shed some light on the issue. It does this by examining evidence available for calculating more detailed measures of accessibility on foot, indicators that for example take perceptions into account.

In order to bring clarity to the robustness of distance-only walking indicators and how impedance for pedestrian networks could best be measured, this chapter starts by discussing different approaches to investigating pedestrian accessibility, e.g. the validity

of studying observed travel behaviour when trying to assess accessibility needs. A second section of the chapter examines the general role urban form plays for travel behaviour. Thirdly, findings on walking propensity from studies on urban form and travel are investigated. Fourthly, factors reported to affect 'walkability' and route quality of travel are looked at. Next, studies on pedestrian route choice behaviour are looked into before problems reported by pedestrians are described. Finally, this chapter concludes by discussing the strengths of the evidence on pedestrian behaviour, how observed behaviour may or may not relate to accessibility needs and accessibility on foot and then suggests further research.

5.2. Study approach: accessibility needs vs. observed behaviour

This thesis has previously argued that it cannot be assumed that the level of accessibility in an area necessarily corresponds to observed travel behaviour (see Chapter 2, e.g. Section 2.4.2). This is because data on observed behaviour does not necessarily say much about accessibility needs. One reason for this is that data on observed travel behaviour largely excludes the needs and aspirations of those that deem current infrastructure inadequate either because deficiencies inhibits them from travelling or because insufficiencies force people to make more expensive or longer trips than they want or can afford. However, data on actual travel behaviour may, indirectly, be important for establishing gaps between accessibility needs and reality (the extent to which needs are satisfied). For example, if many deem the infrastructure on a particular pedestrian route sub-standard this would be likely to show up in observed behaviour, typically in the form of a detour to take a more feasible route. This would not only increase travel costs and hence decrease accessibility but may also push some destinations beyond acceptable walking distance. So, even though data on observed behaviour may say little about accessibility needs it may be a useful way to examine the relative strength of different factors affecting pedestrians' aspirations and needs.

It is also a fact that much research has aimed to study pedestrian behaviour (see e.g. May et al. 1985, van de Coevering et al. 2006). It seems therefore rather limiting to exclude this source of information from a review on accessibility on foot.

5.3. Factors important for walking propensity

5.3.1. Overview of studies investigated

The next sub-section provides an introduction to studies on urban form and travel behaviour. The following sections present findings from two groups of studies on pedestrian propensity. First, studies that investigated walking propensity based on area-wide characteristics. These studies tend to use density and high-level characteristics of urban environments to explain walking propensity. This group is hereafter called research on *non-specific routes*. A second group of studies examined route qualities and local area attributes in order to explain differences in walking propensity in different areas. The latter group also includes some major studies using stated preference methods.

5.3.2. Introduction to research on urban form, travel behaviour and pedestrians

A great deal of literature investigates relationships between urban form and travel patterns. A previous review (Handy 2005) suggested that that there were 70 studies published during the 1990s alone. Most studies examined how urban form influences population and employment densities and therefore distances to suitable destinations. This stream of research also contains data on walking propensity. In addition, some studies have explored how land use influences street patterns (block sizes, junction designs) and therefore the availability and quality of walking routes. A brief summary of the general findings of studies on urban form and travel behaviour is provided below.

An influential study that examined the role of urban form was undertaken by Newman & Kenworthy (1989). They found a strong link between urban density and travel behaviour. Later studies have refined the evidence, but also criticised it. For example, Gomez-Ibanez (1991) criticised the conclusions made by Newman & Kenworthy for paying insufficient attention to differences in income and fuel prices. He suggested that socioeconomic differences could explain much of the strong correlation between density (urban form) and the travel patterns that Newman & Kenworthy found.

Steiner (1994) reviewed a number of predominately North American studies on land use and travel patterns. She found that earlier studies did not separate out factors such as income, fuel price, household size and characteristics from those factors of urban form, and that the evidence for how population and employment density affects travel was

therefore relatively weak. Stead (2001) investigated variations in travel distance using land use statistics, socioeconomic data and travel diaries from the UK National Travel Survey. His starting point, in line with Steiner's, was that many studies on urban form and travel behaviour were too simplistic and did not take socioeconomic characteristics into account. Stead found that land use characteristics in Britain accounted for up to one third of the difference in travel distance while socioeconomic factors exerted stronger influence and accounted for up to half of all variations. There were also potential interactions between land use and socioeconomic factors. Cervero & Duncan (2003, p.1480) added to the dissatisfaction with methodologies used in previous studies examining urban form and travel. They suggested that population and employment density used in many earlier studies was not that important because they were only indicators of other more important factors such as street design. Mackett (2003, p.330) commented that it was "difficult" to assess the strength of the evidence because there were strong correlations between factors and the different assessment scales used would affect the results. Van de Coevering et al. (2006) reassessed the data used by Newman & Kenworthy (1989). They found, similarly to Stead (2001), that urban form seemed relevant for all travel patterns, even when taking socioeconomic differences between cities into account, but less so than suggested earlier (van de Coevering et al. 2006, p. 238). The debate on urban form and travel behaviour is still ongoing.

Planning concepts such as 'Smart Growth', 'Transit-Oriented Development' and 'New Urbanism' has been at the forefront of much of the area-wide high-level research on urban form outlined above. In this literature, the walking mode has been treated with varying degrees of depth with many of the studies mentioned above paying relatively little attention to it. One reason for this is that most studies investigated variance in total travel distance (e.g. from environmental and energy conservation perspectives) and paid only little attention to walking distance. For example, van de Coevering et al. (2006) investigated only the combined impact on distance travelled by walking and cycling together.

5.3.3. Findings in studies on non-specific routes

Several studies have indicated that urban form and attractiveness of street environments is important for walking propensity. This section provides, in chronological order, details of selected larger studies in the area studying non-specific routes (i.e. using density and

other rather 'high-level' area-wide characteristics of urban environments to explain walking propensity). Key findings are summarised in Table 5.1.

Lövmemark (1972) undertook 700 interviews in two urban neighbourhoods of Göteborg. According to the author, environmental quality was an important factor in explaining pedestrian behaviour. It was found that walking trips were on average one third (30%) longer in one of the two areas surveyed. Lövmemark concluded that it seemed like the zone in which people were willing to walk could be expanded by 50% by ample pavement widths and, building designs and streetscapes attractive to pedestrians. He did not explain in detail what streetscapes attractive to pedestrians looked like. Neither did the study collect data on the design of streets in the two areas. It was also unclear from the study if the longer average walking trips found in one area to some extent could be explained by differences in demography, car ownership levels, facilities available or trip purposes.

Hillman & Whalley (1979) and Hillman et al. (1990) identified a strong relationship between population density of an urban area and the number of walking trips per person based on data from the National Travel Survey. The link between density and trips by non-car travel modes was found to be non-linear. In particular, the number of walking trips increased with higher bands of density (Hillman & Whalley 1979). The evidence held true for households with one car as well as households with multiple cars living in different areas. The increase in walking modal split in high density areas was particularly evident on essential trips (work, education, shopping, personal business and 'escort').

Lynch & Atkins (1988) used a questionnaire-based survey to investigate the role of perception of poor personal security on travel behaviour in Southampton. Personal security fears were found to have particularly negative impacts on the number of walking and public transport trips made by women. Women felt the most apprehensive about isolated locations where the sense of surveillance was low (p.268). The authors suggested that knowledge about violent incidents and harassments, from personal experience, hearsay or the media, was likely to have a significant negative impact on people's perceptions about walking. The authors suggested that such information was misleading in terms of actual risks involved in walking through an area. The study found that women and ethnic minorities were the most affected by fear for their personal security, and this has later been confirmed by other studies (DfT 1999, Berglund et al. 2006).

Table 5.1. Findings on urban form and walking propensity: selected studies on non-specific routes

| Location | Methodology (n) | Walking propensity element | Environment(s) | Key factor(s) | Other factors | Main trip purpose(s) | Time of day | Key findings |
|---|--|---|---|---|--|---|---------------------|---|
| Rockridge & Lafayette, San Francisco (Cervero & Radisch 1996) | Two postal questionnaires incl. travel diaries (non-work 620, commuting 820) | Walking frequency in 2 areas with similar socio-economic profile, car ownership & rail access | Two suburban areas, (one car-oriented & one neo-traditional) | Traditional urban design (mixed-use) | n.a. | All (2 categories: non-work & commuting) | All (non-specific) | Area with pedestrian-oriented design had around 7 times more walk trips for non-work and commuting purposes. Increase was particularly evident for shopping trips < 1 mile. |
| Austin, Texas USA (Handy, Clifton & Fisher 1998) | Postal questionnaire (1368), 6 focus groups, factor analysis | Correlation between walking frequency and perceptions about walking in local neighbourhood. | 6 middle-income neighbourhoods (trad. urban, early modern & late modern) | Stores are perceived within walking distance, it is perceived safe walking. | Quality of local stores perceived high, feel comfortable walking in local shopping areas | Food shopping, shopping & walking for leisure | All (non-specific) | Those who walked more often appeared to replace car trips with pedestrian journeys. Perceptions of walking distances, safety and the number of other people around were found important for neighbourhood walking frequency. |
| Göteborg, Sweden (Forward 1998) | Phone interviews, Theory of Planned Behaviour (188 questionnaires) | Modal choice on short trips among car drivers (non-drivers excluded from sample). | Dispersed city with 700,000 inhabitants | Distance (19%) | Weather (14%), freedom/ pleasure (12%), fresh air (11%) | All, including leisure (non-specific) | All (non-specific) | A model of planned behaviour explained 42% of car drivers' intention to walk a short distance (2.5km) within 3-4 weeks. Improved street lighting suggested increasing walking propensity (p.52). |
| Great Britain (Stead 2001) | National Travel Survey, Land Use Statistics (5,000 households) | Influence of local shops on total travel distance | 240 areas with different land use characteristics | n.a. | n.a. | All | All (non-specific) | People in areas with their nearest post office, chemist and grocers within a 3-minute walk travelled on average up to 46 kilometres per person per week shorter (p.512). |
| Five areas in the UK (Mackett 2003) | Household interviews (377) | Stated reasons for car use on short trips | Several different settlements (rural, town, large town, city, major city) | Heavy goods to carry (19%), giving a lift (17%), | Short of time (11%), distance (11%), convenience (11%), car needed for 2nd trip (9%) | All (9 categories) | Daytime & when dark | Respondents considered walking an alternative for 31% of short car trips. Improvements of walking environments low priority for switching mode, most important for those apprehensive about walking when dark. |
| San Francisco Bay Area (Cervero & Duncan 2003) | Postal questionnaire incl. travel diary, discrete choice logit modelling (7,836) | Influence of block size, junction types (no. of 3 & 4-way jtns) and land use mix on modal split for trips < 5 miles | Metropolitan area | Personal and household attributes (gender, race, car ownership, income) | Gradients, land use mix, personal security | Non-work (5 categories) | All (non-specific) | Personal and household attributes had higher predictive power than high-level urban design elements. In particular steep gradients decreased walking significantly. Lack of personal security suggested having great neg. impact on walking trips. Land use mix increased walk trips somewhat. |
| Austin, Texas (Cao, Handy & Mokhtarian 2006) | Postal questionnaire, regression analysis (837) | Correlations between walking frequency and perceptions of local walking in local neighbourhood | See Handy, Clifton & Fisher (1998) | Residential preferences, distance to shop | Lower motor traffic levels | Walking to shops | All (non-specific) | Self-selection of neighbourhood important for walking frequency to shops. Respondents stating that "stores within walking distance" was an important factor in their decision to live in their current neighbourhood walked more often. Traffic calming suggested to increase walking somewhat. |
| 31 cities (van de Coevering & Schwanen 2006) | Regr. analysis of travel, land use & socio-economic macro data (31) | Correlations between various urban form factors and combined walking & cycling modal split | Major cities and metropolitan areas in Europe, Canada & USA. | Higher % of rental dwellings increased combined walk & cycling modal split | Higher population density increased combined walking & cycling modal split in American cities. | Commuting to work only | All (non-specific) | Urban form "appear... relevant to all dimensions of travel patterns" including combined walking & cycling behaviour (p. 238). Land use characteristics of older central areas promoted walking & cycling and reduced kilometres driven. |

Cervero & Radisch (1996) conducted a study of travel patterns in two San Francisco neighbourhoods with different levels of pedestrian infrastructure and urban form but similar socioeconomic profiles. The authors found that the pedestrian-oriented area in the study experienced 7 times more walking trips. However, the differences between different areas were relatively small in terms of the total number of trips made and distance travelled. For example, walking modal split was 6 percentage points higher for trips to work in the more pedestrian-oriented area (excluding any extra walk to access rail), and around 10 percentage points for non-work trips.

Forward (1998) used a one-day travel diary and a model of planned behaviour to investigate modal choice on short trips (trips up to 2.5km). Stated reasons for why respondents chose to walk were short distance (19%), weather (14%), freedom/ pleasure (12%) and fresh air (11%). The model of planned behaviour created was able to explain 42% of car drivers' intention to walk on a short trip within 3-4 weeks. This leaves plenty of scope for the suggestion that environmental attributes are important for walking propensity. Habit, measured as the frequency with which each respondent used each mode for a short trip during the last two months, contributed most towards the 42% prediction rate (p.28). Perceived behavioural control was the second most important factor. Perceived behavioural control variables were the stated likelihood to use a particular mode when in hurry, when traffic was heavy, when weather was dry, when dark and when carrying a lot. Also, subjective norm increased the prediction rate somewhat (what respondents thought other people perceived as appropriate travel behaviour). The model's ability to explain intention to cycle and drive was higher than for walking propensity at 60% and 69% respectively. The author suggested that improved street lighting and more pedestrian facilities and traffic designs that give pedestrians priority would increase walking propensity (p.52).

Handy, Clifton & Fisher (1998) analysed how the perception of the local environment affected walking frequency on non-work trips, in particular trips to local shops, in six neighbourhoods in Austin, Texas. The study also included five socio-economic factors. The study found that urban form was one of many factors that affected walking propensity, and that walking frequency to shops strongly correlated with distance. Respondents in two traditional urban areas walked more than those in the other

neighbourhoods. The proportion of walking trips to local shops in these areas was 15% and 42% respectively, compared with only 2-3% in car-oriented areas. A positive correlation was found between walking frequency and a perception that local shops were within walking distance (p. 67). However, it was unclear whether this was cause or effect. There was also a correlation between walking frequency and the *perception* that local walking routes are safe for walking, and that the quality of local shops is high and meet many needs, and to a lesser extent, with feeling comfortable walking in local shopping areas. All the correlations above were statistically significant at the 99% level (note that no clear distinction was made in the questionnaire between traffic safety and personal security). A perception amongst respondents that shade provided along routes in their neighbourhood was statistically correlated with the likelihood of walking for leisure. Respondents who walked more often to local shops and other destinations appeared to replace car trips with pedestrian journeys. The reduction in overall kilometres driven was about 8 km per resident per month.

A minor study, reported in Lucas et al. (2001), indicated that walking could be the preferred mode for those without a car, even where public transport services were frequent. This is, it was explained, because those without a car, especially young people, considered bus fares too costly.

Stead (2001), as mentioned earlier, focused on how land use and socioeconomic factors affected total travel distance. However his study also generated some interesting findings on the role of local accessibility for travel behaviour (p. 512). National Travel Survey data at an individual level did not provide a clear link between the availability of local shops nearby where people lived and their travel distance. However, a ward level analysis found that the average total travel distance was 46 kilometres shorter per person per week where the nearest post office, chemist and grocers were all within a 3-minute walk. The findings seemed to conform to those of Hillman & Whalley (1979) that higher bands of density (where a variety of shops were more likely to be available close by) increased the number of walking trips significantly. Stead's study did not attempt to take differences in the quality of pedestrian routes into account.

CfIT (2001) reported on a survey of 2,200 face-to-face interviews across England. The purpose of the study was to investigate people's attitudes towards transport, how important transport issues were to them locally and what transport developments that should be given priority. The survey found that a quarter of the population said that they would drive less if local conditions for walking were better. A significantly higher proportion, two-thirds of the respondents identified issues which, if addressed, would make them walk more. Enhanced pavement surface quality (32% of respondents), safer routes (26%) and better street lighting (26%) were the most frequently desired improvements. The majority of respondents (53%) said that they were dissatisfied with pavement maintenance. Note that what people say they will do does not always equal what they actually do.

Mackett (2003) investigated reasons for car use on short trips and alternative modes that the respondents considered to be available. Amongst other things, adults were asked why they used the car for escorting children to school. Common answers were that driving was quicker than other modes of transport, the distance too long for walking or cycling, bad weather, concerns about safety, going in the same direction anyway and/ or that the children were too young to walk. In earlier surveys, reported in Mackett (2003), the convenience of the car was stated as the main reason for not walking or cycling on short trips.

Cervero & Duncan (2003) found in their study of neighbourhoods in San Francisco that policy-related attributes of the urban environment (features of the urban environment influenced by planning) had only a small influence on walking frequency. The factor for pedestrian friendly design used in the study included data on block sizes and intersection designs (proportion of 3-way and 4-way junctions) within one mile of each individual's residential location. Note that no information on crossing facilities, pavements or other environmental attributes was used. Other attributes included in the study were indices of land use diversity, hilliness, employment density and retail density. Topography (i.e. steep terrain) was found to decrease walking frequency significantly, and more than distance did. The study confirmed the findings by Stead (2001) that personal and household attributes have far higher predictive powers than high-level urban design elements for walking propensity. Land use mix was the only

variable of built environment found to be statistically significant (at the 95% probability level). Greater mix of land uses increased walking trips somewhat, i.e. the presence of shops nearby was found to have the most important influence on walking behaviour among the attributes investigated. Quite surprisingly, although not statistically significant, the data set indicated that walking frequency was greatly reduced in areas where many low-income households lived. The authors suggested this was a response to personal security concerns. Cervero & Duncan (2003) appreciated that the evidence presented in their study had limitations. They did not rule out that other factors than those used in the study may have provided a different answer (p.1483). Landscaping and detailed design was mentioned as examples of factors that may have an impact. These factors were not included in the study because of data limitations. This said, the authors concluded that such features of the urban environment investigated in several other studies had been found to have little influence on mode choice. However, exactly what studies the authors referred to is unclear.

Cao, Handy & Mokhtarian (2006) used data from the study in Austin (Handy, Clifton & Fisher 1998) to assess the impact residents' perception of the walking environment have on residential location and walking frequency to shops. Their study indicated that neighbourhood self-selection is a more important factor for walking frequency to shops than neighbourhood design and distance to nearest shop. Respondents that stated that "stores within walking distance" is an important factor in their decision to live in their current neighbourhood walked more often to shops. The study acknowledged that the built environment may itself to some extent shape people's preferences (p.4). After self-selection, the data set indicated that the respondents' perception of walking connections was the second most important factor. Respondents *perceiving* that their pedestrian connections to shops were good walked more often. Distance to the nearest shop was only the third most important factor. An increase of 1 mile in distance to the nearest shop reduced average walking frequency to shops by nearly 3 trips per month (the average number of walking trips to shops for all respondents was 2.9). The data set indicated that the design characteristics of commercial environments were somewhat less important. Perceptions of high vehicle flows on commercial streets tended to decrease walking frequency to shops. Perceptions that walking comfort near shops was good increased walking frequency. Perceptions that there was too much car traffic near

where respondents lived decreased walking frequency somewhat, which made the authors suggest that traffic calming would increase walking in the areas surveyed (p.18).

From a pedestrian perspective, the most sophisticated major studies in the field to date were, perhaps, those by Handy, Clifton & Fischer (1998), Cervero & Duncan (2003) and Cao, Handy & Mokhtarian (2006). Of these, the study by Cervero & Duncan (2003) was the only one with a methodology that included some, but very limited, empirical data on pedestrian environments. All three studies were carried out in North America. These studies will be further commented on in Section 5.7.3.

5.3.4. Findings in studies on route and local area attributes

This section provides, in chronological order, details of selected larger surveys investigating the role of route and local area attributes for walking propensity. The studies presented here differ from the studies described in the previous section through their clearer focus on continuous route quality and environmental street design attributes. Key findings are illustrated in Table 5.2.

Hillman et al. (1990) surveyed 3,500 children's journeys to school and 1,700 parents' willingness to license children to travel alone on local trips. The main purpose of the study was to investigate children's independent mobility. The surveys were carried out in five areas of the UK and five areas in West Germany. The authors found that the average age of which a child was allowed to walk alone was postponed by 2.5 years between 1971 and 1990. Increases in motorised traffic and fear of crime were suggested to be the two chief reasons for children's loss of independent mobility. 43% of parents with children not allowed to travel home on their own stated the reason being traffic danger (p.24). Other reasons were that parents thought their child was unreliable, and that distance to school was too great. 76% of children 11-15 years old were not allowed out when dark, mainly because of fear of crime (p.108). German children surveyed were generally allowed greater independent mobility than English children of the same age. The authors attributed this to cultural differences, better local play facilities and more traffic calmed streets in Germany. A similar, more recent, survey in Hereford found that children identified motor traffic as a danger on their route to school, but only 2% percent mentioned risks from strangers as a reason not to walk (reported in DfT 1999,

p.10). However, a survey in Wolverhampton provided evidence that personal security fears were the main reason for 43% of parents not allowing children to walk to school (DfT 1999, p.122). It seems therefore clear that pedestrian behaviour may differ significantly in different areas.

Hass-Klau et al. (1993) carried out 3,275 on-street interviews with pedestrians in central Edinburgh. The main purpose of the study was to investigate how the pedestrian environment in the city centre could be improved. The sample was based on the number of pedestrians recorded at 48 locations in the city core. Among other things the survey respondents were asked what improvements would make them walk more in the area. In particular, the respondents were invited to rank improvements that they thought would make them walk more. In falling order, the issues mentioned most often were: less motor traffic, no motor traffic in the centre, pedestrianisation of Princes Street (main shopping street), less dirt/ litter, improved public transport, more crossings and better pavements. The study recorded the highest pedestrian flows where most shops and work places were located. At these locations, it was found, also motor traffic flows were the highest.

Ecotec (1993, pp.46-50) reported on results from eight postal surveys in Greenwich, Sandwell and Shrewsbury. The authors found that the range of facilities offered in specific locations impacted on the number of trips made to local centres. The surveys provided evidence that those living closer to their neighbourhood centre on average used their local shops more often than those living further away. But the study also found that distance was not a very reliable indicator of modal split and frequency of walking trips to local centres. The modal split for pedestrian trips to the local centres varied from less than 10% in Charlemount (Sandwell) to above 40% in Cherry Orchard (Shrewsbury) and Lakedale (Greenwich). These differences could not be explained by variation in walking distances or in car ownership levels (p.48). In fact, the level of car ownership in Lakedale was significantly higher than in most of the other areas. The authors suggested that the attractiveness of walking and the level of car congestion were the most important additional factors in explaining the number of walking trips. However, neither of these two factors was measured in the areas surveyed. The availability of competing non-local shopping facilities within 20 minutes drive was also

thought to be a potentially important factor for the overall number of trips made to local centres, especially for journeys to local centres by car. Neither this factor was empirically investigated.

Painter (1996) investigated impacts on walking behaviour and street crime from improved street lighting in three areas of London. Four poorly lit locations, three streets and one footpath in traditional urban mixed-use locations, were investigated. All four locations had some presence of graffiti and, in one case, some buildings along the street were boarded up. New street lighting increased average illuminance to 10 lux and minimum illuminance to 5 lux, designed to meet British Standard 5489. Previous street lighting did not meet these lighting requirements. The number of pedestrians when dark was counted six weeks before and six weeks after the new lighting was installed. Household interviews and focus groups were used in addition to pedestrian counts. Pedestrian usage of the four routes increased on average by 51% and reduced pedestrians', in particularly the elderly's, fears of going out when dark. The total number of pedestrians increased from 11,179 to 16,884. Note that the main purpose of the survey by Painter was not to investigate walking propensity but to study the role of street lighting improvements on crime and fear of crime.

Adonis (1998) provided evidence that car traffic may have both negative and positive impacts on walking propensity. Heavy traffic was primarily seen as an incentive to walk in Barcelona, because driving was made difficult. However, heavy motorised traffic was mainly viewed as a disincentive to walk in Copenhagen. The study suggested that less regular walkers regarded movements of motor vehicles as stressful (Adonis, 1998, p.15). The authors of the Adonis study drew a number of conclusions on the most likely factors to increase walking. Amongst these attributes were: providing more pedestrian space with good lighting, police surveillance, and more traffic calmed/ car-free areas (Adonis, 1998, p.5). Cao et al. (2006) presented some further evidence on the negative role that car traffic (speed and volume) may have on walking behaviour in residential areas.

Table 5.2. Findings on urban form and walking propensity: selected studies on route and local area attributes

| Location | Methodology (n) | Walking propensity element | Environment(s) | Key factor(s) | Other factors | Main trip purpose(s) | Time of day | Mean trip distance | Key findings |
|---|---|---|---|--|--|-----------------------------|-------------------------|--------------------|---|
| 10 areas in England and West Germany (Hillman et al. 1990) | Two questionnaire surveys (3,583 children, 1,700 parents) | Why children 7-11 and 11-15 years old were not allowed to walk on their own | Routes to school in 5 types of areas (village, town, city, metropolitan area) | Traffic danger (43%) | Child unreliable (21%), Molestation (21%), distance too great (14%) bullying (2%) | School | Daytime & when dark | Unclear | Traffic danger was the most important reason for parents that restrict children from walking home alone after school. Fear of crime was most important reason for parents that restricted children from going out when dark |
| Edinburgh (Hass-Klau et al. 1993) | On-street interviews (3,275) | Reasons for walking more (or longer) | City centre routes | Less motor traffic (23%), no motor traffic in centre (12%), | More ped. zones (7%), less litter (6%), improved public transport (5%), more crossings (4%), better pavements (4%), < pollution (4%) | Shopping, leisure | Daytime (07.30-18.30) | 1.3km (average) | Large increase in pedestrian journeys possible if core shopping street was pedestrianised (no. of trips were estimated to double) |
| Hammersmith, Edmonton and Tower Hamlet, London (Painter 1996) | Ped. counts before & after improved lighting was implemented (>11,000) | Street lighting quality and its impact on pedestrian use | 3 streets and one footpath in mixed-use locations | Good quality street lighting (average 10 lux, minimum 5lux) | n.a. | Work, shopping, leisure | When dark (17.00-23.30) | Unclear | Improved street lighting increased pedestrian usage with on average 51% and reduced pedestrians', in particularly the elderly's, fears of going out when dark |
| Wolverhampton (DfT 1999) | On-street interviews (160), 'non-user' questionnaires (100), focus groups (4) | Reasons for not walking to town centre | Routes to town centre (near pedestrian subways) | Poor personal security (67% when dark, 26% during daytime.) | Weather (6% when dark, 27% during daytime), road safety concerns (7% when dark, 4% during daytime) | Not specified | Daytime & when dark | Unclear | Results indicated upgrading pedestrian subways and providing at-level crossings over major roads had reduced personal security fears and made some people walk more often, especially when dark |
| Southend (DfT 1999) | On-street interviews (160), 'non-user' questionnaires (100) | Reasons for a dislike of walking a particular route | Route from railway station to town centre | Lack of personal security (car owners 36%, non-car 62%) | Too far to walk (16% for car owners, 10% for those with no access to car) | Shopping, work (women only) | Daytime & when dark | Unclear | Authors suggested that, for women, route quality, in particular level of personal security was an important factor when accessing public transport and shops by walking |
| Five cities in Germany (Monheim 2003) | On-street interviews (>1,000) | Most appealing things about walking | City centre routes in Regensburg, Lübeck, Nuremberg, Bremen & Munich | Old town, its townscape and architecture (40-56%) | Pedestrian zones (5-39%), shopping (14-34%) | Shopping & leisure | Daytime | >1.5km (mean) | Importance of walking conditions often underestimated for city centre attractiveness (p.336) |
| York & Leeds Tight et al. (2004) | Questionnaire (2,000 residents) | Importance of different factors when walking | Mid-size city (180,000 inhab.), large city (700,000 inhab) | Street lighting, crossing places, no cyclists on pavements, no litter (all >30%) | Pavement surface, no obstructions, local shops, pavement drainage, low car speeds etc. (all 20-30%) | Not specified | Daytime & when dark | n/ a | Many factors important. Pedestrians consider the local environment as a whole, not just pavement designs and travel time, when making a decision to walk. |

Pedestrian subways have been suggested to provide substandard personal security for pedestrian movements (Hitchcock & Mitchell 1984, p.179). DfT (1999) reported on a survey that found that respondents felt much more apprehensive about using subways than at-grade crossings in an area under re-development. It has been suggested that pedestrian access should normally be facilitated by traffic calming and not by grade separation or restrictive guard rails (Barton 2000a, pp 136-137.). McWhannell & Brauholtz (2002) found some evidence that waiting at bus stops in urban areas deterred young people from using evening bus services. An interview survey in Los Angeles found that half of the 212 respondents intercepted at 10 'high-crime' bus stops stated feeling unsafe when waiting at the bus stop while only about one quarter felt unsafe on buses (Loukaitou-Sideris 1999, p.400). DfT (1999) and Mackett (2003) found evidence that people used their car on short trips not only because it was convenient but also, to some extent, because they were concerned about personal security when walking.

DfT (1999) presented findings from eight surveys of walking behaviour. The most relevant for walking propensity were a countrywide postal questionnaire and studies of walking behaviour in Wolverhampton and Southend respectively. The countrywide survey provided evidence that personal security fears could lead to suppressed demand for walking. Between 29 and 62% of respondents in these areas stated that 'fears for personal security often or sometimes' stopped them from going out (DfT 1999, p. 32). Personal security issues were the main deterrence factor for pedestrian accessibility in seven areas surveyed. Another, more detailed, survey of 260 women in Southend investigated what respondents disliked most about walking a specific route from the train station to the nearby town centre (DfT 1999). Both frequent and less frequent pedestrians were surveyed and it was found that 'personal security' was the main issue amongst both those with access to a car and those without. Amongst car owners, 36% stated that personal security was the most important factor while more than 62% of those without a car stated the same. People with access to cars were found to be less likely to access the local town centre. The results indicated that a possible benefit of car ownership was avoiding walking trips perceived as unsafe.

Monheim (2003) reported results from five surveys of pedestrians visiting the city centres of Regensburg, Lübeck, Nuremberg, Bremen and Munich. Pedestrians indicated that the most appealing thing about walking in the areas surveyed was the old town, its townscape and architecture. Between 40-56% of the respondents in four of the cities gave this answer (multiple answers). Only in Munich was the figure considerably lower (23-28%). The second most frequently stated factor was a liking for pedestrian zones (5- 39%) and shopping (14 -34%). It was unclear if the survey methodology was based on prompted or open-ended questions. However, the results nevertheless provided evidence of the emphasis that pedestrians put on architectural features and pedestrian zones in city centres.

Tight et al. (2004) surveyed 47 single factors for their importance when walking. The survey was sent to 2,000 residents in Leeds and York. Their starting point was a lack of previous studies that had considered cumulative effects of environmental attributes or that had investigated whether removal of factors considered to be barriers would facilitate walking. Respondents were asked to use a five-point scale from 'not important' to 'extremely important'. Five factors were rated as 'extremely important' to over 30% of respondents in their walking environment. These factors were street lighting, safe crossing places, no cyclists, and improvements to dog mess and dirty pavements (including removing litter and graffiti). Factors ranked extremely important by 20-30% of respondents were smooth pavement surfaces, obstruction free pavements, local shops along the route, pavement drainage, low vehicle speed, dogs on leads, space to walk at your own pace, no gangs of youths, ease of crossing the road and 'feeling like the pavement network was designed for pedestrians'. Note that it seemed unclear if respondents found local shops important because they walked to them or because they provided other benefits, e.g. increased sense of personal security when dark. In addition, the research team tested three methods (contingent valuation, stated preference and level selection technique) for their ability to estimate respondents' willingness to pay for three hypothetical improvements of the pedestrian environment. 25 respondents were used for each of the three experiments. This part of the survey indicated that respondents were willing to pay more for reducing litter and dog mess (a litter free environment) than for improvements in pavement quality or reduction in the number of obstructions. However, the study struggled somewhat in finding a methodology that respondents

felt was easy to understand. One reason for this may be that the methods relied on relatively vague questioning techniques. For example, in one experiment respondents had to imagine what the improvements would mean from merely looking at a number of photos. Another experiment described differences in the quality of routes as the number of 'incidences of litter' and percentage of a route with 'uneven pavements'. The study concluded that (most) respondents have concerns for the local environment as a whole, not just pavement designs and travel time, when making a decision to walk.

The most comprehensive studies looking into the influence of local area attributes on pedestrian propensity were the studies by Hillman et al. (1990), Hass-Klau et al. (1993), Painter (1996), DfT (1999) and Tight et al. (2004). Only one of these studies, Painter (1996), included a systematic analysis of empirical data on walking environments. All were carried out in Britain (one also included data from Germany).

5.4. Factors affecting pedestrian quality of travel

5.4.1. Findings in studies on quality of travel

Many factors affect pedestrian 'walkability' and quality of travel. This section reports on studies where such factors have been investigated. It differs from the previous section in that the studies presented here did not seek to draw conclusions on the implications of these factors for walking propensity.

Jacobs (1961) illustrated a number of things that can make streets safe for people based on her personal experiences. She placed emphasis on mixed-use neighbourhoods, in order to ensure natural surveillance as the most important and principal design issue for cities. Jacobs highlighted several aspects of street design as important to pedestrians' use of streets. She suggested that: neighbourhoods ought to be overlooked both day and night even if not mixed-use, urban settlements ought to be integrated without clear boundaries between neighbourhoods, and that there ought to be a clear division of private and public space. Several later studies built upon the

ideas of Jacobs. The studies by Jeffery (1971), Newman (1973) and Crowe (2000) suggested a number of factors that can influence pedestrians' perceived security either positively (+) or negatively (-). The main factors suggested as important for pedestrians were:

- Windows overlooking footways and parking areas (+),
- Mixed land use (+),
- Scheduled activities that increase the presence of people in the neighbourhood (+),
- Planting trees to increase visual attractiveness of an area (+),
- Vegetation and fences that limit natural surveillance (-),
- Razor-wire fencing and other features that signalise the absence of physical presence of people (-), and
- Poor building maintenance and other features that signalise absence of people and that local people are less willing to intervene or report crime (-).

Note that none of the studies by Jeffery (1971), Newman (1973) or Crowe (2000) reported on any firm empirical evidence where improvements to the bulleted list of factors increased walking propensity, affected route choice or changed pedestrian behaviour.

Landis et al. (2001) investigated how street link designs affected pedestrians' perceived safety and comfort. A starting point for the study was that planners and traffic engineers had not yet reached a consensus on which features were of significance to pedestrians. 75 individual respondents walked a two hour urban route assessing 21 street links on a single six-point scale from A to F depending on how 'safe and comfortable' they felt using each segment. The predefined route mostly used arterial and collector roads as well as a few local streets and was located in the Pensacola metropolitan area, Florida. The respondents provided a total of 1,250 link assessments carried out during weekend daytime. Respondents only considered links and were asked to exclude intersection and crossing conditions from their assessments. Data were then collected on a number of characteristics of each link. The respondents' assessments and environmental attributes were analysed using a stepwise regression analysis. The best-fit model included three factors: lateral separation between motor traffic and the pedestrian (including presence of a

pavement), motor traffic volume and average speed. This model achieved a correlation of 0.85 based on the averaged observation for each street link. Each of the three factors above was significant at the 95% level.

Practical studies sometimes use frameworks for pedestrian audits. The broad purpose of the audits is to make more journeys on foot possible, as a mode of transport and for leisure (Holdsworth 2002, Walkinginfo 2005). Other objectives include improving accessibility for certain groups, e.g. disabled pedestrians, increasing walking comfort and giving pedestrians the infrastructure and urban environment that they appreciate. The British charity 'Living Streets' promotes a predominately qualitative street audit procedure for evaluating pedestrian environments and the quality of urban space (Holdsworth 2002). The audit uses eight assessment categories: surfaces and obstructions, facilities and signage (benches, bins etc.), personal security, crossing points and desire lines, road layout and space allocation, aesthetics, and vehicular traffic. Walkinginfo (2005) promotes a similar audit for neighbourhood 'walkability'. Their checklist comprises pavement widths and surface condition, crossing facilities, behaviour of drivers, ease of following safety rules and the walks' pleasantness. It should be noted that little evidence to date has yet been presented on how well existing pedestrian audits capture pedestrian values.

Litman (2007) reviewed the economic value of 'walkability' (good quality walking conditions). He suggested that conventional transport planning tools do not incorporate many aspects of transport networks important to pedestrians and that more research is needed in order to quantify the full benefits of a good walking environment (p. 5).

5.5. Factors important for pedestrian route choice

5.5.1. Findings on pedestrian route choice

This section provides, largely in chronological order, details of selected route choice studies. Particular attention was paid to evidence from different types of urban environments. Key findings from selected studies are presented in Table 5.3.

Marchand (1974) collected data on pedestrian behaviour in St Maur, Paris. Commuters travelling from a metro station were given a questionnaire in the morning to be returned on their way home. Route choices to the station were collected for 100 pedestrians. Respondents were also asked to provide a mental map of the relative position of a number of well-known landmarks in the area. The results of the route choice survey indicated that pedestrians tended to use the simplest route even if it was not the shortest. Pedestrians were found to initially head from home to the nearest main axis and then keep to the simplest path, rather than using smaller streets that were more direct. In addition, Marchand analysed the landmarks' relative position on the mental map. It was found that respondents' mental maps corresponded relatively poorly with real world distances. Mathematical analysis of the mental maps led the author to believe that pedestrians perceive space through their perception of time and "speed better than distance" (p.501). As a consequence of this, Marchand suggested that making a pedestrian route more interesting would be likely to increase its use because a less boring route would appear quicker to walk (p.502).

TEST (1976) carried out on-street interviews at Putney High Street and Kentish Town, two areas in central London. 50% and 70% of pedestrians respectively stated that they had chosen the "most direct" (p.44) route to the destination they were heading to at that time. Other priorities were to take in intermediate stops (10-25%), pleasantness, safety, avoid traffic or pollution (15-20%), habit (5-10%) and finally no special reason (10-15%). Note that "direct" might mean shortest distance, shortest time or simplest route in everyday language. A subsequent analysis of the routes actually used by the respondents suggested that, in many cases, they used the "simplest" route rather than the "shortest" (ibid. p.43-45). The main journey purpose among the respondents was shopping, with 55-65% of respondents stating this reason. Another survey carried out by the same group of researchers found that office staff on a lunch break in central Birmingham to a significant extent took detours to avoid crowding and lack of capacity on certain streets.

May et al. (1985, p.55) reviewed evidence presented in a number of studies on pedestrian behaviour and concluded that the main factor in pedestrian route choice appeared to be shortest distance, or more precisely, shortest perceived distance.

However, from the studies by Marchand (1974) and TEST (1976) it seems clear that several other factors were significant too.

Seneviratne & Morrall (1985) carried out an on-street interview survey intercepting 2,685 pedestrians at 36 locations in central Calgary. An interview technique making use of prompted answers was used for the survey. Each respondent was read out a list of 10 reasons for their route choice. The majority (51%) of respondents indicated that they chose the 'quickest' route. Other important route choice criteria were in falling order; habit/ always use (22%), number of shops along route (6%), only route available (4%), least number of street crossings (1.6%), least crowded (1%), noise levels (0.4%) and personal security (0.04%). Those arriving by bus in order to visit shops more frequently reported number of attractions along route as their main route choice criterion. The authors suggested that quickest route should be translated as shortest distance between origin and destination. Perhaps, one reason for this was the fairly small and homogeneous study area. The study was restricted to eight blocks in central Calgary and the origins and destinations covered 1/5 of the central area. Bovy & Stern (1990, p.155) commented that there were few alternative route choices in the relatively small area surveyed by Seneviratne & Morrall (1985) and that there was little variance in environmental attributes along different routes. This in turn may make it difficult to transfer the results to other urban areas. It should also be noted that if all routes in an area have similar deficiencies then the role these insufficiencies may have for pedestrian behaviour would not show up in a survey of route choice.

Seneviratne & Fraser (1987) carried out a survey identical in methodology to the study in Calgary (Seneviratne & Morrall 1985). The study, in the central business district of Halifax, Canada interviewed 410 pedestrians. 56% stated that they chose the quickest route for the trip made when intercepted. 25% indicated that they did not make an active choice – instead they indicated that they used their regular route and 5% stated the route they took was the only one available. The study found that route choice criteria varied somewhat with trip purpose. Shop to shop trips and work to shop trips were more influenced by route attractiveness. Personal security was reported as an unimportant reason for route choice (note that study only included daytime walking trips).

Gärling & Gärling (1988) looked into pedestrian route optimisation when arriving by car to a town centre and visiting a number of shopping destinations on foot. The study concluded that distance and minimising effort (distance carrying heavy shopping bags) was an important factor in deciding route choice and in what order different destinations were visited.

Hopkinson et al. (1989, p.24) made a similar review of evidence on pedestrian behaviour to that of May et al. (1985), but with a stronger focus on surveys of pedestrian route choice and suggested that the literature on pedestrian route choice at large was 'inadequate'. A number of key shortcomings were identified (Hopkinson et al. pp. 9-10, 24):

- more than one factor can be important for route choice while many previous studies only surveyed the single most important factor,
- previous studies had often assumed that when a respondent had indicated that they took the quickest route then they would also apply the same criteria when carrying out the same journey during other times of day or weather conditions,
- existing studies provided little information on the relative importance of different factors and the extent and character of alternative routes available for the pedestrians surveyed,
- some previous studies had not distinguished sufficiently carefully between shortest distance and shortest time,
- previous surveys were carried out under dry warm weather conditions only, and
- little evidence was provided of whether the pedestrians surveyed were representative of the population as a whole.

Despite the shortcomings highlighted above, Hopkinson et al. (1989) found that the literature supported three key points. Firstly, that distance and travel time emerged as central factors in pedestrian route choice although effort may be an underlying factor. Secondly, they suggested that factors not previously surveyed such as weather may have an important role for route choice. Thirdly, they suggested that pedestrian route

choice criteria may vary with trip purpose (as previously indicated by Seneviratne & Fraser 1987). The shortcomings above were used to specify new data collection efforts, see Westerdijk (1990) below. In addition to the key points identified by Hopkinson et al. (1989) above, it could be commented that previous studies often implied that route choice behaviour when dark was similar to that during daytime. This was even though the surveys these studies were based on had been carried out during daytime only.

A study by Westerdijk (1990) is one of few studies hitherto testing the prediction rate of a transport model in relation to pedestrian route choice (in heterogeneous urban environments). Westerdijk used Multi Attribute Utility Theory (see Fischer 1979) to analyse factors influencing pedestrian route choice in three European cities, Groningen in The Netherlands, Leeds in the UK and Växjö in Sweden. A total of 164 pedestrians were interviewed using a computer-aided survey methodology. Respondents were asked to point out the origin and destination of a trip they “regularly” made on a map (p.10) which should be long enough to provide a choice of alternative routes. In addition they were asked to point out one to three alternative routes for the same trip and give an overall preference for the best route. The subjects were then asked to recall how each of the routes compared in terms of seven prompted attributes. The attributes used were perceived distance, number of crossings with and without traffic lights, ‘pleasantness’, gradients, number of attractions, pavement quality and the feeling of traffic safety. The Leeds survey also included a factor describing protection from bad weather along routes. Examples of questions were: ‘how long in distance is the best route’, ‘how pleasant do you find the worst route’ and ‘how many times do you ‘cross a road at places without traffic’. For most responses a seven-point scale from ‘very poor’ to ‘very well’ or ‘very few’ to ‘very many’ or similar was used. The methodology used allowed respondents to state additional attributes but too few respondents chose to do so in order to permit any further analysis. If the respondents could not recall any difference between alternative routes in terms of a specific attribute this attribute was left out from further analysis. The number of times respondents were not able to recall any difference in quality for one or more factors of two routes varied greatly between the three countries. In the UK study, respondents left out attributes of the number of crossings without lights 58% of times, number of crossings with lights was left out

48% of the time, gradients 46% of times, pavement quality 37%, pleasantness 34%, attractions 25%, distance 24% and traffic safety 24% of times. This was more often than for attributes in the other two countries. For example, in Sweden respondents left out gradient 57% of times and pavement quality 48%. The number of crossings without lights was only left out 25% of times. The model took into consideration respondents' global route choice score for routes they chose frequently as well as routes they used rarely. In order to define the global preference a score was defined as follows. Respondents were asked to choose the 'best' route (p.10). This was set a score of 100. Secondly, respondents chose the 'worst' route. This was given a value of '0'. Remaining routes were given values ranging from 0 to 100. The model provided evidence that perceived shortest distance (see Ibid. p. 10) and 'pleasantness' were the two most important route choice factors for 'regularly' made trips in an familiar urban area. When perceived distance and 'pleasantness' were used the correlation was 0.70. The correlation between global route preference values and perceived route distance was 0.56. The study also found that when travelling during bad weather respondents put greater emphasis on distance, pavement quality and few gradients than during dry conditions. The study did not comment on the fact, as implied by Marchand (1974), that more attractive routes may be perceived shorter. However, it could be noted that not only does a study need to distinguish between the shortest and quickest route as mentioned by Hopkinson et al. (1989). An equally important distinction may be whether a study considers objectively measured distance or perceived distance, as a more pleasant route may be perceived shorter.

On average the respondents in the three cities offset an extra distance of 160m with one point lower score on the seven-point scale from 'very pleasant' to 'very unpleasant'. Pleasantness was in the study defined as a route with 'many shops, pleasantly crowded or with many trees and other green' features (p. 29). It should be noted that crowdedness, presence of shops and trees are obviously quite different features combined into one. The purpose of grouping the pleasantness attributes into one attribute was to make factors independent from each other.

Table 5.3. Findings in selected studies on pedestrian route choice

| Location | Methodology (n) | Route choice element | Main trip purpose(s) | Environment | Key route choice reason | Other reason(s) | Mean trip length | Time of day | Key findings |
|---|---|--|--|---|----------------------------|---|--------------------------|-----------------------------------|---|
| St Maur, Paris (Marchand 1974) | Questionnaire (246; 100) | Perceived distance (n 246), route drawn on map (n 100) | Journey to work (walking route to metro station) | Traditional urban (mixed retail & residential) | Simplest route | Distance | Unclear (probably >300m) | Daytime (mainly morning peak) | Pedestrians show tendency to use the simplest route even if it is not the shortest (initially heading to nearest main axis and then keep to the simplest path). Author suggested pedestrians seem to perceive walking speed better than distance, making more interesting routes perceived shorter. |
| Putney High Street (PH) & Kentish Town (KT), London (TEST 1976) | On-street interviews, postal questionnaires (n unclear) | Stated reason for route choice, route drawn on map | Mainly shopping (55-65%) | Traditional urban (high street, mixed retail & residential) | Distance (PH 50%, KT 70%), | Intermediate stops (PH 25%, KT 10%), other reasons (PH 20%, KT 15%) | PH 755m, KT 870m | Daytime | Respondents indicated that the majority of routes were selected because they were the most direct. Subsequent analysis of route choices showed that "simplicity seems more important than directness" (p.63). |
| Calgary, Canada (Seneviratne & Morrall 1985) | On-street interviews (2,685) | Stated reason, route drawn on map | Work place, business, shopping | Central Business District (high-risers) | Quickest route (51%) | Always use (22%), most attractions (6%) | ~330m | Daytime (07.30 – 17.00) | Distance is dominant route choice factor (quickest route suggested equal shortest route). Personal security unimportant. Pedestrians ranked attractiveness higher than route length for shop to shop trips (n 81). |
| Halifax, Canada (Seneviratne & Fraser 1987) | On-street interviews (410) | Stated reason, route drawn on map | Work place, business, shopping | Central Business District (high-risers) | Quickest route (56%) | Always go that way (25%), only available (5%) | ~220m | Daytime (morning – mid afternoon) | >80% of pedestrians consider distance to be most important route choice factor. Personal security unimportant. |
| Groningen, The Netherlands (van Schagen 1990) | On-street interviews (1,045), observation of interviewees (100) | Stated reason, route drawn on map | Mainly shopping (60%) | Traditional urban (major shopping street entering city, 500m from centre) | Distance (31%) | Pleasantness (20%), attractions (16%), time (12%) | <170m | Daytime (9.00 - 18.00) | Influence of gender on route choice motive was marginal. 14% of pedestrians did not draw route on map that corresponded to observed behaviour (most differences minor). The majority of pedestrians walk alone, not in company. |
| Three cities in UK, Sweden & the Netherlands (Westerdijk 1990) | Computer-aided interviews (164) | Stated preference experiment | Mainly 'social/recreational' (>70%) | Various urban areas | Distance | Pleasantness | Unclear | Daytime | Distance and pleasantness important for route choice. An extra distance of 160m can be offset by one point higher 'pleasantness' (on a 7 point scale) |

Sharpley & Fletcher (2001) undertook 890 on-street interviews of pedestrians in six Scottish towns. The study aimed to understand how crossing facilities could be improved and their role for encouraging walking. Pedestrians interviewed were both those that used crossing facilities and those that crossed roads nearby existing facilities (but not on dedicated locations). The most important reason for using a crossing facility was convenience (39%), the fact that it was on route (39%) and safety (36%). One in four pedestrians interviewed (23%) did not use crossing facilities available even where they were nearby. In addition, many potential respondents that did not use dedicated crossing facilities declined to be interviewed. Increase in route distance and travel time, in particular at locations with little vehicle traffic, were the main reasons for not using a crossing point. In addition to on-street interviews, the study undertook 32 interviews with people that had mobility impairments. These interviews indicated that this group was more dependent on good-quality crossing facilities than the general user. The survey concluded that "provision of crossing facilities is probably a minor factor in maintaining levels of walking" (Ibid. p.3). However, exactly how the authors came to this conclusion was somewhat unclear as the main survey intercepted users at locations with crossing facilities and only included respondents' thoughts on the role of existing and improved crossing facilities. For example, the survey did not attempt to survey places without any crossing facilities.

Hodgson et al. (2002) reviewed the literature to identify features that influenced pedestrian street use and route choice. The review was part of a larger study that aimed to enable more people to make journeys on foot. In total more than 40 potential factors for route choice were identified. They found that evidence on several factors, in particular those positive for walking, were absent in the literature. They concluded that it was "difficult" to identify the most important factors in determining route choice (p.11). Previous studies were largely found to agree that 'straightest path' was the most important factor and that travel time considerations were included in this route choice strategy. Hodgson et al. suggested that travel time could well be the single most important factor in pedestrian route choice. They also suggested, similarly to Seneviratne & Fraser (1987) and Hopkinson et al. (1989) that the role of travel time versus distance may differ depending on trip purpose. Furthermore, Hodgson et al. suggested that route strategies may vary somewhat between pedestrian groups. For

example, elderly and slower pedestrians may find it more difficult to find an acceptable gap in traffic and therefore use pedestrian crossing facilities even where this meant a significant detour.

The most comprehensive studies on pedestrian route choice identified were the studies by Marchand (1974), Seneviratne & Morrall (1985) and Westerdijk 1990. All three studies were carried out during daytime. They covered a variety of urban areas including town centres, dense urban core and business districts in Europe and North America. Westerdijk (1990) was the only study that attempted to model the influence of environmental attributes on route choice and it used differences in route qualities that respondents could recall. None of the main studies included a systematic analysis of empirical data on walking environments.

5.6. Problems reported by pedestrians

5.6.1. Findings in surveys on pedestrian problems

A large number of studies have investigated pedestrian perceptions about the walking environment, in particular near where they live. Four of the largest UK studies were reported in HMSO (1987), NCC (1995), GCCNI (1997) and Bonsall et al. (2005).

A study by MORI (reported in HMSO 1987, p.23) interviewed 2,000 adults living in the UK. The study followed up an earlier survey in 1979-80 covering ‘all aspects of people’s lives as consumers’ that identified the pedestrian environment as a source of many problems, with one in four respondents stating that they had encountered problems as pedestrians over the last 12 months and over half of these considering their problems serious. The MORI poll (HMSO 1987) was undertaken in two steps and aimed at ranking factors that respondents found problematic when walking. Firstly an open-ended question was asked: “what, if any, do you think are the main problems for pedestrians in your area?” (p.22). The three most common and spontaneously stated difficulties were; volume of traffic (22%), cracked or uneven pavements (19%) and lack of pedestrian crossings (11%). Secondly, 19 potential problems were presented to the respondents. The combined responses, where a respondent either spontaneously mentioned a factor as a problem or identified a prompted factor as a problem are reported in Table 5.4. Only 6% of respondents reported no problems. Those who walked more frequently reported more

problems than those who almost never made a trip entirely by foot. However, the differences in number of problems reported were less than anticipated. Those walking children to school and those making frequent trips to main food shops stood out in terms of experiencing a wider range of problems than others. Women and people over 65 more frequently reported problems with cracked and uneven pavements (52% of women, 54% of 65+). Furthermore, the same groups experienced problems at pelican crossings more often than others (12% for women, 15% for 65 +). People of lower social class (DE) reported a higher frequency of problem related to cracked and uneven pavements (51%) and with bicycles ridden on pavements (23%). People of social class AB reported significantly less problems with vehicles parked on pavements (16%) and too little time at pelicans (8%), but more problems with narrow pavements (16%) and no pavements (10%). Young people reported more problems with poor or broken street lighting compared to older people (16% for 16-24, 8% for 65 +). Additional MORI surveys were undertaken in 1995 and 1997 (NCC 1995, GCCNI 1997). The ranking of problems in the three studies mentioned above has changed little during the last 20 years (Goodman & Tolley 2003).

Table 5.4. Proportion of pedestrians reporting problems (HMSO 1987)

| Factor | Proportion that found it a problem |
|------------------------------------|------------------------------------|
| Cracked or uneven pavements | 46% |
| Dog dirt | 42% |
| Too much traffic | 37% |
| Uncleared snow/ ice/ leaves | 32% |
| Vehicles parked on pavements | 24% |
| No pedestrian crossing | 23% |
| Bicycles ridden on pavement | 19% |
| Litter and rubbish | 17% |
| Pavements being dug up | 13% |
| Poor/ out of order street lighting | 13% |
| Narrow pavements | 11% |
| Overhanging vegetation | 11% |
| Too little time at sign. crossings | 10% |
| No pavements | 7% |
| Weeds/ overgrown hedges | 6% |
| No street lighting | 6% |
| Kerbs too high | 5% |
| Obstructions on pavements | 4% |
| Need to use underpasses | 3% |
| Any other problems | 17% |
| No problems | 6% |

Bonsall et al. (2005) surveyed 2,695 individuals in nine areas of the UK. The purpose of the survey was to gather evidence on people's experiences of problems as road users. The survey found that there were differences between the problems respondents experienced personally and those they considered to be problems for most users. For example, respondents indicated that accident risk for themselves as pedestrians/ cyclists was less of an issue than for users in general. Similarly, respondents said that they were less affected by problems of personal security as pedestrians/ cyclists and that of high transport costs than were users in general. The degree to which respondents reported differences between their personal experiences and that of users in general varied somewhat for different problems. The authors of the survey suggested that this could be a consequence of the role media has in informing people about 'the experiences of others' and the fact that people generally have a tendency to remember bad news better than good.

5.6.2. Comment

Surveys which investigate the frequency of problems do not necessarily say anything about the importance of them, although, as mentioned above, in this case the significance of the MORI poll (HMSO 1987) was supported by the fact that 50% of respondents in an earlier survey found the deficiencies they reported to be a serious problem. It should also be noted that the MORI poll (HMSO 1987) asked people what they believed to be problems for pedestrians rather than what problems respondents themselves experienced. This may affect the outcome of the survey because road users in Britain systematically think that other people are more affected by transport problems than themselves (see Bonsall et al. 2005, and Section 5.5.1).

5.7. Discussion

5.7.1. Summary of findings

The review found empirical evidence supporting the following factors which affected walking propensity and/ or user satisfaction and hence are of potential importance for pedestrian accessibility:

- distance to destinations (approximate for travel time),
- pleasantness (including visual attractiveness, trees and shops along route),
- hilliness,
- street lighting,

- perceived personal security (incl. natural surveillance),
- speed and volume of motor vehicles,
- perceived traffic safety (for children),
- crossing facilities (for the elderly/ mobility impaired),
- ease of orientation,
- pavement quality (incl. presence of obstructions),
- street cleaning services, and
- shade (although unlikely to be significant in the UK).

There were significant differences between the factors that pedestrians reported as problems (Section 5.6.1), those found to affect pedestrian quality of travel and route choice (Sections 5.4.1 and 5.5.1) and those found to affect walking propensity (Sections 5.3.3 – 5.3.4). For example, surveys on quality of travel indicated that street lighting (e.g. Painter 1996), personal security factors (e.g. DfT 1999), route pleasantness (e.g. Westerdijk 1990) as well as vehicle traffic speed and volume (e.g. Landis et al. 2001) were important. Surveys of pedestrian problems identified pavement quality and litter as key concerns (see e.g. HMSO 1987) while a North American study of walking propensity (e.g. Cervero & Duncan 2003) suggested that the above mentioned factors may be of relatively little importance for how often (and where) most people walk.

5.7.2. Relevance of findings for Accessibility Planning

Different definitions of accessibility would focus on different aspects of travel, e.g. reported problems and pedestrian user satisfaction vs. factors important for observed behaviour (see also Section 5.2). An important question is therefore how one decides to what extent an accessibility indicator should take, for example, user aspirations into account. To answer this question one needs to know how important different factors are, for whom they are important and in what way.

Findings on factors inhibiting trips to basic services in areas with few local shops and a high proportion of residents dependent on other modes than the car are, perhaps, the most valuable. This is because Accessibility Planning guidance (DfT 2004a) gives priority to these types of areas. Findings in the study by Cervero & Duncan (2003, p. 1481) can be mentioned as an example of highly relevant results. The study indicated that walking frequency was lower in and near low-income areas. One would perhaps expect the

opposite; that walking frequencies would be higher in low-income areas, because of greater reliance on walking and lower car ownership. The authors suggested that a lower perception of personal security in low-income areas, many with higher than average levels of street crime, was a reasonable explanation for fewer walking trips than expected being carried out there.

Studies that do not include the behaviour of those dependent on non-car modes may be seen as less relevant for Accessibility Planning. For example, the study by Mackett (2003), although useful in many ways, examined car drivers' likelihood to switch to walking on short trips and may therefore say little about the needs and behaviour of groups more dependent on walking.

5.7.3. Critique of the evidence

Study limitations

The studies examined typically surveyed the general public. The review therefore included groups in society dependent on walking, cycling and public transport but did not put focus on the needs of these groups only (as mentioned earlier, limiting the literature review to studies analysing the needs of groups dependent on modes other than the private car only would have excluded many of the most comprehensive studies in the field).

The role of distance

Distance was directly or indirectly treated as a main, or key, component in almost all the studies examined. For example, Stead (2001) reported a strong correlation between availability of local shops within a short walk and walking propensity. However, the empirical findings on the role of distance versus other factors varied considerably between different studies. Cervero & Duncan (2003) found that steep gradients (steep terrain) were more important for walking propensity than distance. Cao et al. (2006) found that preferences for walking (incl. selection of a walking friendly neighbourhood) were more important for walking frequency than distance to the nearest shop. Travel time was, in some cases, suggested to be a better indicator than distance, for example for crossing behaviour at major roads. Hodgson et al. (2002) suggested that travel time could well be the single most important factor in pedestrian route choice whilst recognising that

this was not really reported in the literature. In fact, some of the most sophisticated studies (e.g. Seneviratne & Morrall 1985) assumed with little further analysis that shortest distance and quickest route was the same. Consequently, most studies seemed to assume that shortest route was, in principle, equal to the quickest.

Much of the existing evidence on the importance of different route qualities relied on comparing the relative strength of *perceived* distance to a destination and other factors. For example, the study by Westerdijk (1990) did not measure distance objectively. This was despite the fact that Marchand (1974) had found that pedestrians were rather poor at recalling distances. Furthermore, previous studies of pedestrian route choice focused almost entirely on pedestrians' movements in city centres (see Section 5.5.1). Pedestrian behaviour in city centres with many facilities and the areas relevant for Accessibility Planning with long distances to local shops and other services may differ in many ways (see also Section 5.7.2).

Factors other than distance affecting walking propensity

Evidence on the strength of other factors than distance affecting pedestrian behaviour and user satisfaction was largely inconclusive. For example, the differences between the findings of Cervero & Duncan (2003) and Cao et al. (2006), and those of Hillman et al. (1990) and Stead (2001) may be explained by local differences in survey areas (variations in hilliness, route quality and attractiveness of local shops) as well as variations in survey methodology and type of data used (see Sections 5.3.2 - 5.3.3). One explanation for the different outcomes may be the fact that many studies investigating walking propensity excluded the role of route quality because of lack of data. The studies on walking propensity generally presented few findings on how walking propensity varied for different groups. Still this type of studies contains some of the most comprehensive surveys of walking propensity hitherto. It is also worth noting that most studies on the role of urban form for walking propensity were from North America and little is known about the transferability of results (e.g. between North America and Europe).

The review uncovered some slightly contradictory evidence. For example, Seneviratne & Fraser (1987) found the role of personal security irrelevant for route choice in the area they surveyed while other studies found that this factor, and for example good quality street lighting, was very significant (e.g. Lynch & Atkins 1988, Painter 1996). Survey

differences in study scope (daytime, when dark) and urban environments may, perhaps, be the most likely reasons for the discrepancies. Hillman et al. (1990) reported that poor perceptions of traffic safety restricted children's independent mobility. The studies by Ecotec (1993) and Cervero & Radisch (1996) suggested that qualities of the walking environment and local shops played an important role for walking propensity. Many of the studies on how urban form influenced pedestrian behaviour had some noteworthy limitations. For example, a high score on the pedestrian friendly index used by Cervero & Duncan (2003) did not necessarily mean that walking routes to the nearest main shopping street were good. The higher the pedestrian friendly index was, the more likely it was that most people had long sections of good walking routes. Those with long sections of good routes could have these interrupted by short sections of very poor facilities. On the other hand, people in areas with a poor score could still have a good route to their local shops. It could therefore be claimed that the most sophisticated studies of environmental attributes may provide only relatively weak evidence on the role continuous route quality has on walking propensity. High-level indicators such as those used by Cervero & Duncan (2003) may have greater impact in planning practice because they are fairly easy to compute. However, because of what is said above, area-wide calculations are likely to underestimate the role of environmental attributes.

Factors affecting quality of travel

The evidence base on user satisfaction and pedestrian behaviour was found to be relatively weak. Relatively few surveys were found to investigate perceptions of walking. Studies examined that had surveyed user problems (e.g. HMSO 1987, CfIT 2001) said little about the relative strengths of different factors and how pedestrians may trade them off against each other. Surveys using stated preferences made use of rather high-level factors which are not easy to measure objectively (see e.g. Westerdijk 1990) or produced results that were not entirely convincing because respondents found the methodology difficult to use and/or because the factors on which respondents were asked to base their choices were not those which actually affect pedestrians' decisions to walk (see e.g. Tight et al. 2004, p. 18). In addition, only few experiments studied the role of improved pedestrian facilities from a walking propensity point of view. Only one such study, Painter (1996), was found in peer-reviewed journals. Furthermore, many of the studies the most comprehensive studies on walking propensity analysed area characteristics only and not the role of continuous route quality (Sections 5.3.3 – 5.3.4). This was probably

mainly because of lack of data. Studies on route choices may therefore, in principle, present the best evidence on the role of route quality for pedestrian accessibility, i.e. the role different factors have for trip costs/ effort. However, no main study on pedestrian route choices focused on utility trips and examined areas with few local shops nearby, and none investigated route choice when dark (Section 5.5.1). In addition, most route choice studies covered relatively short walking trips (<500m) and in rather homogeneous environments, while long walking distances (>1,000m) may be seen as the most relevant for Accessibility Planning. This is because of the fact that less serious shortcomings on a short route may add to transport costs (e.g. increased effort) while negative attributes on a long route may push a destination beyond reach by walking. In addition, factors that inhibit walking are more likely to be present on long routes than shorter ones.

The problems pedestrians most frequently reported were uneven pavements, litter/ dog dirt and too much car traffic (Section 5.6.1). Consequently there seem to be a strong aversion to some factors despite them being less common than motor vehicle traffic on a route. Factors ranked 'extremely important' by up to a third of people when walking were for example smooth pavement surfaces, obstruction free pavements, local shops along the route, pavement drainage, low vehicle speed, dogs on leads, no gangs of youth, and ease of crossing the road (Tight et al. 2004). Landis et al. (2001) found that the speed, volume and lateral separation of carriageways and pavements had a significant impact on pedestrians' quality of travel. Other studies found that pedestrians were apprehensive about using routes where footpaths were located away from roads (see e.g. Lynch & Atkins 1988, DfT 1999). This indicates that the presence of motor vehicles may have a dual impact on pedestrian amenity, with traffic being a negative attribute of walking routes but motor traffic also having some of a positive contribution to pedestrians perceived level of security, especially when dark. So, while reducing vehicle speeds and volumes generally will benefit all pedestrians, pursuing such improvements instead of, for example, better street lighting may mean that factors more important for accessibility are overlooked.

Studies of pedestrian route choices concluded that pedestrians showed a tendency to trade off complex routes against simpler ones (Marchand 1974), that personal security was unimportant for route choice during daytime in a central business district type of area (Seneviratne & Fraser 1987), that the influence of gender on route choice was marginal

(van Schagen 1990) and that the average pedestrian on a 'regular' trip was prepared to offset an extra distance of 160m by one point higher 'pleasantness' using a seven-point scale (Westerdijk 1990).

5.8. Conclusions

5.8.1. Limitations of previous studies

It is worth noting that most studies examined here collected very little quantitative data on the quality of the urban environment and that of pedestrian routes. For example, the study by Painter (1996) is in fact the only one in peer-reviewed journals that systematically assesses the effects improvements to pedestrian environments have on walking propensity. Another example, the only study that models the role of continuous route quality to destinations, Westerdijk's (1990), is based on what pedestrians remembered about different routes and it did not collect any objective (real world) data on urban environments. Therefore, much still remains to be proven regarding how quantitatively measured environmental attributes on continuous routes (e.g. indicators for 'pleasantness' and 'perceived safety') can be added to a model and fit the complexity of observed pedestrian behaviour and/ or user aspirations. It is also worth reiterating some of the difficulties in understanding pedestrian needs and behaviour. One of these difficulties is that pedestrian perceptions are likely to be based on how a number of attributes interact (Cervero & Radisch 1996, Tight et al. 2004). Another hurdle is to understand how destination attractiveness affects pedestrian behaviour. In addition, many studies investigating walking propensity have been hampered by the fact that their results included variance in destination attractiveness (see Section 5.7.3). A potential benefit with studies of route choice is that this type of study eliminates the often unknown and difficult to measure factor of destination attractiveness.

5.8.2. Indicators based solely on distance exclude many serious user problems

Taking all the evidence from this chapter into account, the findings did not provide a clear conclusion on which factors that should be added (in what order) to a distance-based accessibility model to improve correlation with observed behaviour. Neither could the findings point out which user needs or aspirations are the most important from an Accessibility Planning point of view. However, it seems sufficiently clear that

accessibility indicators based solely on distance would exclude many serious problems that pedestrians say they have.

5.8.3. Directions for further study

Further study including primary data collection on pedestrian environments is needed to investigate the role of environmental attributes for pedestrian behaviour and accessibility in an area. In addition, it would be useful to investigate how planning practitioners perceive the highlighted gap in knowledge on pedestrian behaviour and needs. Do practitioners actually trust accessibility indicators based solely on distance or are such rather simplistic indicators an underlying reason behind the documented termination of accessibility-enhancing planning strategies? These two points will be picked up in the next chapter as well as in two surveys presented in Chapters 8 and 9.

Chapter 6

Research Propositions

6.1. Introduction

The material presented in Chapters 2-5 provides a useful backdrop for understanding how accessibility indicators have been used in planning and research and our ability to measure different aspects of accessibility. But the reviews left many questions unanswered. More information is needed to fully understand why planning methodologies based on accessibility indicators did not work in the past and if they will in the future. This chapter identifies potential barriers to Accessibility Planning and reformulates any concerns about its effectiveness into testable research propositions. The research propositions will in turn guide the specification of new data collection efforts (see Chapters 8 and 9).

6.2. Motivations for research propositions

6.2.1. Summary of findings in previous chapters

Several authors have described planning for accessibility as something significantly different from planning for mobility (see Chapter 2). However, the extent to which the two concepts differ is far from clearly articulated in the literature. For example, authors who presented accessibility-enhancing planning strategies as something new failed to describe the extent to which current planning tools actually incorporate different aspects of accessibility. In Chapter 2 it also emerged that a key idea in accessibility-enhancing planning strategies is that accessibility indicators can and should be used to identify transport problems and opportunities. Chapter 3 identified that there are several gaps in our knowledge on how to measure accessibility. This research gap, it was suggested, consists of two main elements. The first is the fact that little seems to be known about how to appraise local accessibility by non-motorised modes. A second issue is that we know little about how decision-makers interpret different accessibility indicators and consequently how such relatively complex information can be communicated.

Chapter 4 highlighted the fact that several attempts have been made, in the past, to implement planning strategies based on the use of accessibility indicators. The majority of these planning methodologies were relatively quickly abandoned and the impact that the accessibility indicators actually had on outputs seemed in at least some cases relatively weak. The only surviving accessibility-enhancing planning concept, out of those implemented prior to Accessibility Planning (DfT 2004a, DfT 2006), uses indicators assessing only access *to* the public transport system rather than the functions that can actually be reached. It was not possible to identify exactly why ambitious accessibility-enhancing planning strategies such as the WYTS failed to survive and become influential. However, high costs of calculating accessibility indicators, lack of adequate computer tools and lack of easily obtainable data are three probable reasons. It could also be that planners' perceptions and "worldview" did not support the principles embedded in accessibility-based planning strategies (e.g. proximity being a significant value worth planning for) and that this was a significant reason for the abandonment of earlier accessibility-enhancing planning strategies (see Section 4.5.3). Bringing together the findings from Chapters 2-5, it could for example be that planners viewed accessibility-enhancing planning strategies sceptically because they found accessibility indicators unreliable.

Chapter 5 picked up on the thread related to how accessibility could best be measured and evaluated in relation to what we know about transport system user behaviour and needs (rather than the needs of decision-makers to ably interpret accessibility indicators). It was found that one underlying reason for the lack of local accessibility indicators is the fact that the relative strengths of different pedestrian needs are rather poorly understood. This in turn means that the precision of accessibility indicators incorporated in Accessibility Planning (DfT 2004a, DfT 2006a) is, to a significant extent, unknown.

6.2.2. Development of research propositions and study limitations

The section above highlights findings from the previous literature reviews. These key findings formed the basis for an iterative process developing a number of research propositions. This process initially identified twenty or so potential research questions on barriers to Accessibility Planning. At a second look many of the initial research

questions were found to overlap. Hence the total number of research propositions could be reduced.

Integrated in the process of developing research propositions was the consideration of how data could be gathered to answer them. For each research proposition an assessment needed to be made whether it was feasible to collect the data required to answer it within the resources available for the thesis. In almost all cases this was not considered a significant problem and two surveys were outlined in order to collect data (see Section 6.5.2). However, it was not thought to be feasible to collect the data needed to answer research question targeting the role of institutional frameworks for the success of accessibility-enhancing planning strategies (see e.g. Section 4.5.5.3). Hence this aspect was largely left out of the data collection efforts. There were several reasons for this. One was that it was not deemed feasible to evaluate the function of institutional frameworks in detail at the time that a new policy initiative was about to be implemented. The role of institutional frameworks, it was believed, would be more appropriate to assess a couple of years or so after the Accessibility Planning initiative had been implemented as this would make an analysis more robust (optimising organisational structures for Accessibility Planning may have other drawbacks so quite solid evidence would obviously be needed before any changes are made).

6.2.3. Two overarching research propositions

The key findings presented in Section 6.2.1 helped formulate two overarching research propositions on *culture* and *tools* as barriers to Accessibility Planning. The first overarching proposition, relating to culture, suggests that conflicts between Accessibility Planning and the dominant transport planning culture has been a barrier to effective implementation of Accessibility Planning. The second proposition suggests that Accessibility Planning has been hindered by a lack of tools needed to assess accessibility. The two propositions were used to assess why planning methodologies using accessibility indicators have not yet succeeded. Each overarching proposition was sub-divided into a number of underlying research propositions (see Sections 6.3 and 6.4).

The proposition that *planning culture* is a barrier to Accessibility Planning is motivated by the findings in Chapter 4 that, on a number of occasions, tension was recorded

between the dominant transport planning culture and planning methodologies that used accessibility indicators (see Section 4.5.3). For example, planning methodologies based on accessibility indicators were sometimes not perceived as cost-efficient.

The proposition that the *tools* needed for Accessibility Planning were not available is substantiated by the findings in Chapters 3 and 5. Chapter 3 concluded that most accessibility indicators used in transport research did not examine local accessibility and that relatively little was known about user groups' accessibility needs. There are several difficulties in measuring accessibility and no consensus has yet been reached on how the notion best could be quantified (Chapter 3). Earlier studies suggested that in order to describe accessibility, data other than that for "conventional modelling" was needed (Cooper et al. 1979, p. 28). Chapters 3 and 5 also identified gaps in the evidence on how to measure accessibility. Chapter 4 concluded that a lack of sufficient tools was likely to have contributed to the later abandonment of the methodologies used in the West Yorkshire Transportation Study (see Chapter 4, Section 4.2.3.2). In addition, the West Yorkshire Transportation Studies (Wytconsult 1977b) was held back by a lack of data.

6.3. Propositions on planning culture

The research propositions surrounding *culture* are designed to explore, amongst other things, potential conflicts between Accessibility Planning and the dominant transport planning culture, and, if such a tension could be proven, to investigate it further. In total four research propositions are identified:

- *That there has been a tension between the dominant transport planning culture and that which is espoused in Accessibility Planning (1),*
- *That problems with the specification of accessibility indicators have made transport planners sceptical about their value (2),*
- *That transport planners have perceived a conflict between Accessibility Planning and economic objectives (3), and*
- *That Accessibility Planning requires new skills and ways of working and this has delayed take up of the concept (4).*

Changes over time are an important aspect in examining the research propositions. If it is the case that transport planning culture has changed over time, this needs to be acknowledged.

6.4. Propositions on planning tools

The research propositions for *tools* are designed to assess barriers to the development of methods to measure local accessibility. One element of this is to explore the extent to which traditional transport planning methodologies and appraisal techniques capture local accessibility. In total four research propositions are identified:

- *That Accessibility Planning has been held back by the dominance of traditional transport models in the transport planning toolbox (5).*
- *That difficulties in establishing useful accessibility indicators have hampered Accessibility Planning (6).*
- *That Accessibility Planning has been hindered by a lack of readily available data detailed enough to quantify local accessibility (7), and*
- *That the emphasis on equity in Accessibility Planning does not fit comfortably with conventional appraisal techniques (8).*

If the planning tools, used prior to introduction of the Accessibility Planning initiative, are found to fully capture local accessibility and are consistent with Accessibility Planning, then it would seem that the new initiative adds very little. However, as mentioned earlier, previous authors did not describe how dominant planning tools actually incorporate different aspects of accessibility and therefore failed to establish if planning for accessibility actually was something new or not (see Chapter 2 and Section 6.2.1).

Similarly to the research propositions on *culture*, changes to planning tools that have taken place over time are an important consideration.

6.5. How the propositions are addressed

6.5.1. Consideration of alternative data collection methodologies

Three main data collection methodologies were considered for exploring the eight research propositions: case studies, interviews and a questionnaire survey.

It was initially considered feasible to design the study as a case study, i.e. to document in detail how one or more local authorities approached Accessibility Planning, how they received the new policy initiative, how much time they spent on it and how they choose to implement it. However, this idea was soon abandoned as it was found that local authorities, at the time of implementation of Accessibility Planning in winter/ spring 2005, were under great constraints to meet the submission deadline for the second round of Local Transport Plans. The author was not successful, despite considerable effort, in securing the willingness of any local authority to commit the time and resource and provide the transparency needed for a case study approach. Consideration was next given to carrying out interviews or using a questionnaire to planners in many different local authorities about their perceptions and experiences of the new accessibility-based planning approach. After a careful assessment it was concluded that a short questionnaire would be the most efficient approach. A questionnaire could be distributed relatively promptly to many authorities and hence provide a desired snapshot of the early stages of the implementation process (this was considered important in order to capture as much as possible of planners' perceptions of Accessibility Planning, i.e. the planning culture). Carrying out a questionnaire survey of local authorities would also mean that sufficient resources were made available to study the accuracy of local accessibility indicators in collecting primary data (see next section and Chapter 9). Carrying out interviews would, compared to a questionnaire survey, require additional resources, but perhaps more importantly, it would mean that data would be gathered over several months, perhaps half a year. This in turn meant that developments during those six months would affect the results making the survey perhaps more difficult to interpret. In addition, an interview survey would not leave scope for assessing the reliability of local accessibility indicators in any detail.

6.5.2. Selected approach to data collection

Chapters 8 and 9 will present the results of the two surveys designed to explore the research propositions. In addition to the two surveys, a document analysis of appraisal and transport modelling tools was carried out.

Chapter 8 presents the survey of local authorities. As previously noted in Section 6.5.1, the purpose of this survey was to ask planners about their experiences of implementing Accessibility Planning and their attitudes towards it. Results from the survey of local authorities were used to guide the design of a second survey looking into pedestrian route choices and walking propensity. The second survey, presented in Chapter 9, was designed to investigate how different specifications of accessibility indicators affect their reliability for measuring accessibility on foot. This survey aimed to illustrate difficulties of establishing adequate local accessibility indicators, i.e. to answer the research propositions that difficulties in establishing useful accessibility indicators have hampered Accessibility Planning and that Accessibility Planning has been hindered by a lack of readily available data detailed enough to quantify local accessibility (see Section 6.4). Further details, including a fuller explanation for why a survey of pedestrian route choice was the preferred data collection approach, are provided in Chapter 9, Sections 9.1.2 and 9.1.3.

The choice of questionnaires and a pedestrian survey left a gap concerning data needed to explore the propositions on the potential role that transport models and conventional appraisal techniques (cost-benefit analysis) may have for holding accessibility-enhancing planning strategies back. In addition to the two surveys, therefore, a document analysis of appraisal and transport modelling tools was carried out. The findings of this analysis are presented in Chapter 7.

Table 6.1 indicates the data sources to be used to address each of the research propositions. The table was used to confirm that all eight research propositions were sufficiently covered in the study.

Table 6.1. Relevance of remaining research activities for research propositions

| No. | Research proposition | Main sources of information | | |
|-----|---|-------------------------------|--------------------------------|---------------------------|
| | | Analysis of documents (Ch. 7) | Local authority survey (Ch. 8) | Pedestrian survey (Ch. 9) |
| 1 | There has been a tension between the dominant transport planning culture and that which is espoused in Accessibility Planning | ✓ | ✓ | |
| 2 | Problems with the specification of accessibility indicators have made transport planners sceptical about their value | | ✓ | |
| 3 | Transport planners have perceived a conflict between Accessibility Planning and economic objectives | | ✓ | |
| 4 | Accessibility Planning requires new skills and ways of working and this has delayed the take up of the concept | ✓ | ✓ | |
| 5 | Accessibility Planning has been held back by the dominance of traditional transport models in the transport planning toolbox | ✓ | | |
| 6 | Difficulties in establishing useful accessibility indicators have hampered Accessibility Planning | | | ✓ |
| 7 | Accessibility Planning has been hindered by a lack of readily available data detailed enough to quantify local accessibility | | ✓ | ✓ |
| 8 | The emphasis on equity in Accessibility Planning does not fit comfortably with conventional appraisal techniques | ✓ | | |

Chapter 7

Consistency between tools that have dominated transport planning and those needed for Accessibility Planning

7.1. Introduction

This chapter investigates two of the research propositions identified in Chapter 6: whether the dominance of traditional transport models in the transport planning toolbox held back Accessibility Planning, and whether the emphasis on equity in Accessibility Planning fits with conventional appraisal techniques using aggregate consumer benefits. The two propositions are relevant because of the fact that a lack of adequate tools contributed to the abandonment of earlier planning initiatives similar in scope to that of Accessibility Planning (see Chapter 4). In addition, if the tools that have dominated transport planning are inconsistent with those needed for Accessibility Planning then the new planning initiative (DfT 2006a) risks being marginalised.

7.2. How four stage models and CBA handle local accessibility

7.2.1. Tools used to appraise accessibility

Accessibility impacts are generally appraised using transport demand models and cost-benefit analysis (CBA). Transport demand models are often a vital part of transport planning analysis. They aim to provide a picture of current transport demand, estimate how demand may change over time and assess its consequences for people and transport networks. Outputs of transport demand models are a key input to CBA. For example, IHT (1996, p. 14) proposed that a transport demand model is a “crucial step in any transport strategy study”. IHT also suggested that a model can consume more than two-thirds of the resources allocated for a whole study. Transport demand models can therefore be seen to have been a dominant tool in transport planning (see also Ortúzar & Willumsen 2001, p.2-3, Banister 2002). The outputs may also be used in other assessment frameworks such as Transport Assessment (TA) for new developments. The purpose of CBA and TA is in turn to

value and provide a synthesis of all impacts that a scheme or policy brings including accessibility.

7.2.2. Four stage models and accessibility

A four stage model is one type of transport demand model which aims to estimate the number of trips carried out within and between pre-defined zones. The models were for a long time the most widely used way to assess travel demand (IHT 1996, Holmberg et al. 1996). The name four stage model comes from the fact that four sub-models are used: one for trip generation, one for trip distribution, one for modal choice and one for route assignment. The model was designed to appraise major infrastructure schemes rather than to measure accessibility, but its outputs have sometimes been interpreted as a proxy for accessibility and referred to as “changes in accessibility” (IHT 1997, p. 95).

It has been suggested that the use of four stage models promote higher transport volumes and faster networks and reduces accessibility to “a second order of importance” (Banister 2002, pp. 133-134). Similarly, Bartholomew (2007, p.409) described the four stage models he examined as “structurally deficient” and unable to test the effect of small-scale land use policies on accessibility. The above authors did not fully explain the underlying reasons for these suggested deficiencies. However, one potential reason is that many four stage models tend to take a rather aggregated view on travel demand. For example, models with large zone sizes say little about local accessibility. For example, a zone size of 1,000 squared metres would mean that facilities in a neighbouring zone could be anything between a few and 30 minutes walk away (i.e. beyond walking distance for many elderly). Where zones are as large as this any useful information on the accessibility of local facilities is lost.

As shown in Table 7.1, the sizes of zones used in four stage models vary considerably. A typical zone in an urban context seems to contain between 2,500 - 3,500 residents. This means that zones used in four stage models have been significantly larger than those used in studies that have attempted to measure accessibility. For example, the accessibility study in South Yorkshire (Mallett et al. 1977b) mentioned in Chapter 4 included 1.3 million people and used around 1,500 zones with less than 900 residents per zone. Similarly the West Yorkshire

Transportation Study investigating accessibility to shops included 1,300 zones, with an average of 1,500 residents per zone (Wytconsult 1977b). This in turn implies that many four stage models do not capture variance in local access.

Table 7.1. Typical zone sizes in four stage models

| Area | Type of study | Population | No. of zones | Average no. of residents per zone | Average zone size (sq. km) |
|--|---|------------|--------------|-----------------------------------|----------------------------|
| Merseyside (SCMTT 1965) | Strategic urban transport planning | 1,400,000 | 382 | 3,665 | 2.1 |
| Humberside (CUEP 1969) | Strategic transport and land use planning | 771,000 | 61 | 12,640 | - |
| Greater London 1972 (see Ortúzar et al. 2001, p.114) | Strategic urban transport planning | 7,200,000 | 1,000 | 7,200 | 1.6 |
| South & West Yorkshire (MVA 2002) | Multi-modal study | 3,270,000 | 440 | 7,430 | 8.1 |
| Glasgow City Council (Transport Scotland 2007) | Strategic urban transport planning | 578,000 | 167 | 3,460 | 1.0 |
| City of Edinburgh (Transport Scotland 2007) | Strategic urban transport planning | 457,000 | 181 | 2,520 | 1.4 |

The number of zones in early four stage models was originally limited by computer capacity (see e.g. CUEP 1969). However, zones used in contemporary transport models for urban areas such as Edinburgh and Glasgow (Transport Scotland 2007) are also significantly larger than those used in older studies of accessibility. It thus appears that four stage models have not increasingly included local accessibility needs despite the fact that progress in computer technology has brought consecutively better opportunities to do so.

7.2.3. Cost-benefit analysis, NATA and accessibility

Outputs of four stage models are key inputs to cost-benefit analysis (CBA). The aim of CBA is to assess how (different) travel needs should be valued. CBA does not

normally include local accessibility impacts. This is because assessments of local accessibility, in particular those for walking and cycling, tend to be qualitative in their character. Many impacts relevant for pedestrians and cyclists cannot easily be measured in monetary terms (see e.g. Chapter 3, DfT 2007b) and need to be assessed in other ways (SACTRA 1999, Chapter 9; Grant-Muller et al. 2001). For example, *The New Approach to Appraisal* (NATA) (DETR 1998c), an objective-led framework designed to assess how trunk roads reflect transport policy objectives, includes data from a transport model/ cost-benefit analysis as well as data from other types of analyses. NATA assesses changes in accessibility by non-motorised modes using a 7 point scale. This means that English and Welsh decision support for transport planning, as in most European countries, contains a mix of cost-benefit analysis, cost-effectiveness measures and qualitative assessments (Grant-Muller et al. 2001). Note that recent developments have meant that some benefits of improved walking and cycling infrastructure can now be valued in monetary terms (DfT 2007c). How monetary and non-monetary impacts are brought together differs from country to country. NATA uses a one-page Appraisal Summary Table (AST) to outline all relevant impacts of a scheme for decision makers. The AST presents information from cost-benefit analyses (COBA) (DfT 2006b) alongside information from Environmental Impact Assessments (EIA) and other non-money impacts such as those on walking and cycling. The Netherlands uses a Multi Criteria Analysis (MCA) (Gwilliam & Gommers 1992). Sweden has had a growing tradition to rank transport schemes according to their Net Present Value (NPV) only (Holmberg et al. 1996, p.56; Widlert 2002).

7.2.4. Comment

In order to understand what impact four stage models may have had in holding back Accessibility Planning it would be useful to assess how decision makers interpret model outputs and to what extent they are aware of limitations in the scope of a particular model. Ideally one would like to ask those involved about the extent to which they think that the transport model used in their particular planning process portrays all accessibility needs and compare this with model specifications. This approach would however only be possible in ongoing or recent planning cases and could therefore not be used to assess if the dominance of four stage models, as used in the past, is such a factor. A different approach was therefore applied in this thesis

by using a second best methodology to assess the awareness of potential weaknesses of four stage models more generally. The next section does this by taking a closer look at criticisms of four stage models recorded in transport research.

7.3. Criticism of transport appraisal methodology and its relevance for Accessibility Planning

7.3.1. Four stage models

7.3.1.1. Introduction

As mentioned earlier, this section aims to assess the general awareness of weaknesses in four stage models when it comes to how the models assess different types of travel demand, tracing relevant criticisms of four stage models from the 1970s and forward. Indeed, four stage models have been widely criticised for many years (see e.g. Supernak 1983, Flybjerg et al 2006). One concern has been the sequential structure of traditional four stage models and its lack of resemblance to how travel decisions are made (see IHT 1996, p.134). Another area of concern has been how four stage models have been used in practice (see e.g. IHT 1997). The issues raised have spanned a great number of topics on many different levels of which three were found to be most relevant to Accessibility Planning. These were: criticisms of the limitations in scope of four stage models, concerns over limited prediction accuracy and unease over poor transparency of model assumptions. The next three sections will describe each of these issues in turn.

7.3.1.2. Limitations in scope

Researchers have for a long time been concerned about limitations in the scope of four stage models (e.g. Hutchinson 1981, Niemeier & Mannering 2007). This issue can be broken down into at least two key problems. Firstly, that four stage models lack an underlying theoretical explanation to travel demand (e.g. Supernak 1983, IHT 1996). Secondly, that traditional four stage models may only assess a “very limited” range of policies (Hutchinson 1981, p. 174, see also IHT 1997). Four stage models have also been criticised for not providing sufficient information on which groups of the population tested policies are good or bad (Hutchinson 1981, Supernak 1983, pp.83-84) and for not having sufficient linkages between transport supply and

land use (e.g. Mackett 1998, p.99). Furthermore, traditional four stage models do not handle travel comfort for walking and cycling (IHT 1996, p.140) and early mode choice models “routinely” excluded walking from the modelling process (Stopher 1998, p. 408). These concerns may have contributed to Bruton’s criticism that transport planning methodology was “too concerned with the technical problems associated with traffic estimation and network planning, and too little concerned with the transport needs of the community at large” (Bruton 1985, p. 21). It seems therefore that criticisms of the limitations in scope of four stage models were until relatively recently without direct reference to how these models may or may not measure local accessibility (see Section 7.2.2, Banister 2002 and Bartholomew 2007).

It could be suggested that Land Use and Transport Interaction models (LUTI) are about to replace traditional four stage models and that the role the latter therefore is diminishing. However, this is probably only true to a certain extent. LUTI models still have a long way to go before becoming fully operational (Hunt et al. 2005). In addition, as also highlighted by Hunt et al. (2005, p.372), LUTI models tend to use “excessive spatial aggregation”. This type of models therefore suffers similar weaknesses as four stage models in that zones are too large for measuring changes in local accessibility.

7.3.1.3. Limited prediction accuracy

Poor accuracy of models has probably been the most frequent criticism of transport demand models (see e.g. Hutchinson 1981, Atkins 1987, NAO 1988, Walmsley & Pickett 1992, Flyvbjerg et al. 2005, 2006). Forecasts for urban areas seemed to be more inaccurate than those for rural transport projects (see e.g. Mackinder & Evans 1981, Atkins 1987, pp. 316-317). An obvious problem of this is that money may be invested in little needed transport links and not where they make the most difference. Criticisms of poor accuracy of forecasts have contributed towards development of more and more detailed models. This development is still ongoing despite the fact that “*overwhelming evidence from the experience of forecasting in transport is that increasing mathematical sophistication in forecasting technique does not necessarily bring corresponding increases in accuracy of forecasts*” (Polak 1987, p.71). Recent evidence supports this concern. Flyvbjerg et al. (2005, 2006) found that the accuracy

of transport models had not improved over time despite the fact that modellers had claimed the opposite. More than $\frac{2}{3}$ of rail projects studied by Flyvbjerg had actual traffic levels 40% less than that forecasted. $\frac{1}{4}$ of the road forecasts showed similar inaccuracies with actual traffic being either 40% over or below forecasted traffic one year after opening.

While it seems sufficiently clear that many demand forecasts have been erroneous, the underlying reasons for limited prediction accuracy are more debatable. For example, Mackinder & Evans (1981) suggested that poor data inputs rather than modelling mechanisms were to blame. However, Flyvbjerg et al. (2006, p. 16) found that project managers and researchers, when trying to explain poor accuracy of forecasts, thought that faults in the forecasting models themselves were a contributory cause in a quarter of all cases.

7.3.1.4. Concerns about lack of transparency

A third key criticism of four stage models is concerns about a lack of transparency (e.g. Wachs 1982, Tennøy 2003). A particularly relevant issue for Accessibility Planning is how limitations in scope and quality of model outputs are presented in decision support. This is because, as noted earlier, many aspects of local accessibility may not be included in traditional four stage models. Clarity and transparency would also make it easier for stakeholders to assess the quality of a forecast and built-in assumptions.

Wachs (1982, p.563) suggested an important ethical dilemma as modellers tend to use “*the language of technical objectivity*” for something that is not. He suggested that this contributed to unawareness by most decision-makers of the assumptions underlying models. Kane & Del Mistro (2003, p. 117) suggested in their review of planning methodology that many transport planners viewed themselves as value-free and objective advisors and that the type of technical advice given by four stage models was an important part of this culture. The same authors suggested that urban planners, who once held the same position as transport planners, had moved away from this set of beliefs during the 1970s. The culture of transport planners may therefore to some extent explain why they so often use the language of ‘technical objectivity’. Abandoning this practice would, if Kane & Del Mistro were right,

require a change in how planners perceive their role, their ‘worldview’, not just a simple task of stating a number of assumptions and limitations in a report. Perhaps it is therefore not surprising that recent experiences from Norway suggest that the language of ‘technical objectivity’ still is a prominent phenomenon. Tennøy (2003) found that $\frac{1}{3}$ of the transport planning documents she investigated did not mention uncertainties of forecasts presented. Less than half (44%) of the reports contained a presentation of core assumptions underpinning models (distribution of income growth, cost of motoring, change in population size, size and location of new housing and retail developments).

The level of transparency that transport models (and modellers) provide may be particularly important when one considers the relatively poor accuracy of many forecasts (see Section 7.3.1.2) and the fact that “appraisal optimism” may be the most significant bias in transport appraisal (Mackie & Preston 1998, p.6). Optimism bias is made up of one or several conscious or accidental inaccuracies. It may for example consist of model specification errors, limitations in study objectives and faulty assumptions. However, this review could not find that any research has been made looking into whether more transparent forecasts are more accurate.

7.3.1.5. Consequences for planning practice

Several authors have implied that weaknesses in four stage models (modelling limitations, poor accuracy and limited transparency) have had negative impacts on planning efficiency (e.g. Atkins 1987, Tennøy 2004). For example, an in-depth study of two planning cases in Norway (Tennøy 2004) uncovered that a traditional forecast model was used to test multi-modal accessibility-oriented and demand-oriented policies despite the model’s supposedly well-known limitations. Tennøy found that the model in one case underestimated the impacts of demand-oriented policies and therefore deprived decision makers of real choice. However, empirical studies in this field are few and our understanding of the limitations in the structure and application of four stage models is restricted. Much of the research presented in Sections 7.3.1.2 - 7.3.1.4 is too high-level to explore accessibility or the significance of whether local accessibility is included in a transport model. For example, no studies were found to have investigated whether transport planning decision support highlighted the fact

that some accessibility needs were included in a particular demand model and some were not.

The high-level of the criticisms presented in the literature is perhaps not surprising as there are many difficulties in assessing the role that for example inaccurate forecasts may have. Criticisms of traditional four stage models presented in Sections 7.3.1.2 - 7.3.1.4 nevertheless point to two interesting issues. First, the fact that little is known about how limitations in scope of four stage models may have affected wider transport planning processes, for example attempts to introduce a more complete demand estimation process that includes local accessibility. One of the main purposes of four stage models is large-scale construction scheme justification (IHT 1997). For such schemes the rules of assessment often imply that changes in local accessibility are relatively unimportant (see e.g. DETR 1998c & d, TSO 2007). Four stage models have also played an important part in forming urban transport strategies (and indirectly land use) as a whole (see e.g. Buchanan et al. 1963, CUEP 1969). But how has the exclusion of local accessibility needs in four stage demand models for such planning processes affected their outcomes? We will return to this issue in Section 7.4.1. A second important aspect is how new and traditional tools can work together. Say that Accession² is used for identifying areas with a high level of unmet needs for local access to basic services and that four stage models are used to appraise major construction schemes. How could one then assess the impact large-scale construction schemes in urban areas may have on access to basic services for socially excluded groups? Is there not a risk that the two set of tools, Accession and four stage models, leave quite a significant gap between them, and if so, how could this gap be handled? This issue will be discussed in the next section.

7.3.2 Cost-benefit analysis

7.3.2.1. Introduction

Cost-benefit analysis (CBA) is a “cornerstone” of transport appraisal (SACTRA 1999, p.138) and a key tool for valuing accessibility impacts (DfT 2006b, DfT 2007b). The use of cost-benefit analysis is however not uncontroversial (see e.g. Richardson 2000). Those sceptical about CBA methodology in general raise two

² Accession is the software used by many local authorities in order to analyse accessibility.

types of concerns (Boardman et al 2006, p.2). The first of these criticisms is an attack on the fundamental assumptions in CBA, i.e. the suggestion that different types of impacts can be traded off against each other. Critics have also raised objections against CBA because of its theoretical underpinnings. For example, ICoT (1974, p.261), a proponent of planning for accessibility, claimed that it cannot be accepted that the sum of people's individual decisions necessarily equals what they really want. A suggestion that is likely to refer to the fact that observed travel behaviour does not necessarily correspond to user satisfaction (see Chapter 2, Sections 2.4.2 & 2.5.2). A second main group of concerns relates to disagreements about what impacts policies are likely to have and valuation of these. For example, using CBA in appraisal of policies affecting our environment has been labelled as "fraught with problems" (Hanley & Spash 1993, p.21) not least because it is difficult to put a value on many environmental impacts.

Concerns regarding the use of CBA in transport planning can consequently be separated into a number of issues. Perhaps three issues are the most relevant for Accessibility Planning. Firstly, how equity aspects are treated in CBA compared to how they are viewed in Accessibility Planning. This issue will be discussed in Section 7.3.2.2. Section 7.3.2.3 discusses the interpretation of democratic rights (e.g. the principle of subsidiarity) and ethical values and their relevance for how local accessibility should be valued. A third section examines the usefulness of CBA in a field where some policy instruments such as infrastructure construction are readily quantifiable in monetary terms while measures relevant for Accessibility Planning and their impacts, such as re-location of services, often are not. Valuation problems in general, a topic that many transport studies pursue, may be seen as less relevant for Accessibility Planning at this stage. This is because accessibility to basic services is not normally valued in monetary terms.

7.3.2.2. Treatment of equity aspects

CBA aggregates individual user benefits as a basis for social choice. Costs and benefits are summed up for each option and traded off against each other. Only policies that have positive net benefits should be adopted (the so called Kaldor-Hicks criterion or potential Pareto efficiency). Potential Pareto efficiency means that it would be possible to compensate accessibility losers, but does not require that

compensation necessarily should be paid. This is how CBA is normally applied in transport planning. In other words, the alternative with the greatest net benefits is normally considered optimal, even if it imposes losses on many people. This is a somewhat different perspective from that inherent in Accessibility Planning as the latter promotes advancement of a minimum level of access to basic services for all. In Accessibility Planning, better access or other benefits for some cannot be traded off against reduced access to basic services for those with poor accessibility. In such cases measures of compensation would be needed to raise accessibility levels above stipulated thresholds. Proponents of CBA have defended the methodology saying that it strengthens equity as it must include the impacts on less vocal and less well organised groups in society (Boardman et al 2006, p.40) and that this balances out any negative impacts that low income has on people's willingness to pay for improvements. The latter could however be viewed as a weak argument because it assumes that other forms of decision support would not consider the needs of different groups. However, anecdotal evidence suggests that proponents of efficiency as a decision criterion do to some extent consider other things. For example, Sassone & Schaffer (1978, p. 23.) suggested that most economists would reject a project if it only benefited the rich and cost only the poor. Pearce & Nash (1981, p.18) found sceptics' criticisms that CBA ignores how inputs are distributed "quite justified" where policy outcomes are not subject to an income (or wealth) distribution evaluation. In other words, data on the distribution of impacts would be needed if one would like to make informed decisions that take equity into consideration.

7.3.2.3. Handling of democratic and ethical values

In cost-benefit analysis, a solution highly valued by some or many stakeholders might be preferred to one supported by the majority of a population. Cost-benefit frameworks do therefore not necessarily correspond to democratic values that give individuals equal weight in decision-making.

In CBA, valuation of individuals' willingness to pay for improvements cannot be carried out without the assessors' or decision-makers' value judgements (Dasgupta & Pearce 1978, p.94; Pearce & Nash 1981, p.20; Lichfield 1992, p. 252; Grant-Muller et al. 2001, p. 258). It may therefore be important to understand what values

a particular CBA rest on. One judgement of significant interest is who should have standing (Boardman et al. 2006, p.9). For example, should the value of improved street lighting in a high crime area be determined by those living in such areas or should it be a (lower) average including those living in low crime areas? Such considerations are clearly both significant and difficult.

Cost-benefit analysis has also been questioned from ethical points of view. Ethical concerns typically relate to how different impacts are valued (a common criticism from decision makers that do not like the results of a CBA). An example of an ethical concern that may be relevant to Accessibility Planning is valuation of safety improvements when walking and cycling. Many people, and at least some decision makers, would probably agree that it is more important to protect the innocent from those breaking the law than to protect those that voluntarily break the law, e.g. by speeding. This is not to say that pedestrians and cyclists are fault free. However, when they do make mistakes or break the law they normally pose little risk to others than themselves. A speeding driver poses a significantly increased risk both to themselves and other road users. In CBA the benefits of reducing both types of accidents are typically valued the same. Another example of an ethical concern in CBA is how to handle individual gains when breaking the Highway Code (see e.g. Elvik 2006). The implications of using different parameters in transport appraisal (such as ones derived from 'safe' behaviour compared to actual behaviour) would depend on in what context an analysis is made (Bonsall, Liu & Young 2005). For example, if a model aimed at identifying potential accident locations made use of lower speeds than those in the real world it would be likely to reject locations that would have met a criterion if more realistic speeds had been used.

One way of winning a majority might be to pay compensation to those negatively affected by a scheme or policy. Katzmman (1986) described an interesting example of this where many disabled people preferred being able to use buses like everyone else instead of receiving monetary compensation that could be used for taxi journeys, despite the fact that a cost-benefit analysis identified cash compensation as better value. So, even if compensation was to be paid, which a conventional cost-benefit analysis does not stipulate, there might be tensions between different ways of

viewing transport policy, with efficiency-oriented approaches on one hand and rights-oriented approaches on the other.

7.3.2.4. Use of cost-benefit analysis in a field where some policy instruments are not possible to quantify in monetary terms

One difficulty in transport appraisal is to compare monetary and non-monetary impacts. As mentioned earlier, accessibility impacts are found on both sides. Reduced travel time by car is typically measured in monetary terms while impacts on accessibility to basic services are measured more qualitatively (DETR 1998c & d). Mishan (1988) called this problem one of horse and rabbit stew where one ingredient always tends to dominate the taste. For example, it is sometimes implied that non-monetary impacts have too little influence on decisions made (see e.g. Sayers et al. 2003, p.95). A common response to this problem is that a Multi Criteria Analysis (MCA) should assist the decision-making process (e.g. Mackie & Preston 1998, p.4; Sayers et al. 2003). However the use of MCA also has its problems (Quinet 2000) and in transport appraisal this methodology is still considered to be in a development phase (Grant-Muller et al. 2001). A further difficulty in this respect is that our understanding of the role decision support (e.g. outputs of transport models and CBA) plays in transport planning decision making is relatively poor (Gudmundsson et al. 2007).

7.3.2.5. Consequences for planning practice

Only few, if any, empirical studies have tried to assess the role weaknesses in CBA may have had on planning outcomes. It is therefore difficult to say what impact limitations in CBA methodology may have had in practice. There seems however to be a growing consensus that transport appraisal tools' capability to assess social impacts ought to be improved (see e.g. Imperial College et al. 2006, Marsden et al. 2007, p.12). There are a number of ways this could be done. One frequently mentioned improvement has been to carry out a distributional CBA that presents impacts on different groups depending on their wealth or income (see e.g. Turner 1979, pp. 413-414). Distributionally weighted analysis makes it possible for decision-makers to identify whether poor people or certain vulnerable groups are winners or losers in alternative scheme designs. Other suggested solutions have included attempts to replace conventional CBA with a new form of framework

called Community Impact Analysis (CIA) changing the order in which things are assessed (Lichfield 1992, p.253).

In practice equity analysis has often therefore not been included in transport appraisal. For example, the NATA framework “does not currently identify sub-groups in the population” (Imperial College et al. 2006, p.32). An underlying reason for this is lack of data. This has been recognised for a long time (see e.g. Falcocchio & Cantilli 1974, p. 147) and still is an issue (Imperial College et al. 2006). Unfortunately, not even state-of-the-art demand modelling tools can always produce estimations of equity impacts (see e.g. Jonsson 2003, p.40). However, there are some promising methodologies that may help to overcome some of the data limitations, so that impacts of policy measures on different groups more easily could be estimated. One such technique is the use of synthetic populations (see e.g. Bonsall & Kelly 2005).

7.4. Discussion

7.4.1. How four stage models may have held back Accessibility Planning

Classical four stage models say little about local accessibility (see Section 7.2.2). Principally data on the location and number of, say food shops, could be added as an attribute for each zone in models. However, this solution would normally require substantial changes in the data structure of models because the zones upon which they were based typically are too large to measure local accessibility. Additional analysis using tools other than four stage models (e.g. Accession) would therefore be necessary if one wanted to examine local accessibility. However, there was probably little demand for carrying out such additional analyses as the limitations in scope of for stage models when it comes to how they exclude local accessibility impacts were not well recognised (see Section 7.3.1.2). Could then Accession software have run 15 years ago? The answer to this question is probably yes, but not as easily as today. GIS software with similar functions to those of Accession was available for desktop computers in the early 1990s (see e.g. Miller & Shaw 2001). So, the standardised computer tools needed for Accessibility Planning could potentially have been put in place significantly earlier (indeed such tools were developed during the 1970s, although costly to run and suffering from a lack of readily available data sources, see

Chapter 4). This leaves us with a number of alternative explanations for the role four stage models potentially have had in delaying a wide-ranging take up of Accessibility Planning.

One rationalisation is that most four stage models probably did not aim to incorporate effects on local accessibility. This could be because of a policy context where no or little data on equity impacts were demanded. There may also have been planning processes in which local accessibility issues were ignored because they did not easily fit a selected transport demand model. Furthermore, some transport planners may have ignored needs not included in four stage models because these accessibility demands may have seemed more subjective and thus more difficult to argue for (see e.g. Wachs 1989, Kane & Del Mistro 2003). Another possible argument is that more detailed and mathematically sophisticated four stage models brought increased costs of using them and therefore left fewer resources available for other types of assessments. However, neither of the perspectives above nor the ensuing arguments is directly supported by empirical findings in the literature. Few, if any, studies have discussed how to optimise resources available for transport appraisal to achieve a balance between assessing transport demands in urban areas within and outside the scope of traditional four stage models.

Another possible perspective is that it is only if one believes that local accessibility is captured in four stage models that model limitations become important. Limitations in the scope of four stage models have not always been adequately recognised by transport planners and decision makers (e.g. Wachs 1982, Tennøy 2003). Tennøy (2003) found that decision-makers were often not presented with the delimitations and assumptions underpinning models. As shown in Section 7.3.1.2, it seems that criticisms of the limitations in scope of four stage models were until relatively recently without direct reference to how these models often not measure local accessibility. The language used to describe models has neither made it easier to understand model limitations. For example, models were sometimes presented as “multi-modal” despite the fact that they did not include walking and cycling route quality (IHT 1996, p. 15; MVA 2002). One explanation for this lack of transparency may be the development towards more complex models. Another reason might be a lack of contact between experts writing model specifications and those using models

and their outputs. However, the fact that accessibility to basic services is not really incorporated (in traditional four stage models) does not really explain why attempts to systematically take such impacts into consideration in transport planning were abandoned (see Chapter 4). Still, confusion about the extent to which four stage models capture all relevant accessibility demands may have contributed significantly to the fact that Accessibility Planning was not until recently mainstreamed.

An underlying reason for the failure of Accessibility Planning tools to be mainstreamed may have been that some local accessibility concerns for socially excluded groups were less critical during earlier decades, e.g. there were more local shops and services. In addition, local authorities in the UK had, during the 1980s, more control over public transport services. This meant that profits from money-making routes could relatively easily be used to fund socially motivated public transport services. The ability to cross-subsidise public transport (services needed to achieve a minimum level of accessibility) may also have contributed to a lack of interest from decision makers as well as planners to include pedestrian and cycling accessibility in urban transport strategies.

How can one then explain that four stage models for a considerable period of time during the 1980s and 1990s developed in a direction towards being more and more mathematically complex without much widening in scope? Perhaps the most important reason for this is failings of four stage models in terms of prediction accuracy. This in turn contributed to a push for more mathematically complex models as many modellers seemed to believe this would solve the problem (see Flyvbjerg et al. 2006, p. 16). This increased focus on accuracy then took focus away from other development needs. In addition, increased mathematical complexity also increased costs as it required more sophisticated software often only used by experts. This meant in turn that the focus on mathematical sophistication made it less feasible to use improvements in computer capacity to increase spatial resolution (smaller zone sizes that could capture changes in local accessibility).

7.4.2. Equity, CBA and Accessibility Planning objectives

CBA is often heavily dependent on data from four stage models. One cannot therefore expect a CBA to include the value of changes in accessibility to basic

services (see Section 7.2.2). However, even if all relevant accessibility impacts could be assessed using monetary units it would not necessarily mean that equity impacts embedded in Accessibility Planning would be taken into consideration. CBA based on the principle of potential Pareto efficiency means that compensation to losers, even those with poor accessibility, need not be paid. Principally the emphasis on equity in Accessibility Planning is therefore *not* directly compatible with conventional CBA methodology. This may not be a big problem for investments that do not affect accessibility to basic services, but in order to know if that is the case, some form of assessment needs to be made. One solution to this problem is to present decision makers with the Net Present Value (NPV) as well as other information/ indicators (DETR 1998c, Grant-Muller et al. 2001). Equity impacts can for example be presented in the shape of a distributional CBA or as a part of an AST or MCA. Where a conventional CBA is part of an AST or MCA it cannot therefore be seen as inconsistent with Accessibility Planning, even if there is a tension between values embedded in the CBA itself and Accessibility Planning objectives.

7.5. Conclusions

This chapter has investigated two research propositions. The first proposition examined whether the dominance of traditional transport models in the planning toolbox held back Accessibility Planning. A second proposition explored whether the emphasis on equity in Accessibility Planning fits with conventional appraisal techniques using aggregate consumer benefits. Conclusions on the two propositions will be drawn in that order.

Four stage models cannot be said to conflict with or contradict the tools needed for Accessibility Planning. Most four stage models during the 1980s and 1990s probably did not aim to incorporate local accessibility impacts. The dominance of ‘predict and provide’ philosophy within transport planning during that time was perhaps an underlying reason for this. A lack of standardised tools for measuring local accessibility may also have contributed to many viewing accessibility analyses as too expensive or vague. Thus, although the dominance of four stage models may not have held Accessibility Planning back, confusion about the scope of four stage models may have held it back and contributed to its failure to reach the mainstream. The fact that classical four stage models do not typically include local accessibility

impacts was not widely publicised until recently (see Section 7.3.1.2). Long-standing criticisms of how four stage models have been used in practice and how model outcomes have been presented to decision-makers support the suggestion that there has been a significant element of confusion about the scope of four stage models (see Sections 7.3.1.4 and 7.4.1). Four stage models would have acted as barriers where used to assess travel needs beyond their limitations and where an illusion (e.g. by a lack of clarity) was created that they did (fully) reflect accessibility to basic services. This issue has clearly been a problem in some cases (see e.g. Tennøy 2004). However, there is only little evidence in transport literature of how common such problems have been or its consequences.

The answer to the second proposition is more straightforward. Embedded in the structure of a conventional CBA is the assumption that needs of minority groups with few resources should not get any particular priority. CBA practice indicates that positive net benefits are a good enough criterion for implementation. Accessibility Planning objectives suggest two other things. Firstly that everyone should have a 'fair' level of access to basic services. Secondly, that transport strategies as a whole should carry disproportional positive benefits for those with the poorest accessibility. The emphasis on equity in Accessibility Planning is therefore *not* directly compatible with conventional CBA methodology.

Chapter 8

Local Authority survey

8.1. Introduction

This chapter presents findings from a questionnaire survey to local authorities in England. The purpose of the survey was to collect data on a number of the research propositions presented in Chapter 6. Amongst other things, the survey examines if there was a tension existed between the dominant transport planning culture and Accessibility Planning, if problems with the specification of accessibility indicators made transport planners sceptical about their value and whether transport planners perceive a conflict between Accessibility Planning and economic objectives. Another research proposition that was explored was whether Accessibility Planning continues to be hampered by a lack of data.

8.2. Methodology

8.2.1. Timing

The timing of the survey was carefully chosen and it was sent out so that it would reach respondents approximately three months after the full guidance for Accessibility Planning (DfT 2004c) was published. This, it was anticipated, was a point in time in which most local authorities would be well familiar with the new planning initiative and work intensively with it, an assertion that was supported by the fact that local authorities were required to submit an outline of their accessibility strategies to the Government in summer 2005 (to be incorporated in their draft LTP). The Government requested local authorities to have full accessibility strategies by March 2006.

8.2.2. Questionnaire design

The questionnaire survey was developed in two stages. First a pilot questionnaire was produced. The pilot version of the questionnaire was tested on a handful of people with knowledge of the Accessibility Planning process, including individuals from the Local Government Organisation (LGA), transport consultancies and academia. The results of the pilot survey suggested that using mainly multiple-choice

questions would improve the response rate and make the answers easier to interpret. The pilot questionnaire was subsequently revised and a final version of the questionnaire was taken forward.

The final questionnaire was broadly sub-divided into three sections. The first section explored Accessibility Planning tasks that local authorities had progressed to date. This part of the questionnaire also investigated how local accessibility objectives were dealt with previously. It began with a number of relatively easy to fill in multiple-choice questions. This, it was thought, would make respondents more willing to take on the task.

The second section included a handful of questions directly referring to the previously identified research propositions (see Chapter 6). Amongst other things, the section explored the usefulness of Accessibility Planning to local authorities and covered a number of aspects, including the potential role of Accessibility Planning for identifying needs for transport improvements. The questionnaire also asked respondents to express the extent to which they viewed a number of stated matters as difficulties. The scales used to test the different research propositions typically ranged from not at all useful to very useful or strongly disagree to strongly agree. The use of multiple-choice questions reduced the information gathered to a minimum. However, this could potentially make it difficult to understand underlying issues. Open-ended follow-up questions were therefore added, where so motivated by the complexity of an issue. The second section also examined planners' perceptions of how effective Accessibility Planning was in facilitating improvements for different groups of people.

A third section collected data on difficulties that planners experienced in implementing Accessibility Planning. This section used mainly open-ended questions. The third part also investigated potential conflicts between Accessibility Planning and other policies. A copy of the full questionnaire can be found in Appendix 3.

8.2.3. Sample selection

A list of local authorities was provided by the LGA. From the list a sample of local authorities was selected. The sample included 114 English authorities with responsibility for developing a Local Transport Plan (LTP) and 103 English district authorities. The selected English district authorities (hereafter called non-LTP authorities) were those with a transport planning department or similar. All local authorities in England with a known transport planning department or similar were thus included. Two Passenger Transport Executives (PTEs) with responsibility to develop a LTP were excluded. They did not appear on the original distribution list and this was not noticed until it was too late to include them.

As mentioned earlier, the non-LTP authorities targeted in the study are the ones with a transport planning department or similar. This group may therefore be more likely to influence the priorities of the LTP in their area than the average district authority. The survey results do not include the views of planners at district authorities without a transport department. Hence, the survey results do not take in local authorities with responsibilities within land use planning but limited transport planning responsibilities and the particular problems they may have. This limitation in scope is worth noting when interpreting the findings.

8.2.4. Survey distribution

The questionnaire together with a letter of introduction was sent by post in February 2005. The survey pack was addressed personally to the local authority's Head of Transport. Contact details for this were provided by the Local Government Association (LGA). The names of the local authority's Head of Transport were unknown in ten or so cases. In the absence of a named person, the questionnaire was sent to the "Project Manager/ Co-ordinator of the LTP".

Local authorities were given one month to answer the survey. Two email reminders were sent on 23rd February 2005 and 11th March 2005 to those which had not yet submitted an answer. It is worth noting that 30 or so of the email addresses initially used for reminders were inaccurate. This might, for example, be because a senior officer had moved job. Where the new Head of Transport was unknown to us reminders were sent to the most relevant email address provided on a local

authority's website (e.g. LTP project manager) or the contact address for the Local Transport Plan provided by the Local Transport Planning Network (www.ltpnetwork.gov.uk).

8.2.5. Response rate

Full responses were received from a total of 103 local authorities (47% of sample). This can be broken down further:

- 72 responses from LTP authorities (63% response rate), and
- 31 responses from non-LTP authorities (30% response rate).

In addition to the 31 responses received from non-LTP authorities, a further six authorities in this group returned the questionnaire without answering it. No LTP authorities returned their questionnaires blank. The most common comment provided for returning a blank questionnaire was that the respondent knew little about Accessibility Planning at this stage (as they awaited actions to be taken by the LTP authority in their area). Four non-LTP respondents provided this reason for not answering the questionnaire. Two of these non-LTP authorities indicated that they saw Accessibility Planning as the sole responsibility of LTP authorities.

As mentioned earlier, the questionnaire survey was addressed to the Head of Transport/ LTP Project Officer. It is however anticipated that a significant number of addressees passed it on to officers more directly responsible for Accessibility Planning. As with all questionnaires of this nature the responses are likely to reflect the view of an individual rather than the authority.

8.2.6. Potential biases

The 63% response rate among LTP authorities gives confidence in the generality of the conclusions. That said, and as shown in Table 8.1, the sample was somewhat biased towards larger authorities, towards LTP-authorities with somewhat lower population density than the average and towards non-LTP authorities with higher population density. The LTP authorities in the sample have a somewhat lower deprivation index (see ODPM 2004) than non-responding local authorities. The average population for responding LTP authorities was 403,000 inhabitants while the

average for non-responding LTP-authorities was 300,800 inhabitants. The population for responding non-LTP authorities corresponded to that for the send list.

Table 8.1. Comparison between authorities responding to the questionnaire and those on the send list (averages for each group)

| <i>Feature</i> | <i>Send list</i> | | <i>Responses</i> | |
|--|-------------------------------|-----------------------------------|------------------------------|----------------------------------|
| | LTP authorities (n 114) | Non-LTP authorities (n 103) | LTP authorities (n 72) | Non-LTP authorities (n 31) |
| Population size | 300,800 | 102,900 | 403,000 | 105,800 |
| Population density (people/ sq. km) | 1,526 | 676 | 1,334 | 900 |
| Proportion rural population | 16% | 33% | 19% | 30% |
| Deprivation index | 25.38 | 15.67 | 21.87 | 13.39 |
| Proportion households without a car | 28.8% | 20,4% | 25.6% | 18.5% |

It may be that a relationship exists between non-response and lack of progress taking Accessibility Planning forward, but this is purely speculation. For example, larger LTP authorities may more often have answered the questionnaire simply because they were quicker to take up Accessibility Planning (e.g. because of greater resources). However, there is no obvious way to interpret how abovementioned biases might affect the interpretation of the results.

8.3. Selected findings

This section presents tabulated data on survey responses including differences between different types of local authorities, e.g. LTP and non-LTP authorities. In addition, the sample is split into two groups depending on their population size, population density, proportion of rural population, level of deprivation (see ODPM 2004) and proportion of households without a car. In many cases there are no significant differences between LTP and non-LTP authorities or authorities with a large population and those with smaller ones. However, where clear discrepancies exist, a binomial test (difference in two proportions) is used to test the significance of

differences between different groups of authorities. This is done at the 95% and 99% levels.

8.3.1. Accessibility Planning and transport planning culture

8.3.1.1. Association with transport planning

The respondents were asked if they thought Accessibility Planning fitted into the culture and context of local transport planning. Three-quarters of planners indicated that it did so. One in ten thought that it did not. 21 respondents provided comments as to the motivation of their opinion. Of these, ten or so provided explicit support for a tension between Accessibility Planning and the dominant transport planning culture. A selection of distinguishing comments is presented below.

“...it may have been better lead by the 'corporate centre' with transport as a key stakeholder and corporate centre as the co-ordinator or in a lead role. However, transport [planning] is well suited to problem solving ethos.”

Planning Officer, LTP authority (answered *agree*)

“I feel that it [Accessibility Planning] would be better to deal with from [a] planning and development angle as solutions are not necessarily transport based.”

Planning Officer, LTP authority (answered *neither agree nor disagree*)

“...Accessibility Planning is generally still a bit in advance of transport planning and its culture. There is a strong tendency to concentrate on mobility. Where mobility measures are not thought feasible the tendency is to see accessibility as someone else's problem.”

Planning Officer, LTP authority (answered *disagree*)

“[Accessibility planning] does not fit [the] transport planning culture at present. Clearly [it] has benefits in the future.”

Planning Officer, LTP authority (answered *disagree*)

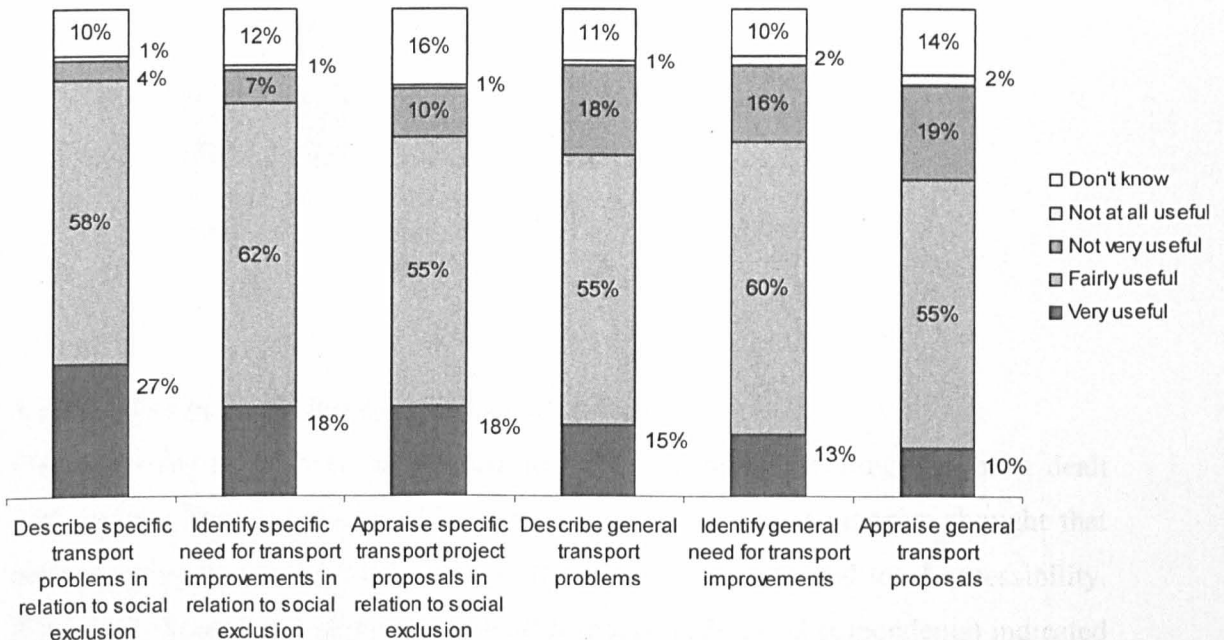
From the 21 comments, two different reasons could be identified for disagreeing. Firstly, those who indicated that Accessibility Planning did not fit with transport

planning culture and ought to be led by someone else. Secondly, those that indicated that implementation of Accessibility Planning would require a significant change in planning culture. A handful of respondents supported each opinion. Appendix 4 presents a complete record of the 21 free text responses.

8.3.1.2. Helpfulness at different stages of a planning process

Respondents were asked to indicate how useful Accessibility Planning was to their local authority *at different stages of a planning process*. Respondents generally perceived the concept of Accessibility Planning to be useful with regards to transport planning, as well as in relation to social exclusion. As shown in Figure 8.1, 88 respondents (85%) found the concept to be *very useful* or *fairly useful* for the purpose of *describing* transport problems in relation to social exclusion. This was higher than for any other reason investigated. Project appraisal was given a less favourable rating with 67 respondents (65%) indicating that the new planning concept was *very useful* or *fairly useful* for appraising generic transport projects.

Figure 8.1. Usefulness of Accessibility Planning to local authorities (n 103)

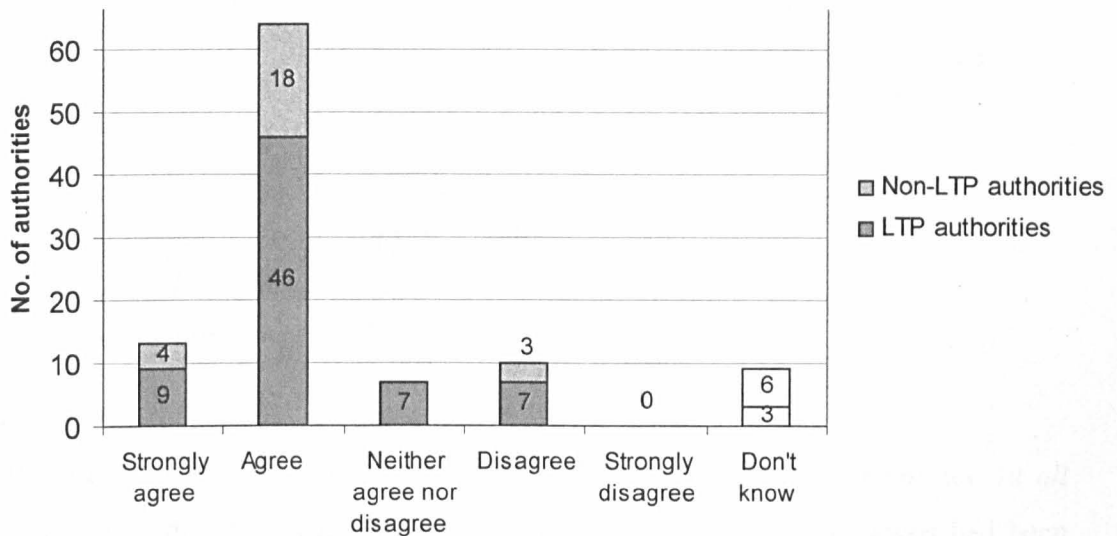


Around 20-25% of non-LTP authorities said they *didn't know* how useful Accessibility Planning was while the same figure for LTP authorities was around 5-10% (difference significant at 95% level). This difference may be a consequence of

the fact that some district authorities at the time of the survey seemed to know relatively little about the details of the new planning initiative.

Local authorities were also asked to rank the usefulness of Accessibility Planning in terms of its ability to communicate transport problems. As can be seen from Figure 8.2, 75% of authorities *strongly agreed* or *agreed* that the outputs of Accessibility Planning will increase the ability to communicate the transport problems faced by residents to local policy makers. Again, non-LTP authorities were more likely to answer *don't know*. 19% of non-LTP authorities answered *don't know* compared with 4% of LTP authorities (difference significant at the 95% level).

Figure 8.2. Do the outputs of Accessibility Planning increase the ability to communicate the transport problems faced by residents to local policy makers? (n 103).

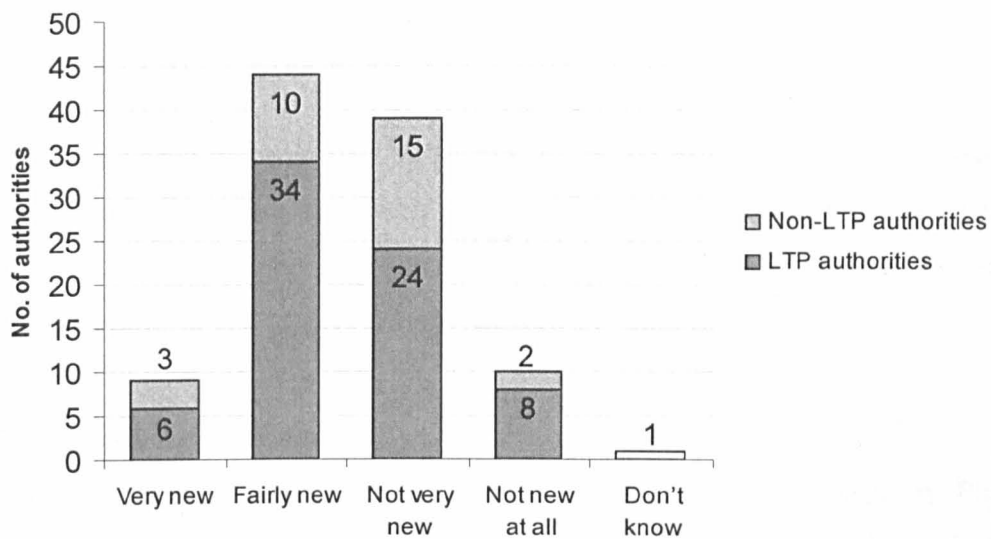


8.3.1.3. How the issue has been dealt with before

Planners were asked how the objectives of Accessibility Planning had been dealt with before. This question sought to explore to what extent planners thought that their planning culture up to the time of the survey had embraced local accessibility. Figure 8.3 shows that a slight majority of planners (52% or 53 respondents) indicated that the concept of Accessibility Planning was *very new* or *fairly new* to their local authority. Almost as many indicated that their local authority had worked with these issues (in a systematic way) before. Around one tenth of respondents identified the concept of Accessibility Planning to be *not new at all*. Authorities with a large

proportion of rural population (>19%) indicated slightly more often that the concept of Accessibility Planning was *very new* than less rural communities (difference significant at the 99% level). In addition, authorities with high car ownership levels (>78% households owning a car) more often indicated that the concept of Accessibility Planning was *very new* or *fairly new* than authorities with lower car ownership levels (difference significant at the 95% level). Non-LTP authorities found the concept of Accessibility Planning less new than LTP authorities (although the difference is statistically insignificant).

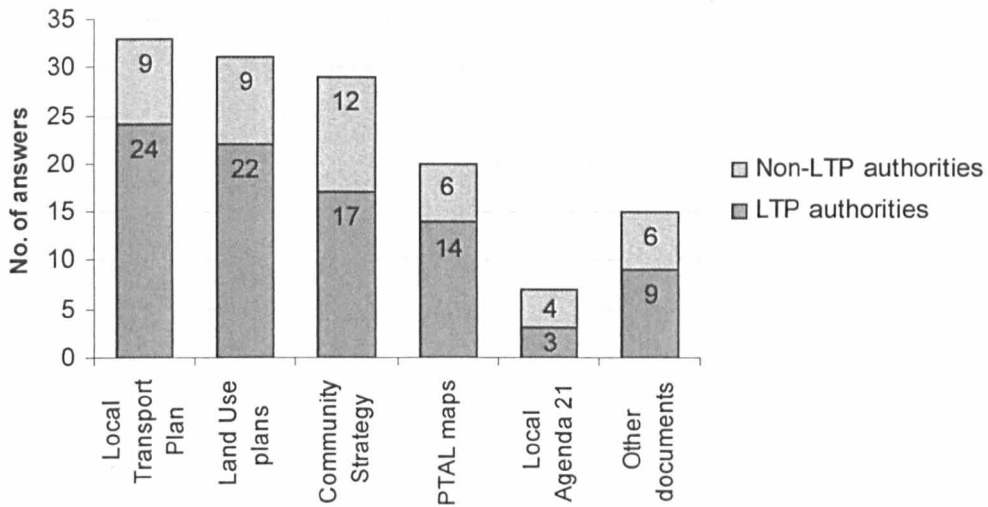
Figure 8.3. Is the concept of Accessibility Planning new to your local authority?



Authorities that identified Accessibility Planning as *not very new* or *not new at all* were asked to detail in which type of planning documents similar issues had been addressed before. A list of planning documents was provided in the questionnaire with an extra line so that additional documents could be added.

As shown in Figure 8.4 below, 54 local authorities mentioned almost 130 planning documents. LTPs, Land Use plans and Community Strategies were most frequently mentioned. The reference some authorities here made to PTAL maps may explain why relatively few local authorities saw Accessibility Planning as something very new (see also Chapter 5).

Figure 8.4. Documents where Accessibility Planning issues have been addressed before (n = 54, of which 33 LTP and 21 non-LTP authorities).



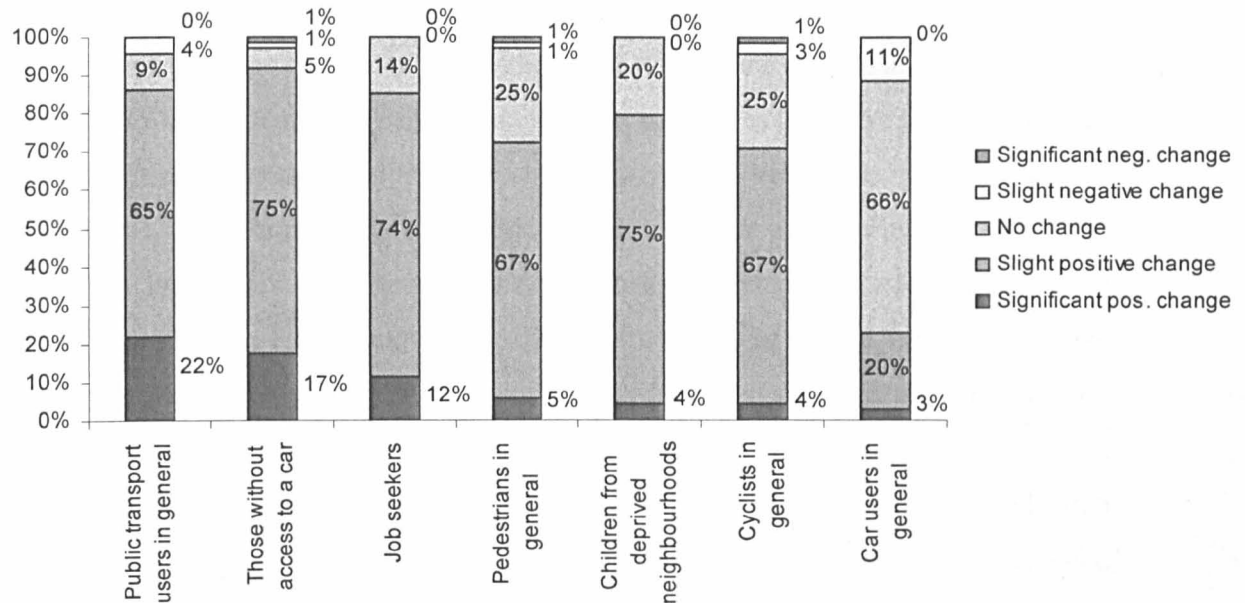
It is worth noting that non-LTP authorities in the sample indicated that accessibility issues hitherto had been dealt with in their Community Strategy more often than in the LTP for their area (the difference in responses between LTP-authorities and non-LTP authorities in this respect was not statistically significant).

8.3.1.4. *Expected outcomes*

Respondents were asked if they believed that anticipated Accessibility Planning measures would achieve a positive change for targeted groups. As shown in Figure 8.5, the majority of local authorities indicated that Accessibility Planning would do so. Hence planners seemed to indicate that there was scope for improving transport planning processes and changing planning culture in its widest sense so that it would take local accessibility needs more fully into account. The improvements that planners thought would be achieved were however relatively small.

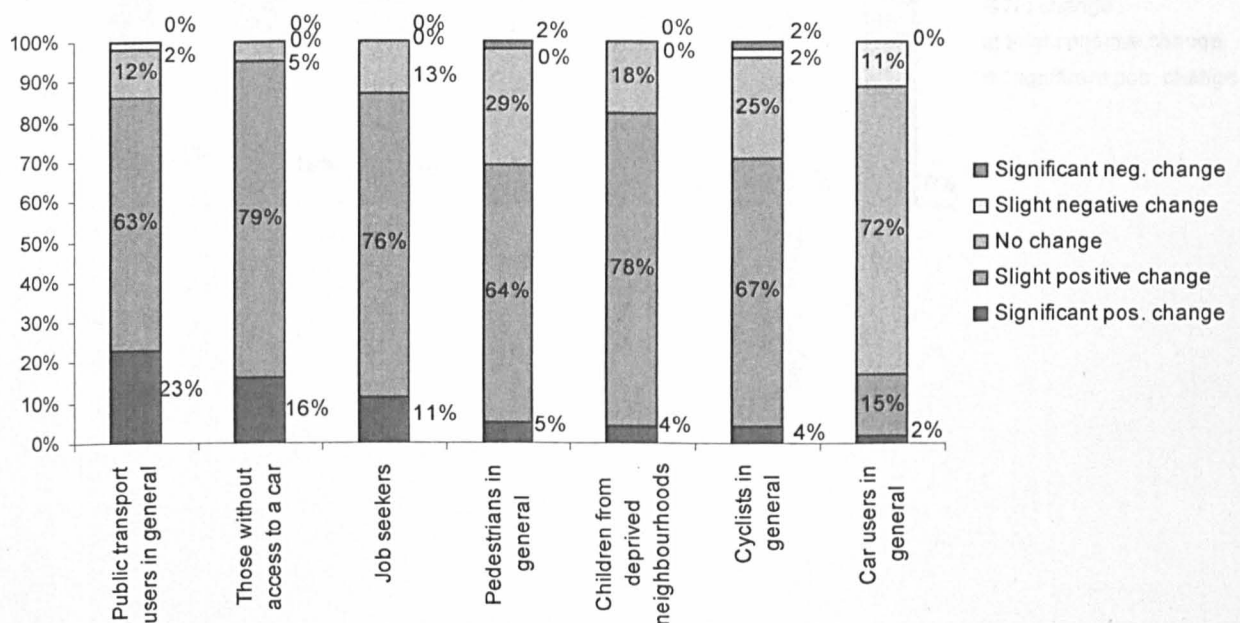
22% of respondents indicated that a significant positive change would be achieved for public transport users. The respondents expected these impacts to be greater than any impacts for more targeted groups such as those without access to a car, children from deprived neighbourhoods or job seekers. The survey did not provide any clear motivations for why this would be the case. It is however worth noting that the survey results seemed to indicate that many planners had a preference for improving public transport accessibility, with a few respondents expressing that Accessibility Planning policy steered in this direction.

Figure 8.5. Expected change in the level of accessibility for user groups (all authorities, n 69-76)



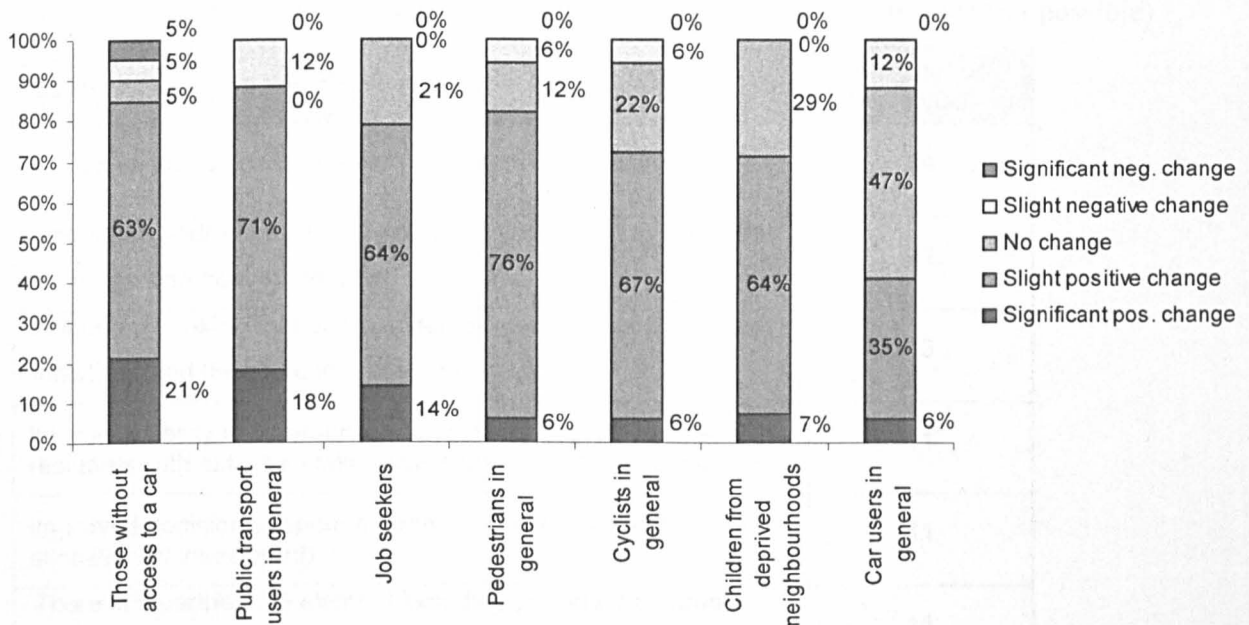
A clear majority of both non-LTP and LTP authorities indicated that there would be at least a slight positive change for those without access to a car, job seekers and children from deprived neighbourhoods. But there were also some noteworthy differences between LTP and non-LTP authorities, as shown when comparing Figures 8.6 and 8.7.

Figure 8.6. Expected change in the level of accessibility for user groups in LTP authorities (n 53 - 57).



Four in ten respondents from non-LTP authorities indicated that Accessibility Planning would result in a positive change for car users. A much lower proportion of LTP-authorities, one in six, indicated the same (difference statistically significant at the 95% level). The most likely explanation for responses given by LTP- authorities on this question was perhaps some confusion about the scope of Accessibility Planning. LTP authorities indicated that public transport users in general would be the group that received the most significant positive change (Figure 8.6). Non-LTP authorities (Figure 8.7) thought that those without a car would benefit the most (difference in the two proportions was not statistically significant). Furthermore, when answering the questions one in five LTP authorities indicated that they did not yet know the likely impact. Many more of non-LTP authorities (39-55%) indicated the same (difference statistically significant at the 95% level). One reason provided for this was that non-LTP authorities perceived themselves to have little influence over the LTP process.

Figure 8.7. Expected change in the level of accessibility for user groups in non-LTP authorities (n 14 -19).



8.3.2. Usefulness of accessibility indicators in transport planning

8.3.2.1. Advantages of Accessibility Planning

Respondents were asked to comment with free text on the advantages of Accessibility Planning. Their answers were categorised by frequency into eight main groups using an iterative keyword process. The process meant that the number of categories was successively narrowed down and keywords were grouped together. For example the category ‘objective and evidence-based assessment and justification procedure’ included keywords such as ‘quantitative methodology’, ‘quantification’ and ‘objective justification’.

As shown in Table 8.2, respondents indicated two main advantages of Accessibility Planning. 24 respondents (27% of those answering this open-ended question) indicated that the main advantage of Accessibility Planning was that it constitutes an *objective and evidence-based assessment procedure*. 22 respondents (25%) indicated that the main advantage of Accessibility Planning was that it facilitates and/ or focuses on improved access to key services for those who need it the most.

Table 8.2. Main advantages of Accessibility Planning (n= 89, multiple answers possible)

| Categorisation of free format text | Number of responses |
|--|---------------------|
| Objective and evidence-based (quantitative) assessment | 24 |
| Facilitates and/or focuses on improved access to key services for those who need it the most | 22 |
| Joined up thinking that brings together many earlier piecemeal initiatives and therefore improves efficiency. | 13 |
| Improved ability to communicate accessibility problems faced by residents with external stakeholders and local decision makers | 11 |
| Improved decision support in general (that for example informs allocation of investment). | 11 |
| There is a partnership element including important external organisations (partnership working) | 11 |
| Greater knowledge and understanding of the problems experienced by those with the poorest accessibility | 11 |
| Other | 15 |

Three respondents (3%) saw no real advantages of Accessibility Planning. Respondents providing comments such as ‘improved decision support’ were included within the ‘improved decision support in general’ category. Only respondents clearly stating that the main advantage was an *objective, evidence-based or quantitative* decision support were included in the category ‘objective and evidence-based assessment’, and not in ‘*improved decision support in general*’. Accessibility indicators are a key part of the (quantitative) assessment methodology for Accessibility Planning (DfT 2004b). The findings above therefore seemed to make it clear that planners found such indicators useful.

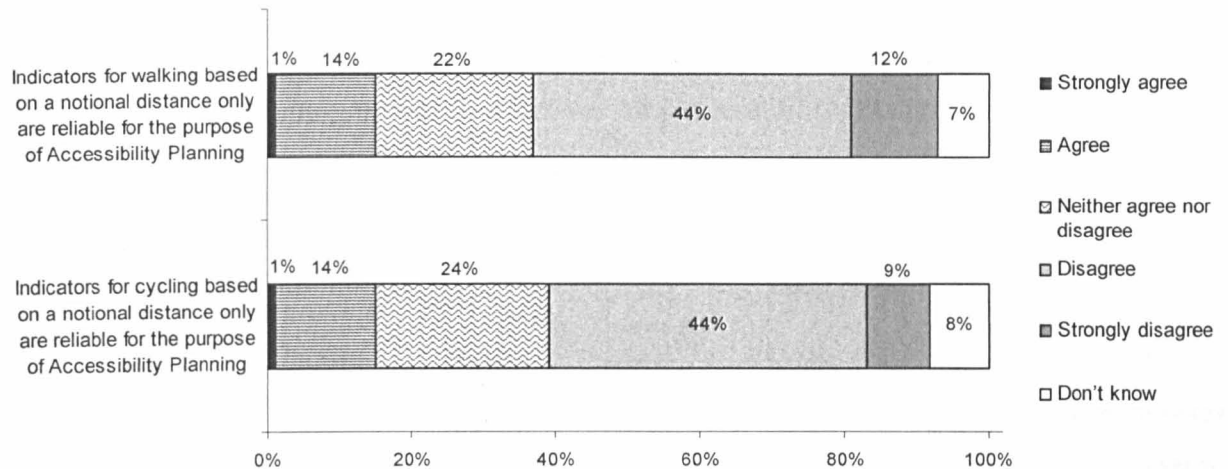
8.3.3. Planners’ perception of the reliability of local accessibility indicators

8.3.3.1. Reliability of walking and cycling indicators

Respondents were asked if they found accessibility indicators based on a notional distance reliable. As shown in Figure 8.8, 56% of respondents *disagreed* or *strongly disagreed* that notional distance was a reliable indicator for access on foot. Non-LTP authorities were somewhat more sceptical about the proposed walking indicator but these differences were not statistically significant. Among non-LTP authorities, 23% *strongly disagreed* and 35% *disagreed* that an indicator based on a notional distance only was reliable for the purpose of Accessibility Planning. The corresponding figures for LTP authorities were 7% and 47% respectively. Similarly as for walking, the majority of respondents (53%) *disagreed* or *strongly disagreed* that notional distance was a reliable indicator for cycling access. Neither in this respect were the differences between LTP and non-LTP authorities statistically significant (among LTP authorities, 8% *strongly disagreed* and 44% *disagreed* while the corresponding figures for non-LTP authorities were 10% and 42% respectively).

Smaller authorities with a population below 190,000 inhabitants more often *strongly disagreed* that walking indicators based on a notional distance are reliable than more populous authorities (difference significant at the 99% level). In addition, authorities with a low level of deprivation (deprivation index <18) more often *strongly agreed* or *agreed* that cycling indicators based on a notional distance are reliable than authorities with higher levels of deprivation (difference significant at the 95% level).

Figure 8.8. Reliability of walking and cycling indicators



Only a few respondents commented on the use of indicators. One of these said that these types of indicators will “*have to do*”. Responses to other questions in the survey supported the point of view that poor reliability of accessibility indicators used in Accessibility Planning was not seen as a major difficulty for implementing it (see Section 8.3.5.1, Table 8.3).

8.3.4. Accessibility Planning and economic objectives

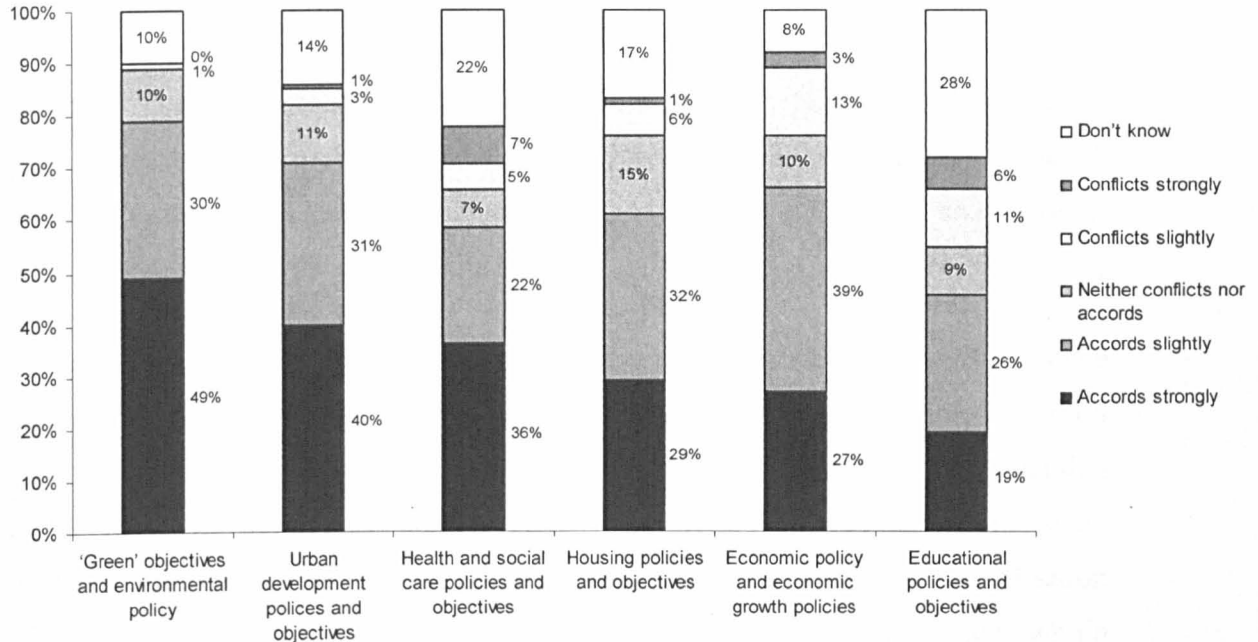
8.3.4.1. Policy synergies and conflicts

Respondents were asked to consider if Accessibility Planning measures accorded or clashed with other policies in their local authority. As shown in Figure 8.9, the majority of respondents found that five of the six policies under investigation accorded with Accessibility Planning (environment, economy, housing, urban development, health and social care).

The findings did not give any strong support for the research proposition that planners perceived a conflict between Accessibility Planning and economic objectives (see Chapter 6). In fact 66% of respondents indicated that local economic objectives *accorded slightly* or *accorded strongly* with Accessibility Planning. Planners in non-LTP authorities perceived economic policy as the issue most likely to conflict with Accessibility Planning; 26% of such officers indicated that local economic policies *conflicted strongly* or *slightly* with Accessibility Planning (the

equivalent figure for LTP officers was 11%, the difference significant at the 95% level).

Figure 8.9. Consistency between objectives of Accessibility Planning and local policies (n 102).



The extent to which Accessibility Planning measures accorded with economic policy was linked to local authorities' demographical context. Larger authorities (>190,000 inhabitants) more often indicated that Accessibility Planning measures *accorded strongly* or *accorded slightly* with local economic authorities (difference significant at the 99% level). Authorities with a low level of rural population more often indicated that Accessibility Planning measures *accorded strongly* with local economic policies than more rural ones (difference significant at the 95% level). So did authorities with lower car ownership levels (difference significant at the 99% level). In addition, local authorities with higher deprivation indices (above 18, see ODPM 2004) were almost three times more likely to indicate that Accessibility Planning measures *accorded strongly* to local economic policies and economic growth policies (difference between the two groups significant at the 99% level).

The highest level of overall synergy appeared between Accessibility Planning and local environmental policy; 79% of respondents indicated that Accessibility Planning objectives and 'green' objectives *accorded slightly* or *accorded strongly*. Educational policies were generally seen as the area with the most conflicts. Ten respondents directly or indirectly commented that educational and health care re-organisations put in place in their local area in order to increase choice might in fact reduce it for groups with poor accessibility. 28% of respondents answered *don't know* to this particular question. The rate of *don't knows* was relatively high also for health and social policies. This perhaps indicate that educational policies, as well as health policies, were seen as less well integrated with Accessibility Planning and transport planning processes at the time for the survey.

The arguments put forward by respondents as a whole suggested that there was some tension between providing a choice of services and making them available by modes other than the private car. The conflict can, for example, be illustrated by the fact that larger and more specialised GP surgeries would require longer and more costly journeys. As indicated by one respondent, a desire and need for greater specialisation within health and education may make it difficult to provide basic services within reach by foot or by public transport. Many types of services may become out of reach of walking (and cycling) altogether. However, as mentioned earlier, the majority of respondents indicated that the different policies corresponded well with the ones of Accessibility Planning; indicating that the way services were provided could be improved so that those without a car could reach them.

8.3.5. Accessibility Planning, skills and ways of working

8.3.5.1. Working in partnerships

Respondents were asked what they perceived as the main difficulties and disadvantages with achieving the objectives of Accessibility Planning. Again, free text comments were categorised into groups, making use of the procedure described earlier (see Section 8.3.2.1). To allow for double counting the number of 'unique responses' was calculated. Unique responses were computed as the number of respondents indicating that an issue was either a difficulty *or* a disadvantage, deducting for those who said it was both.

As shown in Table 8.3, issues related to working in partnerships, lack of a (ring-fenced) funding stream and human resource implications were seen as the main difficulties and disadvantages. These three categories received over 40 unique responses each.

Table 8.3. Main difficulties and disadvantages (difficulties n= 91, disadvantages n= 83, multiple answers possible).

| Categorisation of free format text | Number of responses | | |
|--|---------------------|-------------------|--------------------|
| | Main difficulty | Main disadvantage | 'Unique' responses |
| Lack of understanding of issues among partners (e.g. external stakeholders given too few incentives and obligations). | 41 | 14 | 45 |
| Funding stream not readily available | 26 | 23 | 41 |
| Time and resource consumption (human resource implications in general and/ or time scale provided) | 28 | 22 | 40 |
| Internal priorities and difficulties in engaging other in-house departments (likely to receive too low a priority) | 15 | 6 | 18 |
| Software issues (performance, reliability, availability) | 14 | 8 | 17 |
| Poor accessibility indicators and vague guidance with unclear definitions and targets | 5 | 6 | 11 |
| Steep learning curve (incl. lack of in-house skills and knowledge) | 8 | 3 | 10 |
| Raises unrealistic expectations (there will be no or little change in the accessibility levels experienced by targeted groups) | 1 | 10 | 10 |
| Data availability issues | 7 | 1 | 7 |
| Money could be more effectively used on other groups in society (risk for over emphasis on issue) | 0 | 7 | 7 |
| Lack of incentives given by government to local authorities | 2 | 4 | 6 |
| Accessibility planning provides little new information above what was already known | 0 | 5 | 5 |
| Other | 7 | 5 | 11 |

Working in partnership was seen as a key difficulty. This category of responses included those that thought external stakeholders were given too few incentives and obligations. Issues relating to funding and human resources were seen as both

difficulties and disadvantages. One in six respondents (18 unique responses) indicated that Accessibility Planning was likely to receive too low a priority while one in twelve (7 unique responses) indicated that there was a risk for over-emphasis on the issue.

11 respondents raised a number of difficulties and disadvantages which were categorised as 'other' issues. These included many different things. For example, one respondent indicated that the main difficulty was to engage with socially excluded groups and two respondents thought there was too narrow a focus on public transport in the Accessibility Planning guidance. Some indicated that Government rules on how local authorities were able to use (capital) funding would limit the success of Accessibility Planning. Another respondent said that the Government's funding criteria for successful LTPs did not take Accessibility Planning strategies sufficiently into account. The latter two comments may explain why so many respondents indicated that there was a lack of funding. Only one respondent indicated that there were no main difficulties foreseen in implementing Accessibility Planning.

The findings in Table 8.3 seem to indicate that many planners viewed the way Accessibility Planning works as the main difficulty. For example, 41 respondents (45%) indicated that partnership working was the main difficulty. This could be compared to results of a multiple-choice question in the questionnaire where over 60% of respondents either *agreed* or *strongly agreed* that the ability to engage and sustain partnerships with organisations such as schools and the NHS was or will be a problem. But the strong negative focus planners put on partnership working may also seem somewhat remarkable considering that at the time for the survey only one in three local authorities (32%) had yet established an ongoing partnership (Envall 2006, Figure 3).

One reason for the focus planners put on partnership working may be that they initially were not very successful in encouraging external organisations commit to taking part in Accessibility Planning, perhaps because planners did not have any established personal networks with staff at partnering organisations. 14 respondents viewed partnership working as a main disadvantage. A few of these indicated that they were not used to the idea of solutions being negotiated with multiple partners.

This may be because they preferred conventional planning procedures with solutions primarily decided in-house. Negotiating public service delivery strategies and the level of local accessibility provided may indeed be a task that planners thought they were not trained for. Many planners also commented that external stakeholders had been given too few incentives and obligations. On a more positive note, the survey findings indicate that Accessibility Planning addresses an area which is of concern to many local transport authorities but which they had not previously tackled systematically.

8.3.6. Accessibility Planning and traditional transport models

8.3.6.1. Making use of Accessibility Planning outputs

The survey included two questions in relation to the outputs of Accessibility Planning. The first one investigated whether the outputs allowed *a meaningful comparison with other transport problems*. A second question asked whether the respondent thought Accessibility Planning produced an output that enabled *a meaningful comparison with the output of traditional transport models such as SATURN, EMME/2 and TRIPS*. For these two questions it was assumed that the different types of outputs (maps and tabulated data produced using Accession software) were known to the respondents.

Figure 8.10 illustrates the responses to the first question. Almost half of all authorities indicated that they *strongly agree* (4%) or *agree* (44%) that the outputs of Accessibility Planning would allow a meaningful comparison with other transport problems. However, around one in ten (11%) respondents answered *strongly disagree* or *disagree*. Non-LTP authorities were somewhat more positive with 55% answering *strongly agree* or *agree*. The same figure for LTP authorities was 44% (difference not statistically significant). Around one in four respondents indicated that they did not yet know whether outputs of Accessibility Planning would allow a meaningful comparison with other transport problems.

Figure 8.10. Do outputs of Accessibility Planning allow a meaningful comparison with other *transport problems*?

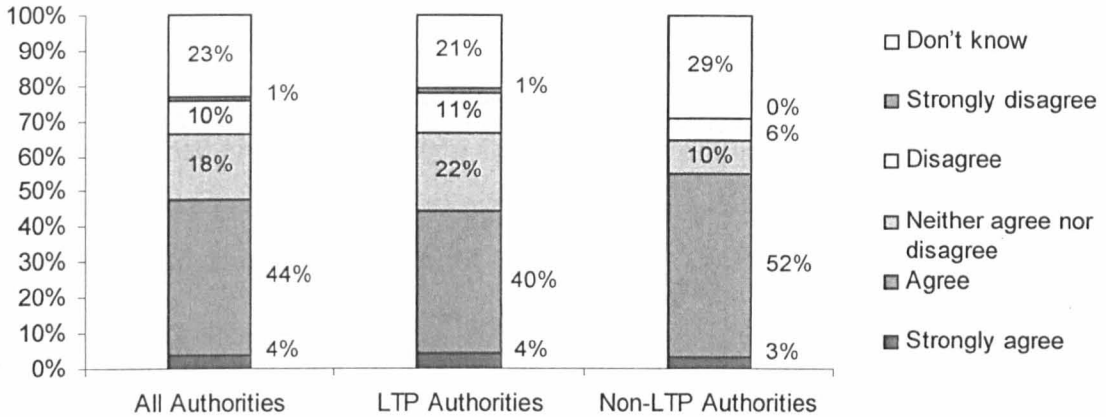
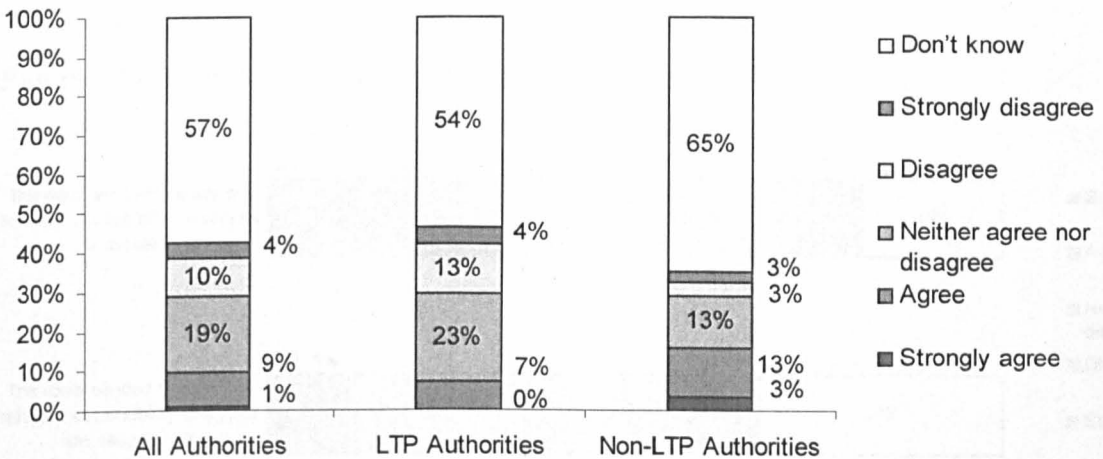


Figure 8.11 illustrates the results of the second question. The majority of respondents (57%) indicated they *didn't know* to what extent a meaningful comparison was possible between the outputs of traditional transport models and Accessibility Planning. However, 10% of all authorities answered *strongly agree* or *agree* to this question. Non-LTP authorities were somewhat more positive in their responses than LTP authorities. 16% of non-LTP authorities answered *strongly agree* or *agree* while the same figure for LTP authorities was 7% (difference not statistically significant).

Figure 8.11. Do outputs of Accessibility Planning allow a meaningful comparison with traditional transport models such as SATURN?



The responses to the above two questions can clearly be interpreted in several ways. For example, the answers perhaps indicate that respondents did not consider there to

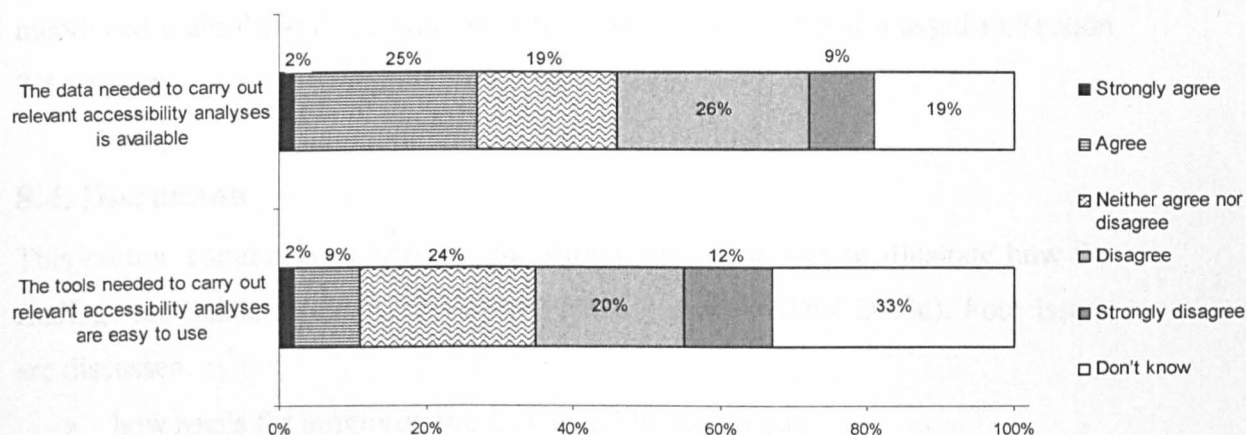
be a need to compare the outputs of Accessibility Planning with other types of transport network improvements/ transport investments appraised using transport models. Another explanation may be that many local authorities simply did not have a transport network model such as SATURN, or that the respondents have little experience or no knowledge of transport models. A third explanation may be that the respondents had given little thought as yet to how the Accessibility Planning process fits into a more general process of transport planning including, for example, option generation and demand forecasting.

8.3.7. Availability of data on local accessibility

8.3.7.1. Data availability, resolution and conversion

Respondents were asked if they thought that the data needed to carry out an accessibility analysis was available. The results gave a rather negative but also mixed picture. As shown in Figure 8.12, around one in three of all authorities *disagreed* (26%) or *strongly disagreed* (9%) that the data needed was available to them. Lack of relevant data on food shops was one issue mentioned. One in four LTP authorities *strongly agreed* (1%) or *agreed* (26%) to the same statement. Authorities with a low proportion of rural population (<19%) more often *strongly agreed* or *agreed* that the data needed was available to them than more rural authorities (difference significant at the 95% level). LTP authorities were slightly more negative than non-LTP authorities (difference not statistically significant).

Figure 8.12. Responses on data availability and tools



Those that *strongly disagreed* raised concerns over poor accuracy of data, poor data resolution but also data format conversion problems. Respondents therefore to some extent treated concerns regarding data availability and software tools as one matter. It is perhaps therefore not surprising that only one in ten respondents indicated that the tools needed to carry out accessibility analyses were easy to use while one in three *disagreed* (20%) or *strongly disagreed* (12%). Again LTP authorities were more negative and one in five (19%) *strongly disagreed* that software tools were easy to use (difference significant at the 95% level). Larger authorities (>190,000 inhabitants) were more positive in this respect than smaller ones (difference significant at the 99% level). In fact, no respondents from authorities with less than 190,000 inhabitants agreed that the tools needed were easy to use. Difficulty importing existing data into the Accession software while maintaining its precision and accuracy was an issue commented on by several respondents.

The open-ended questions on difficulties and disadvantages of Accessibility Planning presented earlier gave further indication of the importance of concerns regarding data availability and software functionality (see Section 8.3.5.1, Table 8.3). Responses to these questions indicated that software issues at the time of the survey were a somewhat greater concern than lack of data. Nearly one in seven respondents (15%) indicated that software issues (performance, conversion, reliability and availability) were a main difficulty of Accessibility Planning. This may not only be about software functionality but also to some extent about in-house skills in using GIS software. Less than one in ten local authorities (7%) indicated that data availability was a main difficulty. The issue was therefore not in the five most frequently mentioned main difficulties. Data requirements will be further discussed in Section 8.4.1 below.

8.4. Discussion

This section comments on some of the survey results. It tries to illustrate how the findings are linked to the Accessibility Planning process (DfT 2004c). Four issues are discussed:

- how needs for improvements best could be identified,
- how responsibilities for accessibility should be shared between land use and transport planning,

- how an optimum balance between mobility-oriented and accessibility-enhancing policy measures could be established, and
- how to deal with areas where commercial services are under risk of closing down.

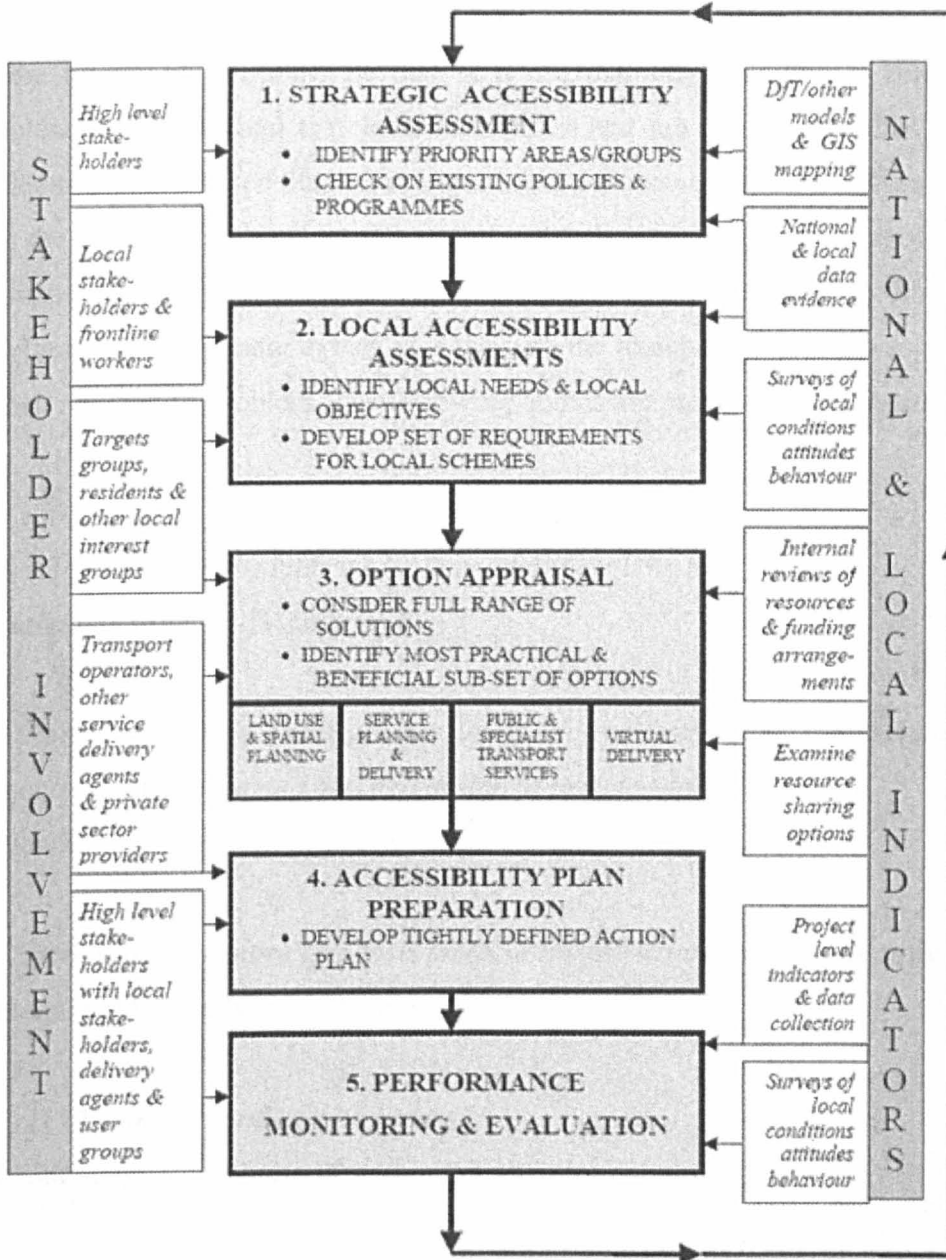
8.4.1. Identifying needs

As shown in Figure 8.13, the first and second stages of the Accessibility Planning process include identifying local accessibility needs as well as priority areas and groups.

In relation to this task, the author of this study anticipated that many respondents would highlight engaging socially excluded groups as a key problem with implementing Accessibility Planning. This proved to be wrong. Only a few respondents mentioned this as a main difficulty (Section 8.3.5.1). Many responses highlighted technical problems instead, such as those to do with data requirements and software functionality. This could be for several reasons. One explanation would be that planners did not experience problems in engaging socially excluded groups (although this seems to be a contradiction in itself). An alternative and more likely explanation is that local authorities relied heavily on accessibility indicators to identify problem areas and local needs (see Section 8.3.2.1, Table 8.2), and, that only a few local authorities had yet approached Accessibility Planning from a resident/user point of view.

The survey results seemed to indicate that planners were quite happy *not* to consult residents about their experiences and instead use accessibility indicators as key pointers of where local accessibility problems were the most pressing (even if many were sceptical about the reliability of the type of indicators they used for this process). Planners seemed to hold on to one notion of a planning methodology where needs and solutions were primarily subject to an in-house analysis of aggregated data and where public consultations were to be carried out once different schemes and priorities had been designed, if not decided.

Figure 8.13. Stages in the Accessibility Planning process (Source: DfT 2004c)



Public consultation at early stages may indeed be seen as costly and difficult to draw conclusions from as many different views and needs are likely to be presented. It could however be argued that Accessibility Planning would be more useful if it used a more robust bottom-up approach, especially considering respondents' doubts about the reliability of some indicators used for the aggregated data analysis. The importance of consultations at the outset of a study (with the purpose to identify local needs) would also depend on to what extent accessibility needs may vary geographically and between different socially excluded groups.

8.4.2. Integrating land use and transport planning

The issue of land use planning did not feature highly in the questionnaire survey. One reason for this may be that land use planning was mainly considered as a potential solution and that local authorities had not yet reached this stage of the planning process (see Stage 3 in Figure 8.13). However, when analysing the answers to the open-ended questions there appeared to be a tendency amongst officers at LTP authorities to perceive poor land use planning as a problem, while non-LTP authorities, to a greater extent, saw the way the transport planning was carried out in their region as a problem. The following quotes are provided as an illustration:

"...if land use authorities fully embrace [Accessibility Planning] then future developments will be built where accessibility will be built in."

Planning Officer, LTP authority

"There needs to be much greater integration with the land use planning system - location of facilities and detailed design of new developments is key."

Planning Officer, LTP authority

"There should be more emphasis on local infrastructure and service provision."

Planning Officer, Non-LTP authority

"...LTP moneys conflict with access"

Planning Officer, Non-LTP authority

"[There is a] danger that [the] process might become too transport oriented and partners will say to LTA's that's your problem not ours to sort out. "

Planning officer, LTP Authority

A check on the extent to which existing land use policies and programmes support the objectives of Accessibility Planning is included in the first stage of the planning process (see Figure 8.13). This is an important task as Accessibility Planning is perhaps not so much about re-distributing official responsibilities for providing a minimum level of accessibility but instead is a process reinforcing the need for co-ordination between public (and private) organisations (see DfT 2004c, DfT 2006a).

A key question is therefore to what extent Accessibility Planning objectives should be allowed to shape land use, so that accessibility objectives gain support already at a strategic planning level. Similarly, it might be important to consider how transport plans and investments shape land use. In practice this is a question of transforming accessibility objectives and responsibilities into practical and transparent guidelines, as well as workable planning and appraisal procedures. The results highlighted above seemed to indicate that this is an issue of concern for at least some local authorities.

8.4.3. Achieving the right balance between building infrastructure and investing in measures that enhance local accessibility

Many respondents indicated that a main advantage of Accessibility Planning was that it aims to improve access to key services for those that need it the most (Table 8.2). Perhaps one would therefore expect that Accessibility Planning leads to that local accessibility needs for targeted groups receive a relatively higher priority in option appraisal for transport improvements. However, comments provided by around 15 respondents also indicated that the Accessibility Planning process may receive a relatively low priority within transport planning itself (Table 8.3). The following quotes are provided as an illustration:

“Getting local authorities to change their priorities to tackling social exclusion as part of transport planning [is the main difficulty].”

Planning officer, non-LTP Authority

“[I don’t know] how high a priority it will receive, and how willing organisations will be to provide solutions identified.”

Planning officer, non-LTP Authority

“There is a tension between using limited Local Authority revenue funding on a) accessibility (often rural) and b) congestion boosting bus services (usually urban).”

Planning Officer, LTP authority

“[There is a] lack of ring fenced funding.”

Planning Officer, LTP authority

“Persuading county members and partners that appropriate staff and resources are required to meet the accessibility planning agenda [is the main disadvantage].”

Planning Officer, LTP authority

It is still too early to say how successful local authorities will be in finding an appropriate balance between improving accessibility for socially excluded groups and other needs and priorities. However, the comments above seem to indicate that there is a real need for tools that can assess the impacts efficiency-oriented transport improvements have on different groups in at least some local authorities (see also findings in Chapter 7, e.g. Section 7.3.2.5).

8.4.4. Addressing negative changes in commercial service patterns

Many wider issues affecting Accessibility Planning are driven by the need to provide choice while saving money in service delivery in commercial sectors. These trends such as the closure of local shops “contradict the accessibility planning theory” (as said by one respondent). The author of this report anticipated that many local authorities would identify the relocation of commercial services to out of town sites and away from public transport nodes such as town centres, as a main difficulty. However, and perhaps surprisingly, only a few respondents highlighted the current drive towards centralisation of commercial facilities and closure of local shops as problematic for Accessibility Planning (except in some authorities where school and health care re-organisations were underway). This was despite the fact that a check on the extent to which existing policies are coherent with Accessibility Planning is included in the first stage of the planning process (see Figure 8.13). The findings in the survey may indicate that local services have closed down in many areas where people are dependent on local accessibility and that the respondents now focused on addressing these issues. But this does little to address abrupt changes in commercial service provision in areas where local accessibility is under risk. Commercial services have fewer incentives than public authorities to meet accessibility objectives and co-operation with other authorities, such as the NHS and schools, was perceived as a main difficulty (Section 8.3.5.1). It will therefore almost certainly prove difficult for local authorities to form local policies that could effectively address abrupt negative changes in service provision such as food shop closures. Perhaps a problem for local authorities is that traditional land use and transport planning regulations and

investments only indirectly deal with closures of commercial service, if at all. The study did not fully investigate to what extent the respondents understand the fundamentals of commercial forces. But perhaps the problems mentioned here have been recognised: 10% of respondents said that unrealistic expectations were a main disadvantage of Accessibility Planning (Table 8.3). These respondents indicated that there would be little or no real change in the accessibility levels experienced by targeted groups in their respective authority. But there are other potential explanations too. Perhaps these 10% of respondents doubted that problems experienced by targeted groups could be accurately identified and prioritised. Or perhaps they felt there was a lack of policy measures, funding opportunities and transport projects 'in the pipeline' that could provide a significant positive change for those who were worst off.

8.5. Conclusions

The survey results provided much useful information indicating which research propositions (see Chapter 6) that should be supported or rejected.

The survey indicated that planners viewed some parts of Accessibility Planning as a hurdle. In particular they highlighted that the partnership element of Accessibility Planning was a difficulty (Section 8.3.5.1). Almost half of respondents indicated that this was the main difficulty. Many respondents also seemed apprehensive about the idea of negotiated solutions influenced by external organisations. Nearly half of respondents would prefer a dedicated funding stream for Accessibility Planning (Section 8.3.5.1, Table 8.3). Time and resource implications were also key concerns. Consequently, the findings gave support for the research proposition that new ways of working embedded in Accessibility Planning and the skills these require may have postponed a general take up of the concept (see Chapter 6, Section 6.3). In addition, the majority of respondents indicated that reliability of walking and cycling indicators based on a notional distance was poor (see Section 8.3.3); thus supporting the proposition that problems of establishing useful accessibility indicators have hampered Accessibility Planning (see Chapter 6, Section 6.4).

Three research propositions received a rather mixed response. One of these was the proposition suggesting that lack of data was a significant planning barrier (see

Chapter 6, Section 6.4). Respondents indicated that data availability to some extent was an issue and around 40% of LTP authorities disagreed that the required data was available to them. Statistical analysis indicated that smaller authorities and rural authorities experienced more issues in respect to data availability and the use of computer-based accessibility analysis tools. However, less than one in ten respondent thought data availability was a key difficulty with implementing Accessibility Planning (Section 8.3.7.1). This might suggest that respondents thought that most data not available at the time of the survey could be collected relatively easily.

A majority of respondents (75%) indicated that Accessibility Planning fitted into the culture and context of transport planning. This finding weakens the research proposition that there has been a tension between Accessibility Planning and the dominant transport planning culture (see Chapter 6, Section 6.3). The results were however not completely unequivocal as one in six respondents indicated that Accessibility Planning received too low a priority (Section 8.3.5.1, Table 8.3). Respondents also indicated that anticipated local accessibility measures would have a greater positive impact on public transport users in general than they would have on those without access to a car and job seekers despite the intentions of Accessibility Planning (see Section 8.3.1.4, Figure 8.4).

Findings in the survey on the role traditional transport models may have had on holding Accessibility Planning back were rather weak. The questionnaire design was lacking in this respect as it allowed little explanation. The results seemed to indicate that respondents at the time of the survey had not really thought about how outputs of Accessibility Planning could be compared with outputs of traditional transport models and to what extent accessibility impacts were already included in conventional models. Alternative explanations may be that respondents had little experience of transport models or saw little need to compare outputs of different assessment tools. This may to some extent indicate that Accessibility Planning has not been held back by the dominance of traditional transport models (see Chapter 6, Section 6.4).

The survey results implied that two research propositions should be rejected. The results undermined the proposition that problems with the specification of

accessibility indicator made transport planners sceptical about their value (see Chapter 6, Section 6.3). In fact, respondents saw the use of accessibility indicators, despite potential weaknesses, as a key strength of Accessibility Planning (Section 8.3.2.1, Table 8.2). The majority of respondents thought that Accessibility Planning procedures were directly useful in transport planning (Section 8.3.1.2). 85% of respondents indicated that the concept was useful for describing certain transport problems. The majority of respondents also thought that Accessibility Planning outputs would increase their ability to communicate transport problems to local policy makers and that it was useful for appraising transport projects. Finally, the results did not support the proposition that planners perceived a conflict between Accessibility Planning and economic objectives (see Chapter 6, Section 6.3). On the contrary, a clear majority of respondents (66%) thought that Accessibility Planning corresponded with local policies for economic growth (Section 8.3.4.1). Larger authorities (> 190,000 inhabitants), those with a low proportion of rural population and those with higher deprivation indices to a greater extent indicated that Accessibility Planning corresponded with local economic policies.

Chapter 9

Pedestrian route choice study

9.1. Introduction

9.1.1. Scope

This chapter investigates two of the previously identified propositions on potential barriers to Accessibility planning, i.e. whether difficulties in establishing useful accessibility indicators have hampered Accessibility Planning and whether Accessibility Planning has been hindered by a lack of readily available data detailed enough to quantify local accessibility (see Chapter 6, Section 6.4). A survey of pedestrian route choice was designed with the purpose of addressing the two propositions. A GIS network model was created to analyse the route choices and the findings used to identify factors important for the impedance of pedestrian networks.

9.1.2. Background

Chapter 5 concluded that the relative strength of different pedestrian needs is rather poorly understood. This, in turn, means that the precision of distance-only accessibility indicators such as those incorporated in Accessibility Planning (DfT 2004a, DfT 2006a) to a significant extent is unknown. The current lack of knowledge on the relative strength of different pedestrian needs raises a number of questions, as does practitioners' desire for better and composite walking indicators (see Chapter 8):

- Which environmental attributes are the most important for the accessibility of main pedestrian groups?
- Does increased complexity of accessibility indicators produce a commensurate increase in ability to reflect actual pedestrian behaviour, e.g. route choices?
- Is the data needed to improve the accuracy of indicators available?
- Would a low-cost composite indicator better reflect pedestrian behaviour than a shortest path algorithm?

These are some of the questions that this chapter seeks to address in order to address the two research propositions outlined earlier.

9.1.3. Why study route choice?

The chapter uses data from a survey of pedestrian route choice to build a model in which pedestrian route choices are analysed. The idea is that greater knowledge of pedestrian route choices would help us understand the extent to which variance in the impedance of pedestrian networks is dependent on route qualities (i.e. the role of environmental attributes). This approach was selected because Chapter 5 (Section 5.6.3) identified a need to study pedestrian route choice behaviour using the characteristics of particular routes, rather than general area characteristics. Without knowledge about route qualities and route choices it would be difficult, if not impossible, to draw conclusions on the strength of different environmental attributes. Alternative methodologies, such as simply asking people whether and if so how often they walk to certain destinations, would risk being flawed by external factors such as the availability of free car parking and differences in destination attractiveness etcetera (see e.g. Ecotec 1993, Section 5.6.3).

The belief underlying the chosen approach is that, if pedestrians were prepared to take a detour to avoid a particular feature in the street environment this may be taken as evidence of a barrier to accessibility, increasing travel costs and pushing some destinations beyond reach by walking. A significant number of pedestrians rejecting their shortest route because they found it sub-standard may be interpreted as evidence that accessibility is poorer than suggested by a shortest path algorithm. In addition, if a relationship between environmental attributes and detours could be established then this correlation could, hopefully, be used to establish a sound algorithm to calculate a more correct level of accessibility.

9.2. Methodology

9.2.1. Survey design

The design of the survey was supported by a number of activities including a pedestrian route choice workshop, consideration of alternative survey techniques, a pilot survey and the selection of an appropriate survey area.

9.2.2.1. Route choice workshop

A workshop with 10 research students at the University of Leeds was used to inform the process of deciding the survey contents. Participants' discussed their own pedestrian route choice reasoning. In particular, route choice strategies during daytime and when dark were discussed. The participants seemed to agree that they and pedestrians in general, were more likely to take a detour when dark than during daytime, but that the frequency of detours varied between different types of areas. Night time detours were often seen to be a result of inadequate street lighting or other features of the street environment. Detours during daytime were often seen as voluntary, for example a route via a park. Subsequently it was decided that the survey should collect route choice data for trips to specified locations during daytime and when dark, preferably in an area with reasonable choice of different types of routes (e.g. along main streets, away from main streets).

9.2.2.2. Consideration of alternative survey techniques

Interviews, self-completion questionnaires and tracking of pedestrians were considered as possible data collection methodologies. However, the idea of tracking pedestrians was abandoned early on because tracking would possibly mean that time would be wasted following people walking to their car or making shorter walking trips rather than longer trips most relevant to Accessibility Planning. Stopping pedestrians' en-route was not considered feasible as it would severely limit the information that could be asked for. It was also anticipated that many people would be hesitant if approached when dark. Hence, the pilot study used three data collection techniques; mail drop (questionnaire), personal handout (questionnaire) and interviews. For each collection method the time consumption for data collection, data quality and response rates were analysed.

9.2.2.3. Preliminary design of questionnaire

Findings from Chapter 5 and the workshop were used to inform the design of a preliminary questionnaire. In addition, four colleagues gave feedback on different versions of the survey. The preliminary design included two main sections. The first part of the questionnaire asked how often respondents walked in their local area. This section of the survey also investigated whether respondents, for any reason to do with the street environment, avoided walking to a particular destination as well as what local improvements, if any, they thought would make them walk more. The second part of the

questionnaire included the route choice element of the survey. It started with asking respondents how often they walked to a well-known pre-selected destination (see Section 9.2.2.6). This part of the questionnaire included two maps (one for walking during daytime and one for walking when dark) on which respondents were asked to draw the route that they walked to the pre-selected destination. In addition, respondents were asked which reasons that they thought were important for choosing the route that they had marked on each map.

It was recognised that map readability would affect the reliability of the results (Bovy & Stern 1990, p.168). Great attention was therefore paid to the maps used in the survey. Initially commercially produced maps, such as the A to Z, were considered but these were not feasible because they left out too many details, back roads and footpaths in dense urban areas. Instead, purpose-made maps were designed using Ordnance Survey Landline map data and CorelDRAW software to add shop names, other easily identifiable features and remove unnecessary clutter.

9.2.2.4. Pilot study

A pilot study was used to estimate likely response rates and decide upon the most appropriate data collection method. The pilot questionnaires were distributed during July 2005 in an area adjoining Woodhouse Moor in Leeds (postcodes LS2, LS3 and LS6). 130 questionnaires were delivered to households. In addition, a total of 108 houses, not included in the postal survey, were visited over the course of three consecutive weekday evenings. The visits were carried out between 5-7 pm. In order to find out more about the willingness of local people to participate in an interview such a question was included in the questionnaire. Only at 40 out of 108 flats/ houses visited was anyone at home. The residents answering their door were given a short outline of the survey and asked if they were willing to participate. Almost all the residents took up on the offer. People not willing to respond were not given a questionnaire. A prepaid envelope was included for safe return of the survey. Furthermore, three interviews were carried out to test the interpretation of the questionnaire. Each interview took between 12 - 25 minutes to perform depending on the level of details provided by respondents (excluding time taken for arranging each interview). The pilot surveys, especially the interviews, provided evidence that respondents' general comprehension of the survey was good. Interviews provided somewhat better data quality regarding the exact

location where respondents preferred to cross a street and on which pavement they walked. However, both interviews and questionnaires were considered to provide adequate route data. Personal handouts received a response rate of 36%. The response rate for postal questionnaires was 18%. From this it was estimated that each response took around 2-3 times longer to obtain via interview than via surveys handed out (including time for interview recruitment).

A high response rate would not only improve the quality of the results it would also reduce other survey costs (if needed, a smaller survey area would equate to less street environments to inspect). The pilot indicated that less than 10% of local residents could be expected to participate in an interview survey. Two to three times as many were quite happy to complete and return a short questionnaire. Interviews would therefore significantly reduce the number of responses that realistically could be obtained from a limited area. Consequently, considering the above and the limited resources available for the study, it was concluded that a self-completion questionnaire was the most efficient approach, and wherever possible, delivered personally at each respondent's home address. If no one answered the door, the questionnaire was to be posted through the letter-box.

9.2.2.5. Final questionnaire design

The final questionnaire included 4 open-ended and 17 multiple choice questions (including sub-questions) and was divided into two main sections as previously outlined in Section 9.2.2.3. It included questions on how often respondents walked to a pre-selected destination, the routes that they used when doing so as well as the reasons behind using these routes. In addition, it collected data on respondents' preferences for improvements that they thought would make them walk more often. See Appendix 5 for a copy of the questionnaire.

The final questionnaire was shortened somewhat compared to the preliminary version and an example was added in the questionnaire illustrating how to mark a route with full details (to increase the number of respondents that provided full details of their route). To maximise respondents' ease of reading the survey maps two different questionnaire versions were used, one with a map for the south part of the survey area and one for the area to the north. In order to reduce bias the key purpose of the survey was masked; the

reason for the study was outlined as an investigation of ‘how street management can best be improved’. A £25 prize draw was added to maximise the response rate. Each questionnaire was addressed to ‘The Occupier’ at a specified house number, street name and postcode (obtained from Royal Mail).

9.2.2.6. Selection of survey area

The selected study area covers parts of Burley and Headingley wards in Leeds as shown in Figure 9.1. The trip data collected concerns local residents’ trips to Somerfield, a medium sized food shop located in the Arndale Centre.

Figure 9.1. Map of study area and the location of the Arndale Centre



The Burley/ Headingley area and the Somerfield store were selected for a number of reasons. For a start, it was known that the study area as many areas in the UK and elsewhere, incorporates several different types of walking routes including routes along main roads and away from busy roads. It was also found that the Somerfield store is the only supermarket in an area where 37% of households do not have access to a car (ONS 2001). Hence, walking to the Somerfield store for food shopping is likely to be important to many local people. For example, it could be assumed that having an adequate walking route to the Arndale Centre would increase many young and elderly persons' independence and quality of life.

People living in the area have many reasons to make a journey to the selected destination, not just for food shopping. The Somerfield store is located in the Arndale Centre, a retail and office building with 10 or so shops, restaurants and other facilities. There is also a main bus stop located immediately outside the Somerfield store. From this stop there are frequent direct services towards Leeds City Centre, the northern suburbs of Leeds and beyond. Local residents would therefore, in many cases, walk the routes studied also when going to work. Hence, it was assumed that the Somerfield store is one of the most well known places in the local area, a fact that obviously makes it easier for respondents to fill in the questionnaire.

Another, but perhaps somewhat less important, fact about the study area is that it is fairly flat. The exception is one gentle hill stretching over the north part of the area (taking in Foxcroft Mount, Bathcliffe Mount, St Anne's Road and parts of Headingley Mount). The top of the hill lies around 15m higher than the flat areas to the south (the south and western areas lying somewhat lower than the Arndale Centre). The shortest route from the northwest corner of the study area to the Arndale Centre rises about 20m over the hill and then down again. Relatively flat routes make it easier to study the importance of factors that planners can actually do something about because pedestrian behaviour will not be masked by the influence of long steep gradients.

Crime levels in the area are similar to the average for West Yorkshire when it comes to 'serious violent crime', lower than average for 'violent crime', 'youth nuisance' and 'anti-social behaviour' but significantly higher than the average for burglaries (West Yorkshire Police 2007).

9.2.3. Model of study network

A model of the study network was created using ArcInfo and MapInfo software. Map data was obtained from EDINA (University of Edinburgh 2006). The network included a total of 774 road links and covered an area of approximately two squared kilometres. The model represented streets and footpaths by a series of links running along the street or footpath centreline. This type of network was found to be suited to analysing principal route choices, after comparing it to a more detailed model where a street with pavements on both sides were modelled as two parallel links. The chosen network representation was similar to the Ordnance Survey's OSCAR transport network model currently used by local authorities for Accessibility Planning. Additionally, one of the main reasons for using this type of network was that many survey responses did not fully specify on which side of the street they normally walked (perhaps because they used either pavement depending on traffic or weather conditions, e.g. the sunny side on a chilly day).

9.2.4. Environmental attributes

Environmental attributes were assigned to links in the network as shown in Table 9.1. The attributes were chosen on the basis of their cost and likely importance for pedestrian behaviour (propensity, route choice).

The assessment of each attribute (the trade-off between cost and relevance) is summarised in Appendix 6 and was based on the findings in Chapter 5, a review of publicly available data sources and private communications with members of staff at Leeds City Council. The limited resources available for the study meant that the total number of environmental attributes had to be restricted. However, the attributes included in the model still meant that each link was represented by one of more than 360 alternative data combinations (six attributes with 2-6 levels). It is not thought likely that a local authority would be able to use more attributes than this if setting up a large scale database.

Table 9.1. Environmental attributes included in the network model

| Environmental attribute | No. of levels | Data Source | Data description | Comment |
|------------------------------|---------------|--------------------|--|--|
| Link length | Continuous | Ordnance Survey | Landline Map data | Network created with ArcView Network Analyst. Calculations using ArcMap software |
| Distance to closest building | 6 | Ordnance Survey | Landline Map data | Calculations using ArcMap software |
| Change in elevation | Continuous | Ordnance Survey | Digital Terrain Model, Landline Map data | Landline data for heights at route origins and destination points. Where Landline data missing OS Digital Terrain Model was used |
| Average gradient | Continuous | Ordnance Survey | Digital Terrain Model, Landline Map data | Heights at route origins and destination points divided with shortest path |
| Vehicle flows | 5 | Leeds City Council | Traffic surveys | Visual inspections of part of network to establish flows on residential streets |
| Street lighting | 3 | Leeds City Council | Lighting Reality software (Leeds City Council) | Levels based on average horizontal illuminance in lux. Visual inspections of part of network to ensure consistency |
| Pavement surface | 2 | Site survey | Visual inspection of network | Sealed or unsealed |
| Short sightline <5m | 2 | Site survey | Visual inspection of network | Minimum sightline along link direction at any point |

9.2.5. Network analysis

The network model/ representation was used to analyse walking propensity and route choice behaviour. The analysis was completed in four main steps.

First, each respondent's route was represented in the network as a series of midline links and this was compared with a digitised representation of the exact routes respondents actually walked (as drawn on the maps). This approach made it possible to assess the differences between the exact alignment and the midline network. The differences in route length were found to be small (often less than 5m, in a few cases up to 30m for a walking trip of 1000m).

Secondly, each respondent's normal route was compared with the shortest distance route available to them. Each respondent started their trip at home so the route was unique for each individual. The shortest path available to the respondent was calculated

using ArcView Network Analyst Software. From this data the extent to which pedestrians took the shortest distance route available to them was assessed. In addition, the characteristics (gender, age etc.) of those taking detours were investigated.

Thirdly, the network model was used to establish which respondents benefited from having high quality routes. Data on environmental attributes for each street link, i.e. section of road or path, was used for the analysis (see Table 9.1). Before the attributes were entered into the database a brief visual examination of a sample of responses was carried out (this was to briefly assess which types of environments that pedestrians seemed to avoid or be attracted to). The outcome of the examination was broadly in line with the evidence provided in the literature (see Chapter 5), perhaps with somewhat extra weight on features related to personal security. The selected route attributes were added to the network model in the anticipated order (see Table 9.1 and Appendix 6). Then the walking propensity of those having high-quality routes (for example, routes that were well lit all the way to Somerfield) was compared with those that did not.

For the fourth step of the analysis, 52 so called 'restricted networks' were created. Each restricted network omitted all links with one or more specified characteristics. For example, one network omitted all unlit streets and paths. Another network removed all segregated footpaths more than 25m away from buildings and so on. A shortest path algorithm was employed to establish the most direct route between the respondents' origins and destinations. The shortest paths in the restricted networks were then compared with the respondents' normal routes (the idea being that, if route choices were better represented in the restricted network than in the full network, it would be reasonable to conclude that the characteristic which defined the omitted links was a cause of diversions and thus could be considered a barrier to access). The procedure was repeated for all of the 52 restricted networks. This step of the analysis investigated the possible role that environmental attributes played as barriers for walking. It was thought that if adding environmental attributes to a network model could explain detours, then these attributes could be added into a new accessibility algorithm, thus improving our capability to measure pedestrian accessibility.

9.3. Key findings

This section outlines key findings from the questionnaire survey.

9.3.1. Sample

A total of 905 questionnaires were distributed during three weeks in September and October 2005. Of these, 631 were handed out personally at the potential respondent's door. The remainder were posted through the letter-box (or sent by post if the mail-box was inaccessible). Responses were received from 221 individuals (24% of sample). 213 of these provided full details of their preferred walking route *during daytime*. Full route descriptions *when dark* were provided by 192 respondents, thus providing a total of 405 route choices. The lower number of night-time routes was a result of some respondents saying that they *do not go out at all when dark* or *do not walk to a particular destination when dark*. All respondents lived between 700m and 1500 metres from their nearest supermarket, i.e. Somerfield at Arndale Centre (as shown in Figure 9.1).

9.3.2. Response bias

The sample was compared with the demographic characteristics for the 11 Census output areas where questionnaires were distributed. As shown in Table 9.2, women and in particular those aged over 25 years were overrepresented in the sample. It was unclear why the survey failed to get a representative number of responses from younger people. However, one reason for this may be that many students in the area live in shared houses with 5 or more residents but only received one questionnaire per house.

Table 9.2. Respondents' characteristics compared with local Census data (ONS 2001)

| Characteristics | Local area | Sample |
|-----------------|------------|--------|
| 16-24 years | 51.3% | 30.7% |
| 25-65 years | 36.0% | 52.4% |
| > 65 years | 12.8% | 17.0% |
| Women | 51.5% | 64.8% |
| Car ownership | 63.1% | 66.5% |

The overrepresentation of women in the sample was mainly seen as beneficial. Each respondent provided route choices for two trips only. Women in general walk more often than men (DfT 2006c, pp.18-19). Thus, it was favourable that the number of female respondents was higher than their proportion of the population.

It was generally believed by long-term residents in the area that the proportion of young persons, especially students, had increased since 2001. Nearly half of all respondents had lived in the survey area for more than 10 years. The sample therefore seemed to be biased towards long-term residents rather than the more semi-permanent and younger student population (see also Table 9.2). Previous research, although relatively limited in this respect, does not indicate that younger pedestrians take different routes from other groups (Chapter 5, Section 5.5). Hence this was not believed to be an issue. However, it may be noted that young persons have a tendency to value good quality street lighting higher than other groups (see Chapter 5, Section 5.6.1).

As noted in Section 9.3.1, the sample only includes longer walking trips (above 700m). The fact that almost all respondents (97.5%) walked to the Arndale Centre at least once a month supports that the respondents, despite the relatively long route distances investigated, were sufficiently familiar to the surveyed destination. There is nothing in the literature review to suggest that pedestrians' behaviour differ on shorter routes than those in the sample (see Chapter 5, Section 5.5).

The sample includes few journeys in an unfamiliar environment. This is a fully appropriate approach because Accessibility Planning is about local people accessing local services.

The weather and temperature during the survey period was typical for the season with both sunny days and those with showers.

9.3.3. Walking to Arndale Centre

As mentioned in the previous section, almost all respondents (97.5%) indicated that they walk at least once a month to the Arndale Centre from their home. As shown in Table 9.3, 175 respondents (79%) walked from their home to/ from the Arndale Centre at least once a week. The majority (58%) walked at least twice per week. Generally women

walked more often than men. A handful of younger respondents indicated that they walk to the destination during evenings only. Most of those never going on foot to the destination experienced difficulties walking, for example health issues.

Around 11% of respondents (of both sexes and all ages) indicated that they had not walked to the Arndale Centre when dark. Some of these respondents indicated that they do not go out at all when dark. Others specifically said that they do not walk to the Arndale Centre when dark. It was more common for a person over 65 years *not* to walk to the particular destination when dark, compared to a young person (16-24 years).

Table 9.3. Characteristics for respondents walking to the Arndale Centre³

| Group | No. of respondents | 16-24 years | Over 65 years | Women | Walking difficulties |
|--|--------------------|-------------|---------------|-------|----------------------|
| All respondents | 221 (100%) | 31% | 17% | 65% | 16% |
| Those walking five times a week or more to destination | 32 (100%) | 48% | 13% | 81% | 16% |
| Those walking twice a week or more to destination | 119 (100%) | 37% | 18% | 67% | 16% |
| Those walking once a week or more to destination | 175 (100%) | 35% | 17% | 64% | 15% |
| Those that have <i>not</i> walked to destination <i>during daytime</i> | 9 (100%) | 57% | 29% | 71% | 86% |
| Those that have <i>not</i> walked to destination <i>when dark</i> | 23 (100%) | 14% | 36% | 77% | 74% |

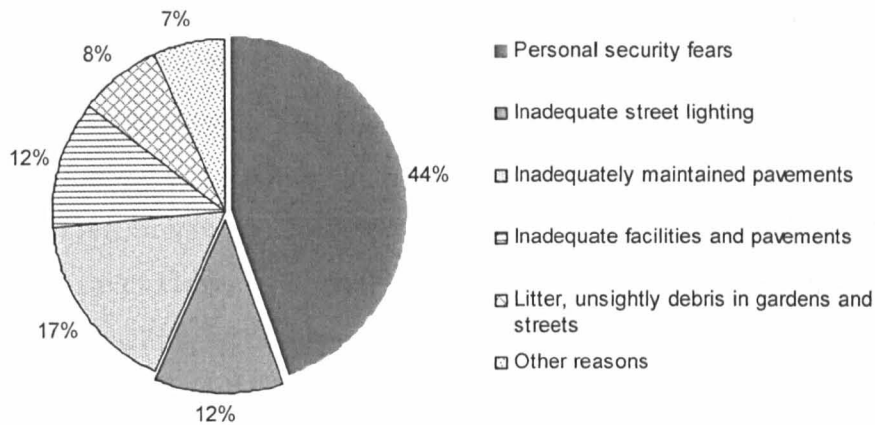
9.3.4. Reasons for not walking to a particular place

An open-ended question investigated specific reasons for not walking to a particular destination (identified by the respondents themselves). 63 respondents (29%) indicated that they avoided walking to a “particular local shop, service, bus stop or other place” for reasons to do with the street environment or personal security. This was most common amongst women and those having walking difficulties. As shown in Figure 9.2, the most frequent reason for not walking was personal security fears (44%), inadequate pavement maintenance (17%) and poor street lighting (12%). The majority

³ Rows 2-5 refer to question 6 in the questionnaire, the last two rows to Questions 7 and 10 (see Appendix 5). Hence the total number of respondents in the table does not add up.

of those indicating that poor street lighting was an issue said that this contributed to personal security fears.

Figure 9.2. Respondents' reasons for avoid walking to a particular local shop, service or bus stop (n 63, open-ended question, multiple answers possible)



Personal security responses included the risk of being the victim of assault, exposure to anti-social behaviour, drunken people, gangs of youth, homeless people and avoiding secluded areas because the respondent felt unsafe there. Respondents' concern regarding street lighting included the fact that lights were not bright enough, lack of lights in places (e.g. in bus shelter, dark spots) and that bulbs were not replaced quickly enough when broken. Concerns regarding the state of pavements could be summed up by: fear of falling over due to broken or slippery surfaces, encroaching vegetation and lack of dropped kerbs. The inadequate facilities and pavements category referred to a lack of crossing points, sub-standard crossings, speeding traffic, heavy traffic, too narrow pavements, cars and wheelie bins blocking pavements, car drivers not being considerate enough to pedestrians, lack of places to sit at bus stops and sections of unsealed/ muddy roads. Other reasons put forward by respondents were an unspecified dislike for a place or the fact that it was too crowded. Where no reason was given this was accounted for in the 'other reasons' category.

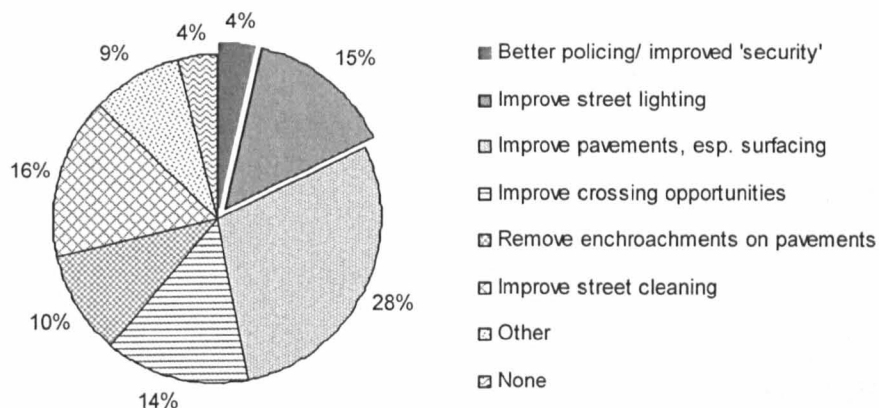
The few responses from those with walking difficulties seemed to indicate that their reasons for not walking were similar to the sample as a whole. However, more people in this group indicated that inadequate pavement maintenance and inadequate facilities in general were reasons for not walking to particular places. Those with walking

difficulties represented 23% and 33% of respondents stating these reasons respectively, but only 16% of the whole sample.

9.3.5. Improvements to make more journeys possible

The respondents were asked to provide the most important improvement in order to *make more local journeys on foot possible* for him/ her. As shown in Figure 9.3, the most important improvement perceived by the respondents was improved pavement maintenance. The most mentioned issues within this category were broken paving slabs, potholes and uneven pavements making it difficult or dangerous to walk especially if using a walking frame or pushing a pram. Improved street lighting, crossing opportunities, street cleaning as well as removal of vegetation and wheelie bins and parked cars encroaching on pavements all received a relatively high level of attention.

Figure 9.3. Improvements that would make more local journeys on foot possible (n 182, open-ended question, multiple answers possible)



Street cleaning improvements, including the removal of debris and litter in gardens, were the second most frequently mentioned measure. This issue was suggested by 16% of respondents. Litter and grease on pavements near take away outlets were mentioned as particular problems. 15% of respondents indicated that improved street lighting was as an important measure to make more journeys possible. Improved crossing opportunities were mentioned by 14% of respondents. This category included requests for new crossing facilities, reduced delays at crossing points, traffic calming measures, car access management and parking regulation. Removal of encroachments on

pavements such as parked cars, wheelie bins and vegetation was called for by 10% of respondents.

Only 4% of respondents thought better policing was the most important measure to make more journeys on foot possible for them. This category also included respondents that suggested unspecified 'security improvements'. A number of other measures were suggested: installation of CCTV, pedestrianisation of streets, that a location should be 'improved', fine cyclists on pavements, provide cyclists with better facilities to avoid them using pavements, re-design secluded areas, fine dog owners, neater gardens, better signage and closing down pubs that generated on-street disorder. 4% of respondents indicated that there were no improvements that would make more journeys on foot possible for them. The implications of the findings above are discussed in Section 9.7.

9.4. Modelling results: walking propensity

This section presents the results from the network analysis. It aims to identify factors explaining walking propensity.

9.4.1. The role of distance

The number of walking trips respondents made to Somerfield supermarket in the Arndale Centre was fairly well correlated with the distance to their home. As shown in Table 9.4, 72% of those living less than 900m from Somerfield walked there at least twice a week. This was true for just over half (59%) of those living up to 1,500m from the Arndale Centre. The influence of distance seemed to tail off for routes longer than 1,300m. Interestingly, the deterrent effect of distance is more apparent for women than for men (although females in the sample walk more often).

Table 9.4. Propensity to walk and distance (day or night)

| Criterion | No. of people | Average length of shortest route | Proportion who walk at least twice a week to the Arndale Centre | | |
|--------------------------|---------------|----------------------------------|---|-----|-------|
| | | | All | Men | Women |
| If shortest route < 900m | 25 | 839m | 72% | 62% | 76% |
| < 1,000m | 63 | 909m | 67% | 64% | 68% |
| < 1,100m | 85 | 941m | 64% | 61% | 65% |
| < 1,200m | 110 | 990m | 61% | 58% | 62% |
| < 1,300m | 153 | 1,063m | 59% | 54% | 61% |
| < 1,400m | 192 | 1,119m | 59% | 55% | 61% |
| < 1,500m | 199 | 1,130m | 59% | 56% | 60% |

9.4.2. The role of differences in elevation

The difference in elevation between origin and destination was determined for each respondent. The sample was then divided into groups according to the magnitude of difference and the number of trips each group made to the Arndale Centre was compared, as shown in Tables 9.5 and 9.6. It should be noted that the change in elevation was based on end-to-end altitude differences. A main reason that this methodology was used was data limitations (difference in elevation for each link was

unknown). Despite its potential limitations this methodology was considered worthwhile as most of the study area is fairly flat. Only six respondents experienced end-to-end differences in elevation of more than 10m (all these respondents living in the northwest corner of the study area).

Table 9.5. Walking propensity and change in elevation (day or night) ⁴

| Criterion | No. of people | Average length of shortest route | Proportion who walk at least twice a week to the Arndale Centre | | |
|--------------------------------|---------------|----------------------------------|---|-----|-------|
| | | | All | Men | Women |
| If change in elevation is < 5m | 101 | 1,048m | 62% | 61% | 63% |
| 5-10m | 92 | 1,223m | 52% | 54% | 58% |

Table 9.6. Walking propensity and average gradient (day or night)

| Criterion | No. of people | Average length of shortest route | Proportion who walk at least twice a week to the Arndale Centre | | |
|-----------------------------|---------------|----------------------------------|---|-----|-------|
| | | | All | Men | Women |
| Average gradient < 0.3% | 58 | 997 | 57% | 53% | 58% |
| Average gradient 0.3 - 0.5% | 92 | 1189 | 59% | 57% | 60% |
| Average gradient 0.5 - 1.2% | 71 | 1120 | 45% | 39% | 50% |

Table 9.5 above indicates that a link exists between walking propensity and change in elevation but this may be correlated with distance. Table 9.6 seeks to overcome this by showing the effect of average gradient. It seems that higher average gradients have some negative effect on walking propensity. However, the influence of differences in elevation and average gradients seem to be relatively small, which perhaps could be expected because most of the study area is relatively flat, that gradients are relatively moderate and the fact that differences in end-to-end altitudes do not capture the height differences for the northwest corner. For example, nine respondents of Queenswood Road in the northwest corner of the study area taking the direct route would need to climb about 20m and then descend around 15m to the Arndale Centre.

⁴ The numbers of respondents in Tables 9.5 and 9.6 differ slightly because changes in end-to-end elevations (Table 9.5) were calculated only for those respondents providing full routes (n 199). For Table 9.6 also respondents including partial information on their routes were included.

9.4.3. The role of continuous high quality routes

Table 9.7 illustrates the walking propensity for those with high quality routes. A high quality route is defined as when a respondent had available a *continuous* route meeting or exceeding a specified standard from their origin (home) to the Arndale Centre. For example, well lit routes are defined as ones with an average horizontal illuminance greater than 10 lux.

Table 9.7. Walking propensity for those with high quality routes (day or night)

| Route quality criterion | No. of people that meet criterion | Average length of shortest route | Average length of shortest route fulfilling route quality criterion | Proportion of people who walk at least twice a week to the Arndale Centre | | |
|--|-----------------------------------|----------------------------------|---|---|-----|-------|
| | | | | All | Men | Women |
| Any link | 199 | 1,130m | 1,130m | 59% | 56% | 60% |
| Route which is well lit (> 10 lux) | 20 | 1,012m | 1,038m | 70% | 71% | 64% |
| A route that avoids being >15m from buildings | 48 | 928m | 973m | 69% | 62% | 71% |
| A route that avoids being >20m from buildings | 72 | 924m | 1,019m | 69% | 67% | 71% |
| A route that avoids being >25m from buildings | 154 | 1,117m | 1,126m | 59% | 54% | 62% |
| A route that avoids using links with <500 veh./day | 64 | 1,099m | 1,109m | 60% | 53% | 64% |
| A route that avoids using links with <3,000 veh./day | 17 | 994m | 1,018m | 71% | 71% | 70% |

Table 9.7, taken with Table 9.4 allows a comparison of the trip frequencies for those with a high quality route with those for the whole sample. The results indicated that having a route with good street lighting seems to increase walking propensity. Table 9.7 shows that 70% of those with a well lit route walk to the Arndale Centre at least twice a week, while Table 9.4 suggests an equivalent figure of around 60% for respondents with a similar average shortest route to the Arndale Centre. Those with a route with *more* than 3,000 vehicles per day walk more frequently than the distance from their home to the destination would imply, 71% walk twice weekly compared to 61% (Tables 9.4 & 9.7).

The analyses above show some interesting results. However, as shown in Table 9.8, there are considerable overlaps between different link qualities and it is therefore

difficult to assess the robustness of the results. For example, 85% of those having a continuous well lit route to the Armdale Centre also have a route with more than 3,000 vehicles per day (first row in Table 9.8. last column to the right).

Table 9.8. Proportion of respondents whose routes qualify as high-quality on two or more criteria

| Group | n | Proportion of respondents in each group whose routes are also | | | | | |
|---|-----|---|---------------------|---------------------|---------------------|--------------------------|----------------------------|
| | | well lit (> 10 lux) | <15m from buildings | <20m from buildings | <25m from buildings | links with >500 veh./day | links with >3,000 veh./day |
| Those with a route which is well lit (> 10 lux) | 20 | - | 20% | 55% | 55% | 85% | 85% |
| Those with a route that avoids being >15m from buildings | 48 | 8% | - | 100% | 100% | 38% | 6% |
| Those with a route that avoids being >20m from buildings | 72 | 15% | 67% | - | 100% | 35% | 14% |
| Those with a route that avoids being >25m from buildings | 154 | 7% | 31% | 47% | - | 32% | 6% |
| Those with a route that avoids using links with <500 veh./day | 64 | 27% | 28% | 39% | 78% | - | 27% |
| Those with a route that avoids using links with <3,000 veh./day | 17 | 100% | 18% | 59% | 59% | 100% | - |

It should be noted that the role of routes with *low* quality street lighting or those that avoided paths segregated from roads (e.g. through a park) could not be assessed in detail using the methodology described because, since all respondents experienced these issues at some point, they could not be separated. The same applies to the need to use and cross heavily trafficked roads. In addition, there might be other unknown factors correlated with certain types of neighbourhoods, e.g. that those living on a main road may have limited parking availability and therefore walk more often on short trips (to avoid the risk of being without a parking space when returning home).

The abovementioned problems (significant overlaps between different route qualities and potential co-variance with, from a pedestrian perspective, unknown external factors)

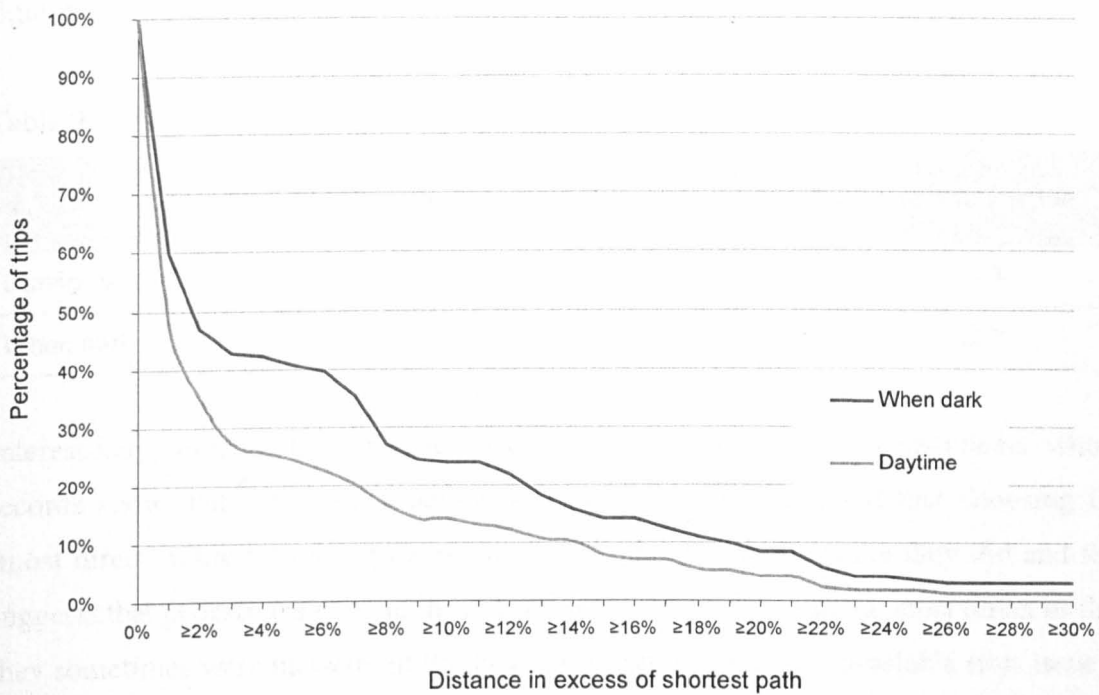
were expected (see Chapter 5, Sections 5.2.3-5.2.4) and the issue was a key reason for also collecting data on the routes that pedestrians actually took.

9.5. Modelling results: pedestrian route choice

9.5.1 Route choice during daytime and when dark

As shown in Figure 9.4, many pedestrians' normal route was *not* the shortest route available. Figure 9.4 also shows that the routes the respondents preferred to take to the Arndale Centre when dark were significantly longer than their daytime routes to the same destination. For example, in daylight, 20% took a route that was at least 7% longer than the shortest available while at night, 20% took a route that was at least 12% longer than the shortest available.

Figure 9.4. Proportion of trips where route distance is greater than shortest path



The graphs in Figure 9.4 bend sharply at about 1.5% excess distance. Around half of respondents choose routes below the 1.5% point and the other half choose routes longer than this (note the slight differences between daytime trips and trips when dark). The sharp bend may indicate that around 1.5% excess distance was a noticeable difference for most people. In other words, it could perhaps be believed that very few people

would be able to tell the difference between a route that is 1,015m and another route to the same destination that is 1,000m.

9.5.2. Proportion not choosing to take the shortest route

When calculating the number of pedestrians not taking the shortest route the level of detour that represents a noticeable difference needs to be decided. This was done in a relatively pragmatic way by dividing the sample into two groups. So, for further analysis, 5% excess distance was chosen to represent a criterion for taking/ not taking the shortest route. This figure was believed to correspond with what most people would be able to identify as a noticeable difference in route length. This meant in turn that the noticeable difference was set to be 35 - 50m in excess distance when walking two alternative routes of around 700 - 1,000m (the typical walking distances in the sample). As shown in Table 9.9, when dark just under half (42%) of pedestrians deviated more than 5% from the shortest route and a quarter (25%) deviated more than 10%. The same figures for daytime trips were 24% and 14% respectively.

Table 9.9. Respondents' detours during daytime and when dark

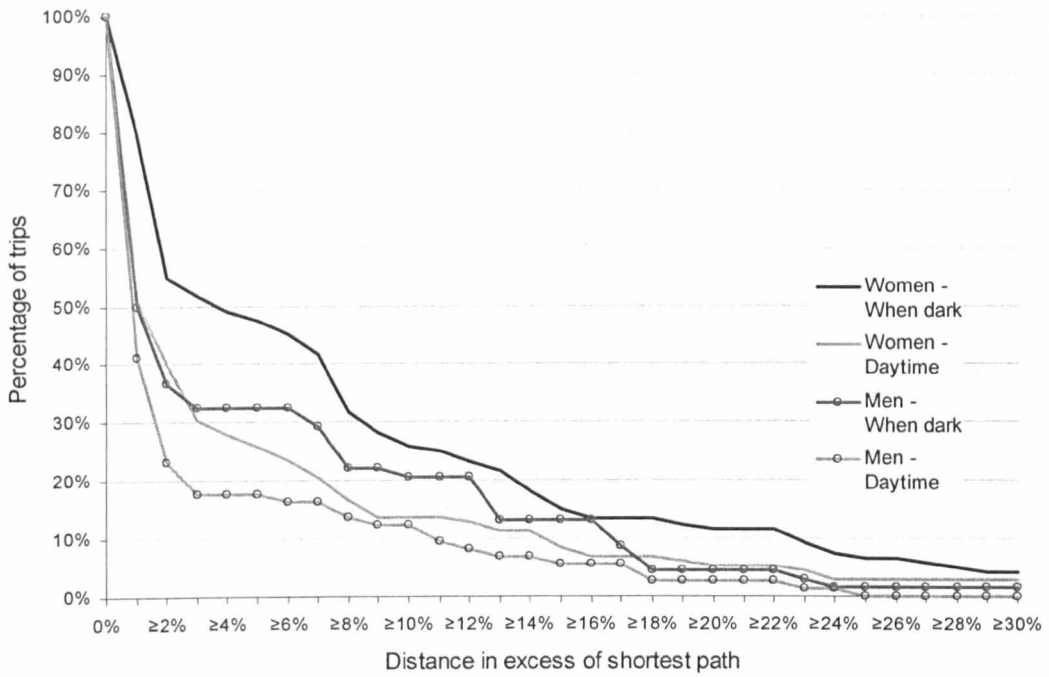
| Time of day | No. of respondents | Taking shortest route | Taking route >5% longer than shortest route | Taking route >10% longer than shortest route |
|----------------|--------------------|-----------------------|---|--|
| During daytime | 213 | 62% | 24% | 14% |
| When dark | 192 | 33% | 42% | 25% |

Interestingly, other data from the survey indicated that half of respondents whose records show that they took a detour of more than 10% indicated that choosing the 'most direct' route was a *very important* reason for taking the route they did and this suggests that pedestrians may not have been sure which route was the most direct or that they sometimes were unaware of the fact that a shorter route was available (this issue is further discussed in Section 9.5.7).

9.5.3. Route choice and gender

Figure 9.5 illustrates that both men and women take detours or avoid the shortest route but that women tend to take more detours than men. Both groups took detours more often when dark than during daytime. Detours made when dark were longer than those made during daytime.

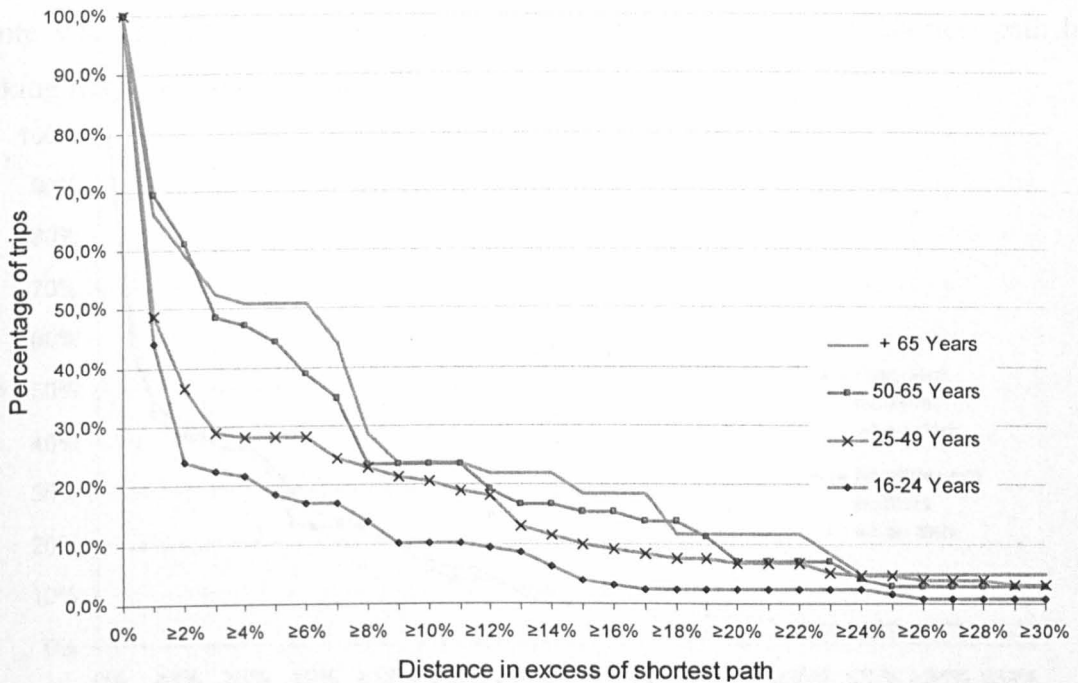
Figure 9.5. Proportion of trips for women and men where route distance is greater than shortest path



9.5.4. Route choice and age

As can be seen in Figure 9.6, older people were more likely to take detours than younger. The figure presents data on trips during day and when dark together.

Figure 9.6. Proportion of trips where route distance is greater than shortest path by age group



9.5.5. Route choice and walking frequency

As can be seen in Figures 9.7 and 9.8, non-frequent pedestrians (those walking less than two times a week to the Arndale Centre) were marginally more likely to take detours than those walking more frequently.

Figure 9.7. Proportion of trips where route distance is greater than shortest path by walking frequency to the Arndale Centre *during daytime*

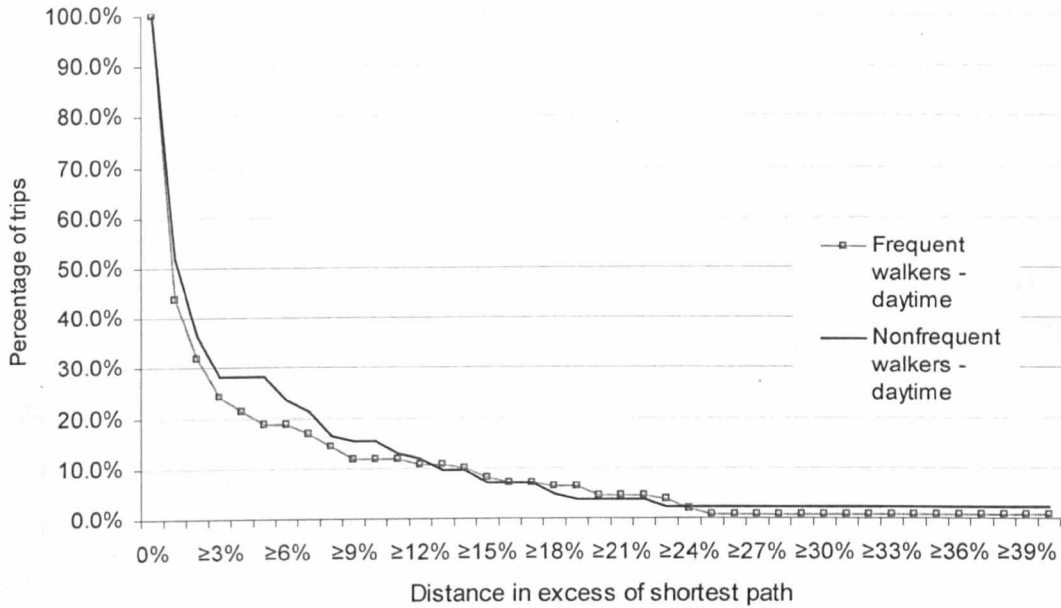
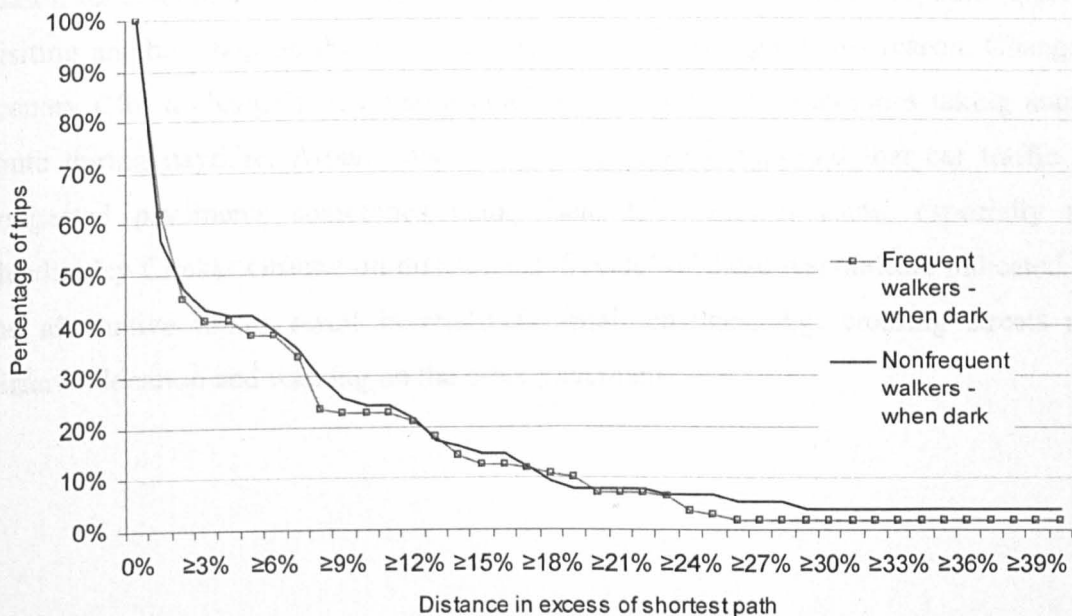


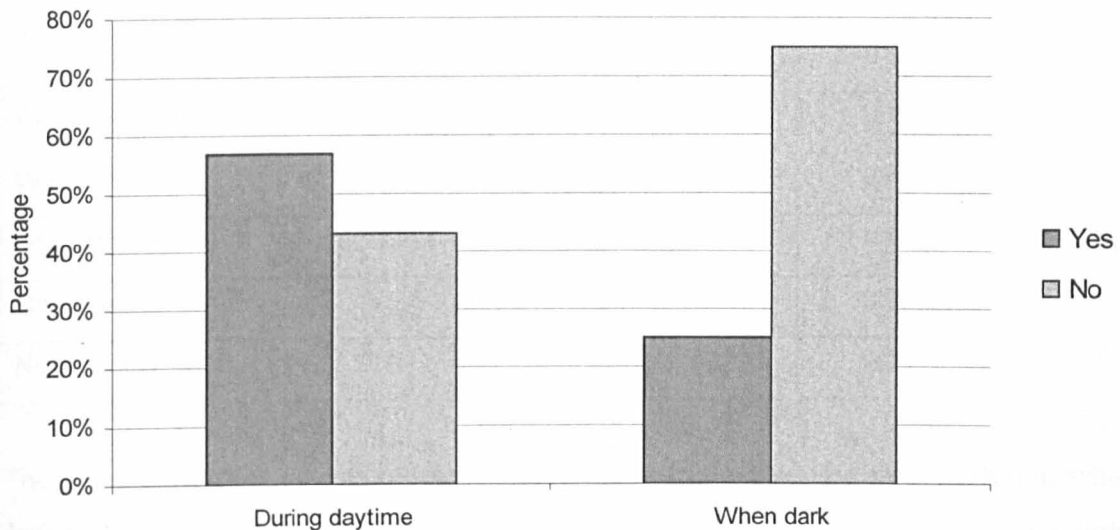
Figure 9.8. Proportion of trips where route distance is greater than shortest path by walking frequency to the Arndale Centre *when dark*



9.5.6. Reasons for taking an alternative route

As shown in Figure 9.9, the majority of respondents indicated that they sometimes, during daytime, use another route to the one they normally take. Only one in four respondents indicated the same for trips when dark despite the fact that many did not take the shortest route when dark (see Figure 9.4).

Figure 9.9. Proportion of respondents indicating that they sometimes take another route than their preferred one to the Arndale Centre



There were significant differences to the reasons given for sometimes taking another route during daytime and when dark. As shown in Table 9.10, trip chaining the main reason for sometimes taking a route other than that preferred during daytime (typically visiting another shop on the way). 52 respondents (43%) gave this reason. Change of scenery ('for a change') was also a noteworthy motive for sometimes taking another route during daytime. Around one in ten respondents indicated that car traffic and congested pavements sometimes made them take another route, especially near Headingley Cricket Ground on match days. Several of these respondents indicated that the alternative routes result in relatively small changes, e.g. crossing streets at a different location and walking on the other pavement.

Table 9.10. Proportion of respondents giving different reasons for sometimes taking another route (multiple answers possible)

| Reason | During daytime (n 122) | When dark (n 47) |
|--|----------------------------|---------------------|
| Trip chaining | 43% | 21% |
| Change of scenery/ 'for a change' | 25% | 6% |
| Peak traffic/ crossings (incl. cricket function traffic) | 11% | 2% |
| Walk alone / together | 7% | 40% |
| Takes other route when dark | 6% | 0% |
| Personal security (e.g. late at night) | 4% | 12% |
| Weather | 4% | 0% |
| Quieter route | 2% | 0% |
| Other reason | 4% | 11% |
| No particular reason | 12% | 15% |

The main reason for taking another route other than the one normally preferred when dark was accompaniment, i.e. differences in route choice behaviour when walking alone and when walking together with someone. 40% of the respondents sometimes taking another route when dark gave this answer. Interestingly, walking together with someone does not necessarily mean that the group takes a quicker route that, for example, is perceived less secure. In fact, a few respondents expressed that they sometimes take a longer way because their company feels unsafe walking a certain route.

9.5.7. Reasons for taking a longer route

Respondents were asked to indicate the most important reasons for choosing their preferred walking route. Tables 9.11 and 9.12 outline the proportion of respondents that indicated a reason was 'very important' during daytime and when dark respectively.

Table 9.11. Proportion of respondents stating 'very important' reasons for choosing their *daytime* walking routes

| Group | n | Proportion answering "very important" for choosing their particular <i>daytime</i> route | | | | | | |
|--------------------------|-----|--|-------------|------------------------------|-----------------|------------------------------|------------------------------------|--------------------|
| | | "Most direct" | "Quick-est" | "Safest in terms of traffic" | "Most pleasant" | "Safest in terms of assault" | "Enough other pedestrians visible" | "Route un-crowded" |
| All respondents | 213 | 59.1% | 56.3% | 34.6% | 16.3% | 34.7% | 27.2% | 11.4% |
| Women | 135 | 58.8% | 56.2% | 41.9% | 19.2% | 45.3% | 37.2% | 15.0% |
| Those taking detour >5% | 51 | 57.1% | 53.1% | 50.0% | 22.9% | 52.2% | 42.6% | 25.5% |
| Those taking detour >10% | 30 | 50.0% | 53.6% | 48.1% | 25.9% | 42.3% | 34.6% | 23.1% |

Directness and travel time were the strongest reasons influencing respondents' choice of route when walking to the Arndale Centre *during daytime*. Over half (59% and 56%) of all respondents indicated that these were very important reasons respectively. Those taking detours during daytime more often indicated that personal security, pleasantness, traffic safety and an 'uncrowded' route were very important reasons for route choices. Pleasantness was more important for those taking longer detours.

Half of those taking a detour of more than 10% maintained that directness was a very important reason for choosing their normal route. One would not expect those taking the longest detours to say that directness was very important and would thus rank other factors relatively higher. Some respondents may not be aware of shorter routes than those they use (typically along main streets). An alternative explanation could be that respondents saw directness as a relative concept. For example, *the longer route I took was the most direct for me, considering that I thought the shorter, poorly lit route was unsafe*. If distance were not seen as a relative concept, then the high proportion of respondents indicating that distance is important despite taking a detour remains difficult to explain.

Table 9.12. Proportion of respondents stating ‘very important’ reason for choosing their walking routes *when dark*

| Group | n | Proportion answering ‘very important’ for choosing their particular route <i>when dark</i> | | | | | | |
|--------------------------|-----|--|-------------|------------------------------|-----------------|------------------------------|------------------------------------|--------------------|
| | | “Most direct” | “Quick-est” | “Safest in terms of traffic” | “Most pleasant” | “Safest in terms of assault” | “Enough other pedestrians visible” | “Route un-crowded” |
| All respondents | 192 | 45.3% | 47.2% | 31.8% | 7.4% | 58.9% | 59.1% | 52.0% |
| Women | 120 | 44.7% | 45.6% | 37.7% | 8.0% | 75.7% | 75.0% | 69.0% |
| Those taking detour >5% | 81 | 36.8% | 35.1% | 33.3% | 8.2% | 72.0% | 72.0% | 66.2% |
| Those taking detour >10% | 48 | 24.4% | 25.0% | 17.8% | 4.5% | 63.0% | 66.7% | 56.8% |

Respondents indicated that safety in terms of assault and sufficient numbers of other pedestrians were very important reasons for their route choice when dark. These two reasons stood out with around 59% indicating they were very important, particularly for women. Three in four female respondents indicated that personal security and having enough other pedestrians visible were very important reasons for taking their normal route.

Some of the studies reviewed in Chapter 5 did not distinguish between route length and duration. In the Headingley study, only nine respondents (4%) indicated that choosing the quickest route was a *very important* reason for taking the route that they did during daytime while stating that choosing the most direct route was less important. All these nine respondents indicated that taking the most direct (here interpreted as the shortest route) was a *fairly important* reason for taking the route that they did. In addition, almost all respondents (85%) that stated that taking the *most direct* route was a *very important* reason for their route choice also indicated that taking the *quickest* route was equally important. Hence it was believed that the most direct (or shortest route) also was the quickest in most cases.

9.5.8. Route quality and route choice

This section summarises results from the ‘restricted route’ analysis (see Section 9.2.5). Table 9.13 presents the results for selected networks achieving high prediction rates. A

successful prediction was taken as being within 5% of the shortest route length (e.g. if a respondent's preferred route was 1049m and the shortest route available was 1000m the difference was seen as so small that most respondents would not be able to tell the difference in length if walking the two routes). The figure of 5% was derived from analysing the distribution of all preferred routes compared with shortest route (see Section 9.5.2). The analysis presents trips during daytime and when dark separately. All analyses were carried out for the full sample of trips as well as for subsets of the sample, e.g. those taking significant detours. Particular attention was paid to networks that could achieve a high prediction rate when dark. This was for a number of reasons, including that route choices when dark had not been studied before (see Chapter 5) and the fact that pedestrians seem more sensitive to negative route qualities when dark than during daytime (see Figure 9.4 and Tables 9.11-12) with some features affecting walking during night-time likely to constitute barriers to access (see e.g. DfT 1999).

The bottom row in Table 9.13 illustrates the results for the full, so called unrestricted, network. The unrestricted network would be consistent with an accessibility indicator based solely on distance. As shown in the table, the unrestricted network was able to correctly predict 74% of route choices during daytime (158 of 213 route choices). The prediction rate for the unrestricted network during daytime rose to 80% if we ignore respondents who did not also provide a night-time route. This may indicate that those that rarely walk when dark were more selective than the average respondent in terms of the routes that they found acceptable during daytime. Furthermore, the unrestricted network correctly predicted 58% of route choices *when dark* (111 of 192 route choices). This left 81 route choices unexplained when dark and a relatively smaller sum during daytime.

Table 9.13. Results for networks achieving high prediction rates

| Network model description | When dark | | | | | During daytime | |
|--|----------------------------|----------------------|---|--|----------------------|----------------------------|--|
| | All respondents (n 192) | | Those with routes >5% longer than shortest path (n 81) | | | All respondents (n 213) | Those providing day and when dark routes only* (n 187) |
| | Prediction rate | No route possible | Prediction rate | Use a route for which a link is omitted | No route possible | Prediction rate | Prediction rate |
| Segregated footpaths omitted where these are >30m from buildings | 73% | 0 | 40% | 5 | 0 | 79% | 80% |
| Links with <500 vehicles omitted where these are >30m from buildings | 73% | 0 | 40% | 5 | 0 | 79% | 80% |
| Segregated footpaths omitted where these are >25m from buildings | 73% | 0 | 40% | 6 | 0 | 79% | 80% |
| Links with sightlines <5m omitted, segregated footpaths omitted where these are > 30m from buildings | 72% | 0 | 44% | 5 | 0 | 77% | 76% |
| Segregated footpaths omitted where these are >15m from buildings | 70% | 0 | 41% | 9 | 0 | 75% | 75% |
| Segregated footpaths omitted | 67% | 11 | 36% | 12 | 9 | 72% | 71% |
| Unrestricted network (notional distance) | 58% | 0 | 0% | 0 | 0 | 74% | 80% |

* Excluding 21 respondents that did not provide a night-time route and 5 respondents that did not give a route during daytime.

The best prediction rate for a restricted network *when dark* was 73% (140 out of 192 route choices compared to 58% for the earlier mentioned unrestricted network that did not consider any route qualities). Three different networks achieved this score: one that omitted segregated footpaths where these were >30m away from buildings, one that omitted segregated footpaths *and* streets with less than 500 vehicles/ day where these were >30m away from buildings and one that that omitted segregated footpaths where these were >25m away from buildings (segregated footpaths were defined as footpaths away from carriageways). These three networks also improved the prediction rate for daytime trips to 79% (from 74% for the unrestricted network). As shown in Table 9.13, the networks with the highest prediction rate had only a handful of respondents that violated the rules upon which they were based, i.e. only a handful of respondents used a route for which one or more links were omitted. For other networks these violations significantly lowered the prediction rate. For example, 12 of those taking significant detours used short sections of segregated paths. In addition, the three networks achieved a similar prediction rate amongst those that took detours (40%). However, note that the network excluding short sightlines had a somewhat higher prediction rate (44%) amongst those that took detours. This may indicate that this factor is relevant, but only in certain contexts.

The different restricted networks varied not only in how well they could reflect route choice behaviour but also in how many respondents that were excluded from analysis. The best performing networks were considered to be those that had the highest overall prediction rate (i.e. not excluding those respondents with no route possible). This definition allowed for the fact that some networks created considerable 'island effects'. For example, omitting all segregated footpaths meant that 11 respondents in the sample had no possible route (third column, second row from the bottom in Table 9.13), i.e. an island effect arose. Note also the differences in prediction rates between the full daytime sample (n = 213, second column from the right) and a subset of the sample including those that provided routes during daytime *and* when dark only (n = 187, last column), i.e. in most cases the prediction rate increased slightly when those that rarely walked when dark were excluded from the sample.

The implications of the findings of this analysis are discussed in Section 9.7. Further details of the 52 networks that were tested are presented in Appendix 7.

9.6. Three illustrative examples of walking behaviour

This section provides illustrative examples of the behaviour reported on in Sections 9.3-9.5.

9.6.1. Selection of locations to be investigated

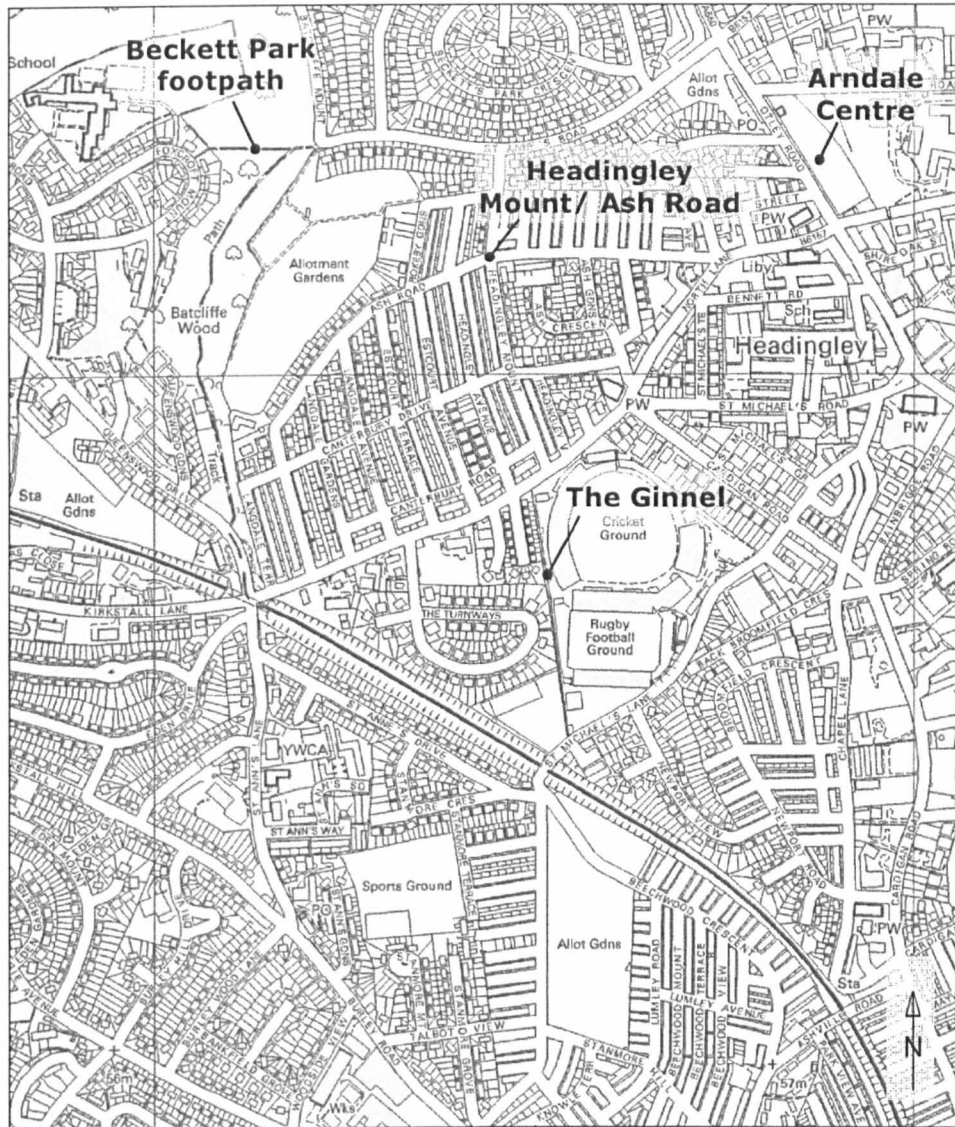
Three locations were more frequently mentioned by the respondents as ‘difficult’ or ‘best avoided’ than others and these were selected for more detailed investigation. Table 9.14 summarises the issues commented on by respondents for each location

Table 9.14. Accessibility issues at three specific locations

| Location | Issues mentioned by respondents |
|---|---|
| Beckett Park footpath | Personal security, through park near forest, dim lighting, no natural surveillance and short sightlines at places. |
| 'The Ginnel' footpath behind Headingley Stadium | Personal security, confined footpath surrounded by walls/ fences, graffiti, limited natural surveillance and complaints about lighting. |
| Headingley Mount/ Ash Road junction | Traffic safety and difficulties when crossing Headingley Mt at Ash Road junction. |

Crossing Headingley Mount at Ash Road junction was perceived as dangerous and difficult due to the high flow of vehicles and lack of crossing facilities. Respondents felt apprehensive walking through The Ginnel behind Headingley Stadium (the footpath/ alley way between St Michaels Lane and Kirkstall Lane). Personal security fears were also mentioned as a reason for avoiding the Beckett Park footpath.

Figure 9.10. Location of Beckett Park, the Ginnel and Headingly Mount



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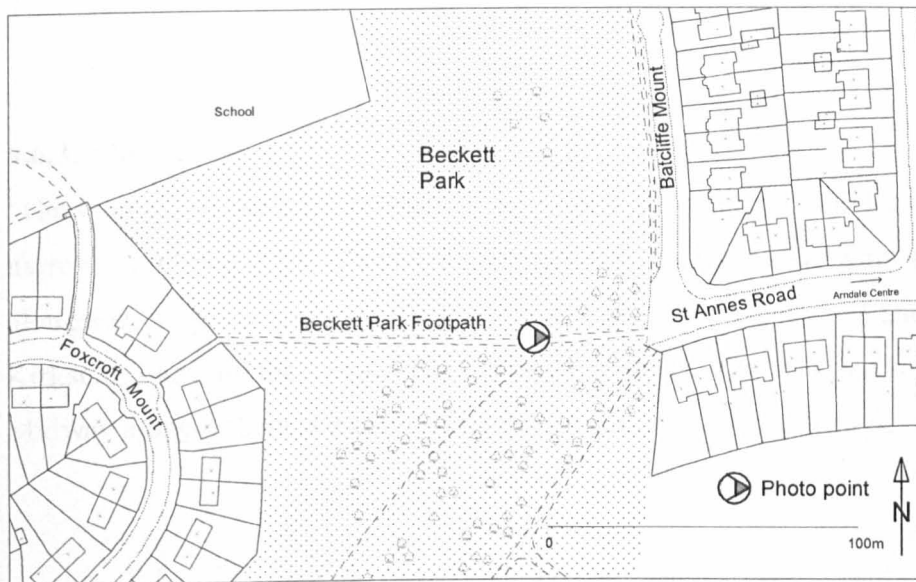
9.6.2. Beckett Park footpath

Beckett Park footpath stretches from Foxcroft Mount to St Anne's Lane in the western part of the study area. It is approximately 165m long and runs east to west along the edge of a field and a fairly open forest. The route provides respondents in the Foxcroft Mount area with their most direct route to the Arndale Centre, park scenery and views of lower lying areas at the western end of Foxcroft Mount and beyond. The shortest route from Foxcroft Mount to the Arndale Centre involves a moderate gradient taking in the Beckett Park footpath (depending on where on Foxcroft Mount one starts the total climb to the top of the mount is 10-15m).

Figure 9.11. Beckett Park footpath due west



Figure 9.12. Plan of Beckett Park footpath

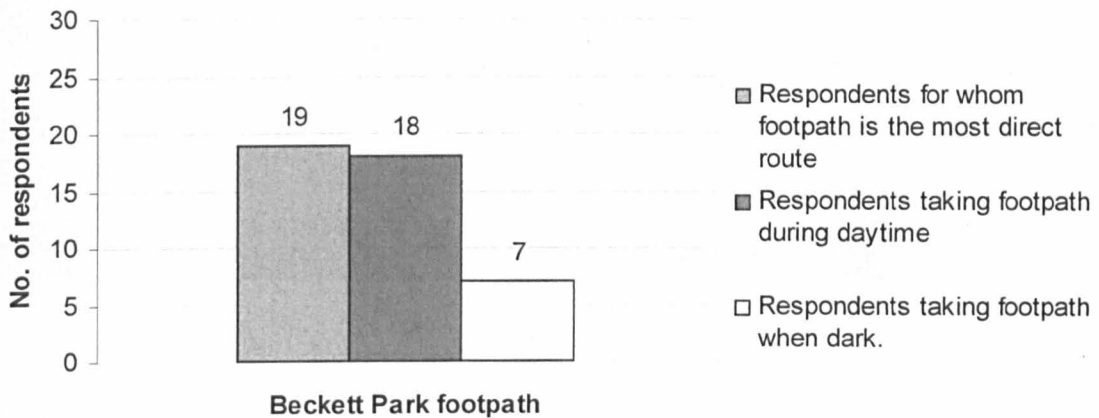


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The footpath consists of two distinctive parts. As shown in Figure 9.12, there is a short 25m section near Foxcroft Mount which is narrow and runs between two gardens. The rest of the path (140m) runs through the park. The route involves a significant climb (~8 metres). The path was lit but average horizontal illuminance was below 5 lux. Alternative routes involved a detour of up to 800m for the 19 respondents that had Beckett Park footpath on their most direct route to Arndale Centre.

As shown in Figure 9.13, of the 19 respondents for whom the Beckett Park footpath was the most direct route to the Arndale Centre, 18 used the path when walking to the Arndale Centre during daytime (despite the gradient this route involves). This was only true for 7 out of the 19 respondents when dark. Consequently the results of the restricted route analysis (Section 9.5.8) were confirmed. In addition, the example painted a clearer picture of the type of environments making pedestrians take detours when dark.

Figure 9.13. Respondents using Beckett Park footpath



9.6.3. The Ginnel

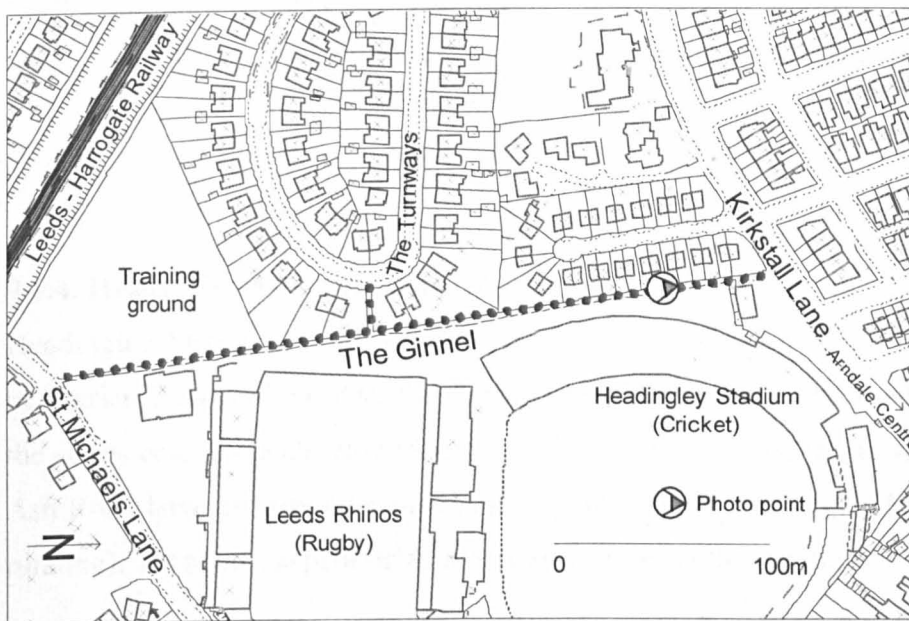
'The Ginnel'⁵ is the local residents' name for a footpath behind Headingley Stadium, a narrow, confined and straight pedestrian-only passageway with fences and walls alongside it (see Figure 9.14). It stretches from St Michaels Lane in the south to Kirkstall Lane in the north. The distance between the two roads is around 330m. Midway along it there is a connecting path leading to The Turnways.

⁵ Ginnel is also a generic Yorkshire term for alleyway.

Figure 9.14. The Ginnel footpath due south



Figure 9.15. Plan of the Ginnel



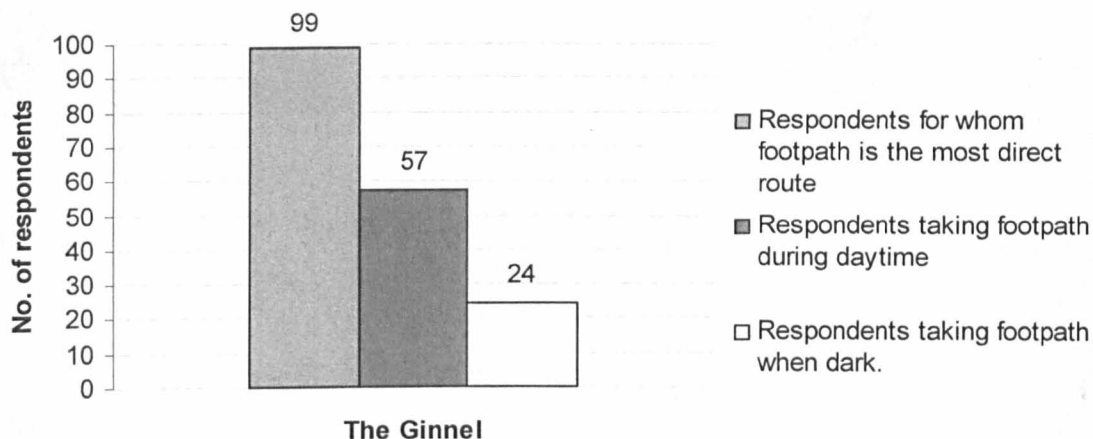
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Average horizontal illuminance along the path is 8.6 lux, brighter than many residential streets surrounding it. For example, Ash Road has an average horizontal illuminance of 4.5 lux. Interestingly some survey respondents still referred to The Ginnel as 'unlit', dimly lit and dark. This could perhaps best be explained by its secluded setting. While alternative routes involves a detour of around only 20m, a busy road (Cardigan Road >

10,000 vehicles per day) has to be crossed at a place without any crossing facilities. No height differences were presented by taking the route or alternatives.

As shown in Figure 9.16 below, The Ginnel provided 99 respondents with the most direct route to the Arndale Centre. Over half used it when walking to the Arndale Centre during daytime. Only 24 out of 99 respondents walked along The Ginnel when dark. Also these results confirmed the results of the restrictive network analysis (Section 9.5.8). In addition, the example gave an illustration of a type of environments that deters pedestrians both during daytime and when dark.

Figure 9.16. Respondents using The Ginnel



9.6.4. Headingley Mount/ Ash Road junction

Headingley Mount and Ash Road meet at a four way uncontrolled junction. The main pedestrian flow is along Ash Road (many pedestrians were observed walking between the shops east of Headingley Mount and the residential area to the west of it). Cars on Ash Road have priority over the main flow of cars on Headingley Mount (to limit rat-running). There are no pedestrian crossing facilities at the junction.

Figure 9.17. Headingley Mount – Ash Road junction looking west along Ash Road



Figure 9.18. Plan of Headingley Mount/ Ash Road junction



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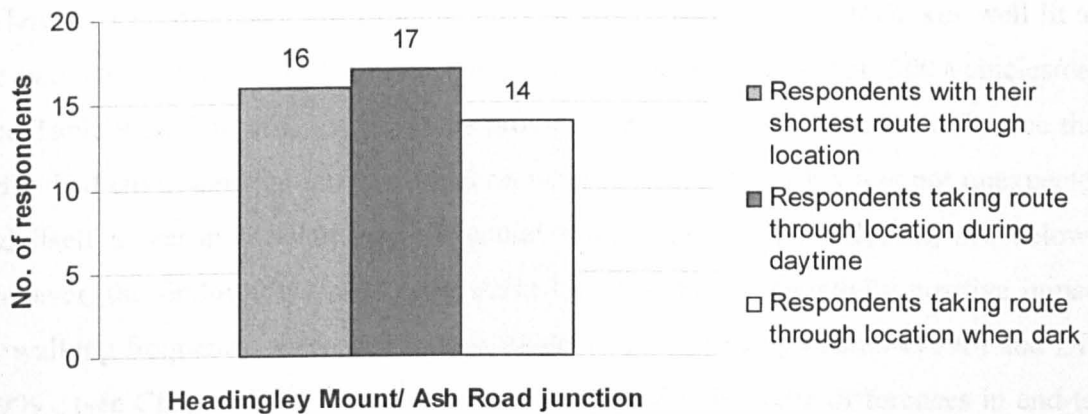
Typical behaviour at the junction is that pedestrians give way to vehicles turning onto Headingley Mount from Ash Road. In addition, less ‘experienced’ pedestrians were often observed to give way to cars waiting on Headingley Mount to cross over Ash Road as well as to cars leaving the junction. During peak hours cars approaching the junction on Headingley Mount frequently block the way for the main pedestrian flow.

Hence, pedestrians are often forced to walk between waiting cars in order to get across the street.

Leeds City Council has had the junction under observation and has considered putting in new pedestrian facilities. A couple of years ago a PV^2 index was calculated for the junction but it seems like the council considered the pedestrian flow too low compared to the car traffic flow to warrant any immediate action.

Pedestrians can cross Headingley Mount at several other places, i.e. to the north near St Annes Drive and to the south near Kirkstall Road. At these places there are t-junctions or junctions with minor access streets. Hence, the Headingley Mount/ Ash Road junction is probably one of the most difficult crossing points that respondents must negotiate on their way to the Arndale Centre (at least during peak hours). Alternative routes involve a detour of 40- 200m (depending on residential location). All other main streets in the area (Kirkstall Lane, Otley Road, North Lane) have signalised pedestrian crossings at reasonable locations when walking to the Arndale Centre.

Figure 9.19. Respondents crossing Headingley Mount at Ash Road junction



As shown in Figure 9.19, 16 respondents had to cross Headingley Mount at Ash Road on their most direct route to the Arndale Centre. Interestingly 17 respondents chose to take this route. For 14 of these it is their shortest route. A few of the respondents taking the route through the junction could have avoided a gentle ascend and reduced their total climb by around 3m (by taking an alternative and longer route). 14 respondents preferred to cross Headingley Mount at Ash Road as part of their route when dark.

The results seem to indicate that perceived poor traffic safety along a route is not a strong deterrent for walking the Ash Road route. What makes these findings interesting is that Headingley Mount/ Ash Road junction is one of a few locations that respondents specifically commented on as unsafe in terms of traffic (see also Section 9.6.1) and the fact that many respondents (35% during daytime, 32% when dark) indicated that traffic safety was a *very important* reason taking the route they did (see Tables 9.11-9.12).

9.7. Discussion

9.7.1. Findings on walking propensity in this and other studies

The first part of the analysis indicated that respondents with continuous high quality routes (good quality street lighting and/or a high degree of natural surveillance) seemed to walk somewhat more often to their local supermarket/ shopping centre than those that did not have such routes (Tables 9.7 and 9.8). Furthermore, respondents having such routes to the Arndale Centre walked more often (total number of trips during daytime and when dark) than the calculated shortest distance from their home would imply. That said, it should be noted that there was a strong overlap between different route attributes. For example 85% of those with a route which was well lit all the way (>10 lux) also had a route that avoided links with less than 500 vehicles/day (see Table 9.8). The analysis therefore provided limited evidence on the influence that individual environmental attributes had on walking propensity (this was not unexpected and itself a reason for that data on actual route choices was collected, see below). However, the findings, e.g. that good street lighting had a potentially positive impact on walking frequency, were in line with evidence presented by Painter (1996) and DfT (1999), (see Chapter 5). A weak link was also identified between differences in end-to-end altitude differences (average gradients) and walking propensity (Section. 9.4.2), perhaps due to the fairly level nature of most of the study area (Section 9.2.2.6) or because this measure did not correspond fully with total meters climbed. Also these results may be seen as consistent with earlier studies indicating that (only) steep gradients have a significant impact on walking propensity (see Chapter 5 and Cervero & Duncan 2003).

9.7.2. Findings on pedestrian route choice in this study

9.7.2.1. General facts on route choice

The data collected on route choices showed that pedestrians in the area took significant detours during daytime and when dark (Figure 9.4). Detours were longer when dark than during daytime and the frequency and length of detours were linked to age and gender (Figures 9.5 and 9.6). One in five respondents (20%) took a route that was at least 12% longer than the shortest when dark (Figure 9.4), equal to, on average, an extra distance of more than 135m. Female respondents and persons over 65 years chose longer routes more frequently than other groups.

9.7.2.2. Explaining route choice behaviour

The restricted network analysis (see Section 9.5.8) suggested that certain environmental attributes of routes influenced pedestrian behaviour. Omitting links with ‘negative’ qualities, typically lack of natural surveillance, increased the network model’s prediction rate for route choices during daytime from 74% to 79%, and when dark from 58% to 73% (Table 9.13). Three different networks achieved this score: one that omitted segregated footpaths where these were >30m away from buildings, one that omitted segregated footpaths *and* streets with less than 500 vehicles/ day where these were >30m away from buildings and one that that omitted segregated footpaths where these were >25m away from buildings (segregated footpaths were defined as footpaths away from carriageways). Consequently, the results indicate that attributes linked to personal security fears seem to have the most significant impact on pedestrian route choices (resulting in the longest detours and most important increases in terms of travel time). This conclusion was supported by pedestrians’ responses to the questionnaire (Figures 9.2-9.3, Table 9.12). For example, when respondents were asked why they did not walk to a particular destination, personal security fears was the strongest deterrent (Figure 9.2). Other survey results also supported the conclusion, e.g. differences between route choices during daytime and when dark (see Figure 9.4). In addition, the most important reason for choosing a particular route when dark, according to the respondents, was to avoid routes with poor(er) personal security and too few people around (see Table 9.12). Hence it was believed that different routes’ qualities in terms of personal security were the most important reason for not walking the shortest route.

It should be noted that the outputs of the restricted network analysis presented above are comparable in predictive abilities to vehicular route choice models (car drivers). Such models, using a generalised cost function (time and running cost) can normally accurately portray 60-80% of route choices for drivers (Ortúzar & Willumsen 2001, p. 327-328). Unaccounted route choices could typically be attributed to differences in perceptions, lack of correct information about route costs or errors (ibid).

9.7.3. Findings on route choice in previous studies

Earlier studies on pedestrian route choices have concluded that, after distance, pedestrians showed a tendency to follow the simplest route (Marchand 1974), that 'attractiveness' was important for route choice on shop to shop trips (Seneviratne & Morrall 1985), that personal security was unimportant for route choice in business districts during daytime (Seneviratne & Fraser 1987), that the influence of gender on route choice was marginal in town centres (van Schagen 1990) and that the average pedestrian on a 'regularly' made trip was prepared to offset an extra distance of 160m by one point higher 'pleasantness' on a 7 point scale (Westerdijk 1990). The results of the restricted network analysis reported in this thesis therefore differ in some aspects from previous results. These differences could perhaps be attributed mainly to different types of study areas (business districts and city centres vs. a less centrally located mixed use area), variation in trip purposes, trip lengths and the fact that none of the earlier studies investigated pedestrian behaviour when dark. Thus the new evidence has significantly enhanced our understanding of pedestrian route choice.

9.7.4. Assessing the strength of the evidence

The findings presented in Section 9.7.2 support previous suggestions that using just network distance is not necessarily a robust indicator of pedestrian accessibility, (see e.g. Chiaradia 2004, Clifton & Lucas 2004, p.21) though not exactly in the way that earlier authors suggested (different causes but similar outcome). Obviously, any analysis based on omitting links may be viewed as a relatively crude way of handling complex characteristics of a good walking environment. However, the strong point of investigating barriers, as was done in this study, is that it is consistent with finding out which environmental attributes have the greatest negative impact on pedestrian accessibility. Where many people's most direct routes are sub-standard and no

alternative routes exist this will have the strongest negative impact on accessibility. For example, if the only alternative route meant a very long detour some people might consider it unacceptable to walk (e.g. because of the extra distance involved to follow a better route). Others may use adaptive strategies, e.g. plan their trips so that they can walk together with someone (see Section 9.5.6). As mentioned earlier in Section 9.7.2, the results of the restricted network analysis were supported by pedestrians' responses to the questionnaire. In addition, the example of route choice at Headingley Mount (see Section 9.6.4) indicated that environmental attributes related to personal security were a relatively stronger factor than perceived traffic safety (even though the latter was stated to be a serious issue). Consequently, there is quite strong evidence that the factors identified in the unrestricted network analysis (in short, the level of natural surveillance) are amongst the strongest factors in inhibiting pedestrian access for main groups. However, it should perhaps not be taken for granted that the factors identified in this thesis are the only ones relevant. For example, the data used for assessing street lighting in the thesis was relatively crude and this area leaves scope for further analysis (e.g. assessing the influence of dark spots and using more detailed data on illuminance and lighting 'colour').

However, one finding in the questionnaire may cast a shadow over the strength of the evidence presented above. When the respondents were asked about improvements that would "make more local journeys on foot possible", pavement improvements were mentioned most frequently. This category received 28% of responses (Figure 9.3). Better policing/ security improvements and street lighting only received 19% of responses. Unfortunately, the role of pavement quality for walking propensity or route choice could not be quantitatively tested using the network model because of lack of data. Obviously pavement quality including dropped kerbs and sufficient width to accommodate a push chair or mobility scooter is critical for some users. That said, no user without walking difficulties indicated that pavement quality was a very important reason for their route choice. It therefore seems unlikely that improved pavement quality would make that big a difference to main user groups.

In summary it can be said that the survey has provided new evidence on pedestrian behaviour; the findings indicate that pedestrians often seem to take significant detours to avoid places or routes that they find sub-standard, more often than previously

appreciated. Hence poor walking routes could reduce walking propensity either directly (e.g. willingness to go out when dark) or indirectly by making pedestrians take detours and therefore increase walking distances and put some destinations beyond reach by walking.

9.7.5. Relevance for Accessibility Planning

The results of the study indicate that the performance of pedestrian accessibility models and indicators could be improved significantly by taking pedestrians' aversion for segregated footpaths and streets with little vehicle traffic (<500 vehicles/day) where these are located >25-30m away from buildings into account. The study findings also point to the fact that there is a danger in relying too much on the distance-only accessibility measures provided by the current Accessibility Planning mapping software (Accession) and core indicators (DfT 2006a, p. 60) when identifying areas for further investigation in Accessibility Planning. This is because distance-only indicators do not take personal security aspects of pedestrian networks into consideration despite the fact that these may be significant to users, and the fact that suburban areas and modernistic housing estates on the fringes of cities with high levels of social deprivation (areas frequently targeted in Accessibility Planning) relatively often have some footpaths and building entrances are located well away from streets.

An issue here is how one can establish the impact of personal security aspects without a quantitative analysis of pedestrian networks or at least without studying the pedestrian networks' qualities in this respect in some detail. Almost certainly there will be places where a notional distance indicator is sufficient, for example in homogeneous areas with good natural surveillance such as that in a traditional grid network. However, in other areas the outputs of distance-only indicators would be flawed because of personal security fears. Systematic investigations of how well pedestrian networks perform in terms of the features highlighted in the thesis may therefore provide vital information about how accessibility could be improved. In addition, a composite accessibility indicator including personal security aspects would have some additional benefits. One of these is that it would provide information on accessibility levels experienced by public transport users (when walking to the bus stop). This may be particularly important because there are some studies indicating that many bus users feel particularly

vulnerable while waiting at bus stops (see Chapter 5, Loukaitou-Sideris 1999, Braunholtz 2002).

9.7.6. Implications of the findings for the specification of indicators

One of the questions asked when developing hypotheses for this work was whether a composite accessibility indicator could better explain walking behaviour than a simple one based solely on distance (see Chapter 5, and Section 9.1.3). Or in other words, is an accessibility indicator based on a notional distance accurate enough? The survey results suggested that pedestrian accessibility must indeed be considered more complex than simply having shopping facilities and other services within a certain distance. The main findings pointing to this conclusion are:

- That respondents with high-quality routes which meet certain environmental standards along the whole route walk somewhat more often than the distance from their home to the destination would imply (Table 9.7),
- That pedestrians take longer detours when dark than during daytime despite saying that positive attributes such as route pleasantness are less important when dark (Figure 9.4, Tables 9.11 and 9.12),
- That over half of respondents (59%) indicate that taking the “safest [route] in terms of assault” is very important when dark, and that this quality is considered the most important overall (Table 9.12), and
- That excluding segregated footpaths and streets with little vehicle traffic where these are located >25-30m away from buildings increased the prediction rate for night time routes from 58% to 73% while prediction rates for daytime trips increased slightly (Table 9.13).

As seen above, the strongest evidence for the fact that other things than distance needed to be considered for pedestrian accessibility is for trips when dark. Is accessibility when dark then important enough to warrant its own indicator or would this just be expensive and take resources away from improving daytime accessibility? Access when dark is certainly important for many people. For example, without night-time accessibility it would not be possible to get home after work during winter months. In fact, around one in three weekday trips (33%) are in progress when dark during the three darkest months of the year (DfT 2005a). In addition, many low and medium income workers in restaurants and shops as well as shift workers are dependant on accessibility when dark

for getting to or from their work place most of the year. One additional important consideration for the specification of accessibility indicators is whether one single indicator could be used to represent diverse sub-groups of pedestrians. The results of the survey indicated, unsurprisingly, that preferences of various subgroups differ and that no single composite indicator could perfectly capture all preferences. However, even when taking into account those walking the shortest route ‘no matter what’, the three network models’ prediction rates were increased from 74% to 79% during daytime and from 58% to 73% when dark (Table 9.13).

9.8. Conclusions

The aim of this chapter was to investigate potential difficulties in establishing useful accessibility indicators and how these may hamper Accessibility Planning (see Chapter 6, Section 6.4). The chapter also considered whether Accessibility Planning has been hindered by a lack of data. Conclusions on these two research propositions will be formulated in the next section.

9.8.1. Overly simple indicators hamper Accessibility Planning

As discussed in Section 9.7.5, accessibility indicators that do not accurately reflect things important to transport system users can hamper Accessibility Planning in several ways. The most important of these is perhaps where inaccurate indicators are used to identify priority areas and, as a consequence of the indicators’ lack of accuracy, steer the Accessibility Planning process⁶ away from some areas where personal security aspects reduce local accessibility to a sub-standard level. The results of the study therefore support the research proposition that difficulties in establishing useful accessibility indicators hamper Accessibility Planning. However, as also shown in this chapter, there are ways in which at least some of these problems can be addressed by incorporating the perceived level of personal security into accessibility indicators. Calculations of such indicators incorporating natural surveillance is a relatively straightforward computer-based exercise that can be carried out for large networks in one single operation using widely available data sources, i.e. data is not really a problem because it is not difficult to collect. Hence this part of the thesis does not give any support to the research proposition that Accessibility Planning has been hindered by unavailability of data.

⁶ See Figure 8.13 for an illustration of the Accessibility Planning process

Perhaps of equal importance to the accuracy of accessibility indicators are their ability to mirror improvements. One might argue that some aspects of measuring pedestrian accessibility would be rather pointless unless the indicator used would illustrate the impact of changes towards policy goals. From this perspective notional distance indicators have several limitations. For example, a notional distance indicator would not be able to measure even a significant step-change in improving pedestrian facilities. Consequently, such improvements would remain 'invisible' to the policy maker or planner (would not appear in quantitative decision support).

9.8.2. Recommendations on pedestrian accessibility indicators

Further research may be warranted in order to specify criteria for sub-standard links. The need for research will be discussed in the next section. That said, a calibrated penalty may clearly be more appropriate than a binary include/exclude rule not least because some undesirable links may have an important role when choice is limited. A composite indicator should therefore include a penalty for links with poor natural surveillance, i.e. an extra cost should be added to segregated footpaths and streets with little vehicle traffic where these are located >25-30m away from buildings. The proposed indicator would not only increase the prediction rate when dark but also during daytime. It therefore seems unnecessary to use a different indicator for daytime. The results of the study indicate that incorporating the above factors in pedestrian accessibility indicators could principally bring their accuracy in line with that of models for vehicle traffic (see Section 9.7.2.2). The cost of taking the identified environmental attributes into account should be relatively low (e.g. to calculate natural surveillance is a relatively straightforward GIS exercise using widely available data sources). Chapter 11, Section 11.5 will present where these recommendations on accessibility indicators fit in relation to Accessibility Planning Guidance (DfT 2006a).

It should be noted that this thesis does not provide any evidence for closing segregated footpaths, especially given the importance pedestrians put on directness and having a variety of routes (e.g. quiet routes away from traffic during daytime).

9.8.3. Further analysis and research

The results of the survey in Headingley and that of the literature review (Chapter 5) have highlighted several gaps in our understanding of pedestrian needs. The role of these gaps for future research can be summarised in three points:

- The study found that pedestrian behaviour seems to vary significantly in different types of areas. This suggests that research into transferability of results is important. For example, the impact of improved street lighting may differ significantly with crime rates, general perceptions of personal security fears as well as with the level of natural surveillance at a particular location.
- Earlier studies have suggested that pedestrians perceive walking speed better than distance, and that more pleasant and visually attractive routes are perceived as shorter (Marchand 1974). The findings in this study support this, that many pedestrians view directness as a relative concept. If this is true, simply asking pedestrians if they took the quickest or shortest route does not necessarily mean that they did so, based on distance alone.
- Pedestrian road safety issues have not really been discussed in this thesis (the study is in this respect limited by study area). However, it should be noted that the analysis could not find any support for the hypothesis that pedestrians take long detours to avoid difficult crossing points. In fact, one crossing point that a handful of respondents said were 'unsafe' was used by more people than those that had it on their direct route (see Section 9.6.4). It could therefore be that pedestrians in areas with routes deemed unsafe in terms of personal security trade off these routes for ones less safe in terms of traffic.

Future research might usefully look into the calibration of appropriate penalty scores for links that pedestrians find are poor quality/ sub-standard. In addition, further research may test additional and more detailed factors (perhaps making more use of the route choice data collected here). One important area would be to analyse the importance of street lighting quality in more detail, taking dark spots into account. Investigating the role that shops and other street-oriented businesses may have for walking behaviour and natural surveillance would also be a useful addition. Another valuable area would be to examine more detailed measures of natural surveillance (e.g. to test the number of entrances facing a route). Results of such research may also be useful elsewhere. For example, better knowledge about pedestrian behaviour may be important in order to correctly prioritise park maintenance (e.g. cutting back of vegetation in places where growth has a negative impact on natural surveillance) or for informing policing strategies in vulnerable communities.

Chapter 10

Discussion

10.1. Introduction

This chapter investigates why Accessibility Planning has taken so long to be recognised as a mainstream planning methodology. It does this by bringing together the key findings on each of the eight research propositions outlined in Chapter 6. The eight propositions, or potential barriers to Accessibility Planning, are assessed in the order that they were first presented (See Sections 6.3 and 6.4). Firstly the four cultural barriers to Accessibility Planning are discussed. Then the four propositions on difficulties in creating tools to measure accessibility are examined.

10.2. Culture as a barrier

10.2.1. Potential tensions between Accessibility Planning and transport planning

10.2.1.1. Key findings

The first research proposition suggested that there has been a tension between the dominant transport planning culture and Accessibility Planning and that this was a barrier to its implementation. Early in the thesis it was found that, in the past, the dominant transport planning culture had not distinguished between general mobility demands and basic accessibility needs (Chapter 3). It was recorded that calls for implementation of accessibility-oriented planning approaches were rejected with little underlying analysis (Chapter 4). It was also identified that where accessibility-based planning approaches were implemented, they were sooner or later abandoned.

Chapter 7 identified that in a few cases transport planning processes were documented as ignoring local accessibility needs despite these being a part of the planning scope (Tennøy 2004). But it was difficult to find facts on how common this had been. It could be that planners excluded local accessibility aspects willingly but it could also be that local accessibility was left out of planning briefs given to planners by elected leaders.

The new data presented in Chapter 8 indicated that transport planners were happy to take Accessibility Planning on-board. A key finding was that three-quarters of respondents (75%) *agreed* or *strongly agreed* that Accessibility Planning fitted into the culture and context of transport planning. Also other key responses to the survey in Chapter 8 show that most planners held a positive view of what could be achieved by Accessibility Planning. For example, 85% of planners indicated that the concept was useful for describing transport problems in relation to social exclusion. Only one in ten respondents explicitly stated that Accessibility Planning would be better lead by some other department or that transport planning culture had to change to take Accessibility Planning on-board (Chapter 8, Section 8.3.1.1 and Appendix 4).

Other findings relevant for assessing the research proposition on planning culture were that one in twelve responded that there was a risk for over-emphasis on Accessibility Planning while one in six respondents indicated that Accessibility Planning was likely to receive too low a priority (Chapter 8, Section 8.3.5.1). These figures together with the fact that almost half of the respondents indicated that a lack of understanding of issues among partnering external organisations was a difficulty and that external organisations had been given too few obligations (Section 8.3.5.1, Table 8.3) could perhaps be interpreted as a way to ‘escape’ responsibilities for accessibility objectives.

10.2.1.2. Assessment

As mentioned above, the majority of respondents (75%) thought that changes brought by Accessibility Planning fitted into the culture and context of transport planning culture. This was understood as the majority of respondents were willing to take on the challenge of Accessibility Planning, not ‘escape’ it. Hence the results of the local authority survey in Chapter 8 indicated that Accessibility Planning was not seen as a competitor to the dominant transport planning culture but as a useful tool to improve it. Earlier, more general evidence has suggested that there is a consensus among people with transport expertise that “major change” to the way we plan transport is required (Tight et al. 2000, p.71). The proposition that there has been a tension between the dominant transport planning culture and Accessibility Planning may therefore once have been true, but is probably not an issue any longer. That is not to say that tensions do not still exist between Accessibility Planning and the beliefs held by a minority of planners and engineers.

10.2.2. Do planners perceive accessibility indicators sceptically?

10.2.2.1. Key findings

The second research proposition suggested that planners have been sceptical about the value of accessibility indicators because of specification problems⁷. A key output of the survey of local authorities presented in Chapter 8 indicated that practitioners placed great value on having such a quantitative appraisal framework based on accessibility indicators. However, the majority of survey respondents (56%) disagreed that a distance-only walking indicator was reliable for the purposes of Accessibility Planning (Section 8.3.3.1). Almost as many disagreed that a similar cycling indicator was reliable. That said, despite potential specification weaknesses of the indicators used, one in four respondents (27%) saw the use of accessibility indicators as the main advantage of Accessibility Planning (Section 8.3.2.1, Table 8.2). This was the most frequently mentioned main advantage of Accessibility Planning and the answers were given in response to an open-ended question. Hence many planners identified the use of accessibility indicators as a key strength of the new planning concept. Only a few respondents expressed limited reliability of accessibility indicators as a particular problem for Accessibility Planning (Section 8.3.5.1).

10.2.2.2. Assessment

A key output of the survey presented in Chapter 8 indicates that the planners surveyed strongly liked the idea of being able to measure accessibility quantitatively. The survey also shows that many respondents expressed doubt over the reliability of the walking and cycling indicators used in Accessibility Planning. However, this did not seem to affect the planners' overall acceptance of the concept of Accessibility Planning where accessibility indicators together with demographic data are used to identify areas where people are worst off in terms of access to basic services (DfT 2004c). The key facts above suggest that planners were either very pragmatic in terms of the indicators they use or that they viewed local accessibility indicators as a way to increase our overall understanding of transport needs and travel behaviour. In

⁷ As mentioned earlier in Chapter 4, walking and cycling indicators used in national monitoring schemes for Accessibility Planning, as well as indicators used for assessing for access to public transport, are based solely on notional distances (DfT 2005b).

any case, the proposition that planners were sceptical about the value of accessibility indicators because of specification problems must be rejected.

10.2.3. Potential conflict with economic objectives

10.2.3.1. Key findings

The third proposition suggested that transport planners had perceived a conflict between Accessibility Planning and economic objectives. Planners have in the past openly demoted attention to local accessibility because of perceived conflicts with economic objectives (Buchanan et al. 1980, SIK A 2001, see also Section 4.5.3). A key finding in the survey of local authorities in Chapter 8 suggested that there had been a change in how transport planners viewed the relationship between local accessibility and economic objectives. In the survey, the majority (66%) believed that Accessibility Planning accorded with economic growth policies. Conflicts between Accessibility Planning and economic objectives were on the whole perceived as less important than conflicts with health and educational policies (Section 8.3.4). Less than one in six respondents indicated a strong (3%) or a slight conflict (13%) between Accessibility Planning and local economic growth policies. Respondents from LTP authorities perceived a higher level of synergy than officers from LTP authorities (difference significant at the 95% level). Within non-LTP authorities a significant minority (26%) seemed to have a ‘gut’ feeling that promoting local accessibility would be somewhat bad for the local economy. This could be compared to experiences from the Netherlands. A key reason that the Dutch VINEX policy was abandoned was that local authorities considered it limiting their choice and powers (VROM 2001).

10.2.3.2. Assessment

The proposition that transport planners perceived a conflict between Accessibility Planning and economic objectives has clearly been true in the past but new data suggests that this is no longer the case. The data presented in Chapter 8 showed that three in four respondents saw no conflict between Accessibility Planning and economic growth policies. This change in perception may have many reasons. One reason could be the effects of local shops closing down (e.g. making the economical benefits of a local food shop for the elderly more obvious). It could also be that

respondents found improvements to walking and public transport infrastructure highly cost-efficient (see e.g. Eddington 2006, DfT 2007c). It could also be that respondents believed that accessibility measures would help reduce congestion and the need for transport. Or, it could be that Accessibility Planning was seen to help more people access jobs and education and therefore increase economic growth.

It is interesting to note that the Eddington study (see Section 4.3.3) did not consider the economic effectiveness of Accessibility Planning.

10.2.4. Skills and ways of working

10.2.4.1. Key findings

The fourth proposition suggested that Accessibility Planning requires planners to adopt new skills and ways of working and that this had postponed a general take up of the concept. The survey of local authorities presented in Chapter 8 painted a relatively clear picture of how planners viewed the skills and ways of working needed in Accessibility Planning. In the survey, only one in ten survey respondents agreed that the computer-based tools needed to carry out accessibility analysis are easy to use. In addition, the majority of respondents (60%) either *agreed* or *strongly agreed* that the ability to engage and sustain meaningful partnerships with organisations such as schools and the NHS was or will be a problem (Section 8.3.5.1). A somewhat smaller majority (52%) identified a lack of understanding of the issues amongst partners as the main implementation difficulty. This was despite the fact that, at the time of the survey, only one in three local authorities (32%) had yet established a partnership with schools, hospitals or other organisations (see Section 8.3.5.1). One in five respondents (or more) therefore had a negative predisposition towards Accessibility Planning partnerships despite not having any real experience of them. Furthermore, one in ten respondents pointed out that a steep learning curve (lack of in-house skills and knowledge) was the main difficulty for implementation (Section 8.3.5.1). This was even though a significant training programme had been rolled out to help local authorities (see DfT 2004a).

It may be argued that the respondents thought partnership working was a difficulty because it required a partly new set of skills. It could also be that respondents

preferred conventional planning procedures with solutions primarily decided in-house. The fact that partnership working was viewed mainly as a difficulty and to a lesser extent a disadvantage (Section 8.3.5.1, Table 8.3) may perhaps support the former explanation.

Which skills may then be required in Accessibility Planning which are not so important in traditional transport planning? Unfortunately the survey did not provide further details on this issue. But it is relatively straightforward to imagine at least two key differences. First, in Accessibility Planning planners need to communicate differences between the values of access to basic services in relation to more recreational travel needs. Secondly, Accessibility Planning requires planners to achieve buy-in from decision makers in non-transport organisations to make their work successful. This might be a quite different thing from traditional consultations in transport planning discussing potential transport solutions to predefined transport problems. One particular concern may be planners' ability to engage socially excluded groups and understand their accessibility problems. That said, communication proficiency is probably not the only skills issue affecting the survey responses highlighted above. One other issue is perhaps how responsibilities for local accessibility should be shared between land use and transport planning (Section 8.4.2). Still, because of a fragmented institutional framework for transport planning, communication skills seem particularly important when implementing an accessibility-based planning approach.

10.2.4.2. Assessment

The key outputs of the survey of local authorities presented in Chapter 8 indicated that Accessibility Planning had been hampered to a significant extent by a mismatch between key skills required for Accessibility Planning and those available within local transport authorities. In the survey, the majority of respondents identified the way Accessibility Planning works as a difficulty. One in ten respondents pointed out explicitly that a steep learning curve (lack of in-house skills and knowledge) was the main implementation problem. It was also believed, for reasons presented in Section 10.2.4.1, that among the majority of respondents that mentioned partnership working as a difficulty, at least one in five respondents found that negotiating service delivery strategies with partnering organisations was complicated at least partly because this

was a new task which planners had little previous experience of. The proposition that Accessibility Planning requires new skills and ways of working and that this had postponed the take up of the concept therefore seems to be confirmed.

10.3. Tools as a barrier

10.3.1. The role of four stage transport models

10.3.1.1. Key findings

The fifth research proposition suggested that Accessibility Planning has been held back by the dominance of traditional transport models in the transport planning toolbox. Chapter 7 reviewed foundations of traditional transport modelling, the main criticisms against it and its relevance for Accessibility Planning. The review found that zone sizes used in four stage models were typically too large to provide useful information about accessibility levels on foot and by bicycle both within zones and between neighbouring zones. In theory, it was found feasible to use very small zone sizes in traditional transport models and thereby capture accessibility levels by non-motorised modes. Although accessibility models and conventional transport demand models could thus be compatible, in practice this may have been difficult because of increased computation times and software limitations. However, zone size is not the only issue. Perhaps equally important is the number of trip categories that are used in models. In addition, Chapter 7 argued that an important issue, and a reason why the dominance of traditional four stage models may have postponed a general take up of accessibility-based models, may be that there has been a lack of clarity of the extent to which the traditional models include access to basic services. Despite the fact that four stage models have been extensively criticised over a long period of time, it was not until recently that the models limitations in terms of local accessibility were widely publicised (see Section 7.3.1.2) One way of putting this is that, because local accessibility impacts were excluded, these needs tended to be ignored or, as expressed by Banister, that conventional transport models reduce accessibility “to a second order of importance” (Banister 2002, p. 134).

The discussion in Chapter 7 argued that confusion about the extent to which four stage models captured all relevant accessibility demands may have contributed

significantly to the delay in mainstreaming Accessibility Planning. This finding was supported by long-standing criticisms of how four stage models have been used in practice (see e.g. Wachs 1982, Tennøy 2003, 2004), i.e. the claim that many transport studies lack transparency in their model assumptions and limitations. Results of the survey of local authorities presented in Chapter 8 gave some support to the notion that respondents were not always aware of whether traditional transport models included local accessibility needs or not. When asked about the extent to which Accessibility Planning outputs allowed a meaningful comparison with the outputs of traditional transport models such as SATURN, the majority of respondents (57%) indicated that they did not know (Section 8.3.6). But this could also be due to a lack of knowledge about Accessibility Planning outputs (or traditional transport demand models).

10.3.1.2. Assessment

Chapter 7 found that four stage models typically had too large zones to provide useful information about accessibility levels on foot and by bicycle within zones and between neighbouring zones. If traditional transport demand models were seen as the only tool to determine future transport problems then local accessibility needs were typically overlooked. But even if traditional transport models were the main tool in the transport planners' toolbox this need not have held back Accessibility Planning as long as the limitations of traditional transport demand models were well recognised and acted on. We must therefore reject the proposition that the dominance of traditional transport models in the transport planning toolbox held back Accessibility Planning. However, *confusion* about traditional transport demand models' limitations in regards to local accessibility may well have held back Accessibility Planning. Such an argument would at least be supported by the fact that it was not until recent times that the weakness of classical four stage models in terms of how they do not portray local accessibility became widely published (see Section 7.3.1.1).

10.3.2. Specification of indicators

10.3.2.1. Key findings

The sixth proposition suggested that Accessibility Planning has been hampered by difficulties in establishing functional accessibility indicators. The survey of

pedestrians presented in Chapter 9 investigated this issue in some detail exploring the accuracy of pedestrian accessibility indicators based on a notional distance as well as the opportunity to formulate more accurate indicators. The survey concluded that the cost of taking some environmental attributes into account was relatively low and that by doing so the performance of a pedestrian accessibility model could be significantly improved (from a prediction rate of 74% to 79% during daytime and from 58% to 73% for walking when dark). Using the indicator recommended in Section 9.8.2 would probably bring the accuracy of impedance in pedestrian accessibility indicators in line with that of models for vehicle traffic (see Section 9.7.2.2). Hence, an indicator based solely on distance would fail to include many factors that pedestrians say are important to them (see also Chapter 9, Table 9.10 and Cervero & Duncan 2003).

10.3.2.2. Assessment

Accession (the software used for accessibility analysis) has made data manipulation easier for local authorities. The training provided has increased the number of staff skilled in using the particular software and similar tools. However, the new software tool per se has done little to address any of the known specification problems reported in the literature. In addition, identification of appropriate accessibility thresholds is far from straightforward and it is not just an issue of measuring the impedance of transport networks (see Chapter 2). Taking all the findings into consideration, it was concluded that there is a significant problem in specifying useful accessibility indicators and that this is a barrier to effective Accessibility Planning. For example, two analyses, one with and one without incorporating sense of personal security on foot would risk leading to different conclusions on which areas have the poorest local accessibility (as illustrated by the key output from Chapter 9). The proposition that difficulties in establishing useful accessibility indicators have hampered Accessibility Planning must therefore be confirmed.

10.3.3. Availability of data

10.3.3.1. Key findings

The seventh research proposition tendered that Accessibility Planning is hindered by a lack of readily available data detailed enough to quantify local accessibility. A key

output of the survey of local authorities presented in Chapter 8 showed that one in four (27%) respondents *agreed* or *strongly agreed* that the data needed to carry out an accessibility analysis was available to them (Section 8.3.7). One in ten (9%) authorities *strongly disagreed* with this. The survey results also suggested that one in fourteen local authorities (7%) thought that data availability was the main implementation difficulty (Section 8.3.5.1, Table 8.3). The difference between the two responses above was taken as being that most respondents thought that data not available at the time for the survey could be collected relatively easily. This may explain why data availability was not one of the five most frequently mentioned difficulties for implementing Accessibility Planning (Section 8.3.5.1). Findings in Chapter 9 supported the idea that key data on important aspects of the walking environment could be collected at relatively low costs and hence that unavailability of data was not really an issue (see Section 9.8.1). The findings in Chapter 9 may also indicate that some of those in the survey of local authority saying that data was a problem seemed not realise what data that is actually available.

In addition to what has been said above, the rather mixed response to the local authority survey may at least partly be a consequence of software issues that the respondents experienced early in the process. The issues brought to light by those in the survey that *strongly disagreed* that the required data was available included not only lack of data but also poor data accuracy and data format conversion problems. Many authorities mentioned that they found it difficult to import data into Accession (the software used for accessibility analysis) while maintaining data accuracy. A few local authorities reported that they were missing data on some destinations, e.g. food shops. Several changes have been made to the software since the survey was carried out. In particular changes have been made to the public transport data importer in Accession (MVA 2005). This should resolve the most significant data import problems that local authorities have experienced (Envall 2006).

10.3.3.2. Assessment

The use of computers, GIS software and new technology has dramatically increased transport planners' ability to collect and store data as well as to analyse it. In addition, the results of the survey of local authorities indicated that where data on destinations was not readily available, such data could be collected at a relatively low

cost if a simple classification framework for destination attractiveness was used (e.g. for food shops: corner shop, mid-sized food shop & supermarket). New detailed 'super output' areas (see e.g. University of Edinburgh 2006) give an opportunity to reduce the risk for errors caused by overly large zone sizes in accessibility models. The proposition that Accessibility Planning is hindered by the unavailability of data detailed enough to quantify local accessibility was therefore rejected. However, on balance it seems that data accuracy, e.g. recent changes to local facilities and public transport services, to some extent remains a problem, although its importance appears to be declining.

10.3.4. Equity and appraisal techniques

10.3.4.1. Key findings

The eighth and last research proposition was that the emphasis on equity in Accessibility Planning does not fit comfortably with conventional appraisal techniques using aggregate consumer benefits and that this was a barrier to Accessibility Planning. Chapter 7 examined how equity aspects were treated in transport appraisal frameworks. It was found that Accessibility Planning can be seen as widening the scope for economic appraisal by considering interventions within land use/ service delivery not just transport network improvements. However, a concept embedded in the structure of a conventional CBA is that the needs of minority groups with few resources should not get special priority. CBA practice indicates that positive net benefits are a good enough criterion for implementation. Accessibility Planning objectives suggest two other things. Firstly that everyone should have a 'fair' level of access to basic services and secondly that transport strategies as a whole should yield disproportional positive benefits for those with the poorest accessibility. The emphasis on equity in Accessibility Planning is therefore *not* directly compatible with conventional CBA methodology. The importance of this tension between values embedded in conventional CBA and those in Accessibility Planning may depend on many things, not least the design of a wider appraisal framework to take equity, other non-monetary impacts as well as economic efficiency into consideration. As a consequence of this, transport schemes motivated by economic efficiency should be subject to a separate accessibility assessment, and so they are to some extent in the UK (Imperial College et al. 2006). This could for

example mean adding accessibility impacts as an extra 'line' in current tools for transport planning (e.g. the Appraisal Summary Table for road appraisal). Such an accessibility appraisal would conform to the framework of *The New Approach to Appraisal* (NATA). Alternatively, where appropriate a distributional cost-benefit analysis could be carried out. A third possible approach would be to develop a framework for Multi Criteria Analysis (MCA). In addition, it may be advantageous to implement a process for steering the early stages of a planning process towards policy objectives such as equity.

10.3.4.2. Assessment

There is a tension between Accessibility Planning and how equity is defined in cost-benefit analysis (CBA). For this reason it would seem that conventional CBA methodology is not necessarily the best suited technique for appraising the distribution of accessibility effects. There are however, as mentioned above, ways in which equity impacts can be included in cost-benefit analysis, e.g. using a distributional cost-benefit analysis. Therefore the proposition that the emphasis on equity in Accessibility Planning does not fit comfortably with conventional appraisal techniques can be rejected.

10.4. Summary of results

The tested research propositions can be divided into three groups: confirmed difficulties when implementing Accessibility Planning, propositions rejected but that may have contributed to postponing a general take up of Accessibility Planning, and, rejected propositions.

Two research propositions are included in the first group. It was concluded that there is a significant problem in specifying useful accessibility indicators and that this is a barrier to effective Accessibility Planning. It was also found that Accessibility Planning requires new skills and ways of working and that this had postponed the take up of the concept.

Four research propositions were placed in the second group: that there has been a tension between the dominant transport planning culture and Accessibility Planning and that this was a barrier to its implementation, that Accessibility Planning has been

held back by the dominance of traditional transport models in the transport planning toolbox, that Accessibility Planning is hindered by a lack of readily available data detailed enough to quantify local accessibility, and, that transport planners had perceived a conflict between Accessibility Planning and economic objectives. These four propositions were rejected as current difficulties but were connected to issues which had probably postponed the mainstreaming of accessibility-based planning approaches (i.e. they were once an issue but are not so any longer).

The third and final group comprised the two rejected research propositions. These were that planners have been sceptical about the value of accessibility indicators because of specification problems and that the emphasis on equity in Accessibility Planning does not fit comfortably with conventional appraisal techniques.

Chapter 11

Conclusions

11.1. Introduction

This thesis has examined Accessibility Planning, a 'new' planning process to improve access for socially excluded groups in the United Kingdom. The aim was to assess whether or not Accessibility Planning is a chimera. Accessibility Planning was initially analysed through a series of literature reviews, then a survey of transport planners' attitudes towards the new policy initiative and finally a study of how a key component of accessibility, pedestrian access, can be measured. The literature reviews identified a number of potential barriers to Accessibility Planning through assessing research literature and collecting information on previously abandoned approaches which were similar in scope to Accessibility Planning. The potential barriers were structured and rephrased into eight research propositions, divided into two groups, *culture* and *tools*. Evidence on each of the propositions was gathered through the abovementioned survey of local authorities (Chapter 8) and a study of pedestrian behaviour (Chapter 9). This chapter concludes the study, presenting the main findings, the thesis' contributions to research and suggestions for further work.

11.2. A chimera or not?

Accessibility Planning aims to analyse trips made under hardship and journeys inhibited by mismatches between individuals' mobility, the transport system and land use. Four key points of the planning concept can be summarised as follows:

- Accessibility Planning distinguishes between essential trips and more discretionary recreational travel desires,
- It focuses on individuals' ability to reach key facilities,
- It promotes the idea that transport planning should bring disproportionate positive benefits for those worst off, and
- It links transport planning, land use and service provision.

Accessibility Planning is a distinctive concept because it focuses on the joint performance of the land use and transport system for different groups and examines

what is within reach rather than the costs which (motorised) travellers face when getting to places in general. Furthermore, Accessibility Planning ties together transport planning and service delivery and so improves the public sector's ability to implement cost effective cross-sector solutions to accessibility problems. Accessibility Planning is therefore *not* a wild fancy or a non-existent concept. Neither is it, as shown in Chapter 7, a concept that is already included in the dominant transport planning methodologies.

11.3. Difficulties and barriers

What is needed to make Accessibility Planning happen? The thesis here identified three main issues that have postponed mainstreaming of Accessibility Planning.

First, the study found that Accessibility Planning had been hampered by difficulties in establishing functional accessibility indicators (Chapter 3, see also Chapter 10, Section 10.3.2). The survey of pedestrian route choice (Chapter 9) suggested that accessibility strategies relying solely on the standard approach to technical analysis incorporated in Accession software using shortest distance only may ignore factors important for local accessibility, particularly at night. However, distance-only accessibility indicators can still say quite a lot about accessibility needs. Specification problems are therefore a difficulty for rather than a barrier to Accessibility Planning.

Secondly, the thesis found that Accessibility Planning requires new skills and ways of working, and that there has been a mismatch between key skills required for Accessibility Planning and those available within many transport authorities (Section 10.2.4). A particular concern may be planners' ability to engage socially excluded groups and understand their accessibility problems (Section 8.4.1). Accessibility Planning requires transport planners to communicate accessibility needs of the socially excluded to in-house service providers as well as to external organisations in order to achieve buy-in from them. The majority of respondents identified these new ways of working required in Accessibility Planning as a difficulty (Section 8.3.5.1). This, it may be argued, is perhaps not surprising since Accessibility Planning operates in a different way from traditional transport planning, the latter to a great extent relying on solutions identified and engineered in-house. There is therefore

reason to believe that the effectiveness of Accessibility Planning is linked to the ability of key workers to adopt new ways of working. The extent to which this barrier will be overcome in many local authorities is still to be established.

Thirdly, the survey of local authorities (Chapter 8) and the findings in the literature review (Chapter 4) supported the idea that the culture of transport planning had delayed a take up of the concept. However, the survey of local authorities also suggested that there has been a change in orthodoxy in how many planners view accessibility objectives, with three-quarters of the planners responding to the survey now agreeing that Accessibility Planning fitted into transport planning (Chapter 8). So, even if transport planning culture has postponed mainstreaming of Accessibility Planning this issue should therefore no longer be a barrier.

The national guidance on Accessibility Planning (DfT 2006a) has been instrumental in making local authorities take up an accessibility-based planning approach. This is for several reasons, not just that local authorities now must implement it and receive a financial incentive to do so, but also because the guidance significantly reduced the abovementioned difficulties facing accessibility-based planning approaches. For example, the results of the survey of local authorities seem to indicate that the Government's establishment of a 'standard' for accessibility indicators per se significantly altered transport planners' perception of the usefulness of local accessibility indicators.

11.4. Is Accessibility Planning worthwhile?

The effectiveness of Accessibility Planning will depend on a number of things, not just the accuracy of accessibility indicators used to identify priority areas and transport planners' ability to negotiate solutions with external organisations even if these two factors currently seem to be the most important (see previous section). Another difficulty is obviously to decide what should be considered a *fair* level of access. Accessibility models may here provide important guidance but it may be argued that this is first and last a policy issue for elected leaders to decide.

In addition to the issues mentioned above, respondents to the local authority survey implied that a dedicated funding stream would be needed to make Accessibility

Planning more effective (Section 8.3.5.1). It is unclear whether the respondents preferred a ring-fenced funding stream for accessibility measures within transport planning or a broader cross-sector one. However, a cross-sector funding stream would perhaps be better as it would help motivate solutions to accessibility needs which go beyond improvements solely to the transport network. In relation to this, it should not be taken for granted that the responsibilities between transport authorities and non-transport authorities are perfectly balanced or distributed (see e.g. Banister 2005, p.57). Furthermore, there may be scope to create more effective tools for Accessibility Planning, e.g. tools that could help planners identify areas where commercial services are under threat of closing down and not only areas which already have poor access (e.g. where local facilities have already closed down).

All the above is not to say that Accessibility Planning as set up today is ineffective. Local accessibility analyses can fill a significant role in the problem identification process which is typically ignored by traditional transport modelling techniques (see Chapter 7). Furthermore, traditional transport planning based on four stage models and standard cost-benefit analysis of improvements to traffic flows would be unlikely to guarantee a minimum level of access for all main groups in society. These methodologies as adopted in traditional transport planning were developed during a time when it was presumed, perhaps quite rightly, that local accessibility needs were sufficiently catered for, at least in urban areas. Today it is different (SEU 2003); increased personal mobility has meant that fewer people are dependent on local facilities. But this does not necessarily mean that the need for Accessibility Planning has been reduced, rather the opposite because increased mobility tends to drain local facilities of some of their customers, putting some of them under threat of closing down. Consequently, Accessibility Planning is needed more than ever because even in big cities it cannot be taken for granted that basic services are within reach for all the main groups in society. Accessibility Planning may also prove beneficial if it facilitates the wider field of transport planning in its long attempt to break away from the predict and provide philosophy towards a perhaps more rigorous accessibility-enhancing planning approach (see Chapter 2).

To sum up, Accessibility Planning is meaningful as long as some groups in society have significantly lower levels of mobility than the average population. Using

appropriate indicators to identify accessibility needs and making sure that those responsible for implementing it have the skills and powers needed makes it more effective.

11.5. Recommendations for policy

A key output of the study of pedestrian route choice presented in Chapter 9 was the new evidence on the extent of detours which pedestrians take in areas outside city centres and how these can be explained by a relatively few environmental attributes of walking routes (see Section 9.7.2.2). As previously mentioned, this part of the thesis presented new data that has significantly enhanced our understanding of pedestrian behaviour (Section 9.7.3). It is recommended that these new findings are incorporated into guidance for Accessibility Planning. The indicator for pedestrian network impedance developed in Chapter 9 could for example be used in pages 63-64 in the Accessibility Planning Guidance (DfT 2006a). It is also recommended that the guidance for Accessibility Planning is updated with a clear description of the importance that personal security factors (e.g. when walking and while waiting at bus stops) may have for identifying correct priority areas, i.e. in the early stages of the Accessibility Planning process (see DfT 2006a, p. 31-40).

11.6. Summary of achievements

The main achievements of this study can be summarised in four points:

- Contribution to the understanding of barriers to Accessibility Planning,
- Providing a history of accessibility-based planning approaches at a time when a new one is being launched,
- Presentation of empirical evidence on transport planners' attitudes towards Accessibility Planning and their experiences implementing it, and
- Presentation of empirical evidence on pedestrian behaviour under different conditions.

As a by-product the study developed a GIS-based methodology for analysing pedestrian route choice behaviour, and demonstrated how pedestrian preferences can be estimated using it.

11.7. Future research

There are at least three main ways in which our understanding of Accessibility Planning could be further enhanced.

First, more information on decision-makers' requirements and interpretation of accessibility indicators would be useful. Several researchers have concluded that the interpretability of accessibility indicators is important for the design of accessibility indicators (see Chapter 3). However, there is little evidence on how accessibility indicators are perceived by residents/decision makers and without this understanding Accessibility Planning may run a risk of being a technocrat's tool and of repeating some of the errors of previous approaches (see Chapter. 4). More information on interpretability of accessibility indicators would also help planners to better communicate data from accessibility audits (so that the issues can be more easily understood by the wider public and non-transport organisations).

Secondly, the analysis of pedestrians' behaviour indicated that walking preferences had a significant impact on the accessibility levels in the study area (Chapter 9) but that this is still poorly understood in the literature and in practice (Chapter 5). Studies investigating the transferability of these results to other areas with lower or higher crime levels and non-metropolitan areas would add to our understanding of pedestrian preferences. Additional studies seem also worthy in terms of access to bus stops. It would also seem important to explore the potential role of more detailed data for pedestrian route choice, perhaps in particular the quality of street lighting and dark spots and the potential role of local shops open at night as well during the day (for personal security). It also seem worth investigating if more detailed measures of natural surveillance, e.g. including the number of entrances facing a route, would correspond better to pedestrian route choice than just the distance to nearby buildings. More research in the abovementioned areas is perhaps particularly useful because few earlier studies have investigated the role of continuous route qualities (see Chapter 5). Further research could take advantage of the GIS-based network model developed within this thesis (see Chapter 9). A beneficial further development of the methodology developed in the thesis would be to add calibrated penalties to links with poor quality as this may correspond better to pedestrian behaviour as a

whole (long higher quality routes would make some pedestrians take a shorter route even if they deemed it sub-standard).

Thirdly, there is a need to monitor the practical success of Accessibility Planning. A follow-up survey of transport authorities would give information on any changes among transport planners' attitudes towards the new approach. Including non-transport organisations in the study would also help identify the right balance between incentives and sanctions and provide sufficient data on any potential need to re-balance responsibilities between transport and non-transport organisations.

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Appendix 1

Overview of the planning approach used in the West Yorkshire Transportation Study

Introduction

The West Yorkshire Transportation Studies (WYTS) were carried out between January 1975 and June 1977. The main purpose of the study was to contribute towards the transport element of the county-wide Structure Plan, preparation of annual transport policies and programmes and the preparation of a public transport plan. When the study first was considered in 1974 it was from the background that the County Council was a new authority. As such it covered a different geographical area from any single previous authority. The new County Council also had a range of new responsibilities in transport. An outline of the personal accessibility measures used for the study is presented in Table A.1.1.

Theoretical foundation and modes included

Personal accessibility is “quite distinct from the characteristics of actual travellers and traffic flows for whose benefit improvements in travel speeds have often (erroneously) been equated with improvements in accessibility.” (Wytconsult 1977b, p.1.) The starting point for the study was that conventional transport modelling processes are designed to quantify travel demand and economic impacts of changes in the transport system and therefore are poor indicators of the extent to which the land use and transport system really serves peoples’ activity requirements and how the impacts are distributed in relation to the population. From this the conclusion was drawn that in order to describe accessibility “data other than that associated with conventional modelling need to be produced” (Cooper et al. 1979, p. 28).

The project was according to its brief to cover *all modes* of transport as well as the land use implications of transport planning (Cooper et al. 1979, p. 27). A problem-based approach to planning was chosen in which expenditure was to be related more closely to identify needs than was previously the case according to new Department of Transport guidelines.

Table A.1.1. Outline of personal accessibility measures used for urban areas in the West Yorkshire Transportation Study

| Measure (measure type) | No. of zones | Population | Modes covered | Impedance components ¹ | Attractiveness components | Generalised cost standard ² | Comment |
|---|--------------|------------|---------------------------------|-----------------------------------|--|--|--|
| Accessibility to work (doubly-constrained) | 19 | ~2,040,000 | Public transport Car | Time and running costs/ fares | Jobs in zone per employment type (5 categories) | Yes | Excess costs appeared among professional/ managerial workers but were at large judged as off-setting accessibility towards residential amenity. |
| Accessibility to schools and colleges (nearest facility) | ~1300 | ~2,020,000 | Public transport Car Walk | Time and running costs/ fares | 4 types of facilities (4 measures for local, middle, upper & higher education) | Yes | No high order accessibility problems to these facilities (Wytconsult 1977c, p. 45). Accessibility issues identified were almost entirely confined to public transport users. |
| Accessibility to shops (nearest facility) | ~1300 | ~2,020,000 | Public transport Car Walk | Time and running costs/ fares | 3 types of shops (local shops, shopping centres & major shopping centres) | Yes | The generalised cost standard used meant that problems normally only arose for public transport users. |
| Accessibility to personal business facilities incl. surgeries, health centres, major hospitals, post offices and social security offices (nearest facility) | ~1300 | ~2,020,000 | Public transport Car Walk | Time and running costs/ fares | 5 types of facilities (5 measures for Doctor's surgery, Health care, major hospital, Post Office and Social Security Office) | Yes | The generalised cost standard used meant that problems normally only arose for public transport users. |

¹ The access costs for facilities within the origin zone were set to zero.

² An accessibility problem was defined as the total costs or cost per person in a particular zone for trips that exceeded the generalised cost standard (the average for one or more trips to the specified function/s).

The travel modes included in the study was selected on basis of the frequency of use and included walk, public transport (bus and rail as one system) and car driver. Cycle, motor cycle and taxi modes were not included to limit the work load (Wytconsult 1977b, pp.29-30). The main implication of excluding these three modes was found to be the potential travel cost advantages by improved cycle network and more cycle trips could not be explored at the subsequently developed transport strategy (Wytconsult 1977b, p.31.).

Accessibility was first taken as the degree of opportunity available to people, both as individuals and as commercial operators, to undertake specified activities. It was also stated that accessibility levels normally not are affected by the amount of travel actually undertaken. Traffic conditions may be seen as representing problems because they involve scarce resources as human time and fuel and have environmental and safety impacts. But in the study these costs only represented *accessibility problems* when the total journey costs of people affected exceed an acceptable limit or standard. It was said that they usually did not. On the contrary poor accessibility was often found to occur in places where operating conditions in terms of e.g. congestion are generally satisfactory. The final definition of accessibility in the WYTS was taken as “A measure of the ease of access to or from an area or facility in terms of the generalised cost of travel” (Wytconsult 1977a, Glossary of Terms).

The focus on accessibility relatively to other objectives.

Four main objectives were identified for the extensive surveys carried out (Wytconsult 1977c, pp.6-7, 10-18). Two of these were directly related to accessibility; personal accessibility to facilities and population catchments for facilities. The other two objectives were safety and environment. The objective of *personal accessibility to facilities* was “to promote a land use/ transport system which provides acceptable standards of accessibility to specified facilities by appropriate transport modes having regard to the needs and mobility characteristics of the population.” The objective of *population catchments for facilities* was “to promote a land use/ transport system such that the facilities provided have adequate catchments of users within an acceptable range having regard to the needs and mobility characteristics of the population.”

Calculation of personal accessibility measures

Using population characteristics of urban areas from 1971 census data the number of people in each zone in each of 11 person types and four car availability classes was determined. The car availability classification used in WYTS was; no car available, car available but no driving licence, less than 0.6 cars per driving licence and 0.6 or more cars per driving licence. For each of the person type a travel need was established. A male semi-skilled working adult was established to have a basic travel need of 20 return journeys a month to a male skilled and semi-skilled manual job, four trips to a shopping centre, two trips to a major shopping centre, one trip each to a health centre, Social Security Office and a major hospital. A woman with dependent children was estimated to have a basic travel need of 16 return journeys to local shops, 30 trips to a primary school (supervising child), eight trips to a shopping centre, three trips each to Doctor's surgery, Post Office and a health centre/ small hospital, two trips to a major shopping centre and one trip each to a Social Security Office and a major hospital.

Twelve types of facilities and five types of jobs were considered in the study. The travel need for each person type was matched with the availability of destinations. For shopping, education, health and welfare the cost of access to the *nearest* of each of the facilities was used as it was used to firstly assess the need for basic requirements and not the choice of people travelling to facilities further away (Wytconsult 1977b, pp. 25-27). Measuring access to work was found "fundamentally different" as a job serve one person only while the other facilities in principal serves all people that so desire (Wytconsult 1977b, p. 27).

The travel costs between every zone pair was calculated for public transport (incl. walk time) and private car respectively. For any type of facilities that were located within the origin zone the travel cost was set to zero with all modes (Cooper et al. 1979, Table II). The travel cost component of public transport was divided into walking time to access bus stop, waiting time, travel time and fare costs. The generalised cost for car was based on travel time and distance-based costs for fuel etc. For car travel the time cost typically represented about 30% of the generalised cost while running costs derived from travelled distance represented about 70% of the total cost.

A key part of the planning approach was to assess the accessibility problems against standards (Wytconsult 1977c, pp. 6, 31). These accessibility standards were set using a Delfi technique within the study team and the “severity of an accessibility problem was defined as the cost in excess of the standard” (Cooper et al. p. 30). Different standards were applied to each of the 12 facilities while the five categories of jobs were split into two groups, e. g. an acceptable trip cost to a shopping centre was assigned to be 30 generalised cost minutes while the standard was 16 generalised cost minutes for local shops. Professional/ managerial jobs were applied a cost standard of cost of 97 generalised cost minutes per return trip equalling 45 min travel time with public transport or 29 minutes by car. The standard for the other four job categories was set to 73 cost minutes equalling 35 minutes by public transport and 22 minutes by car (Cooper et al. p. 30). Excess access costs for work trips were only calculated for car drivers and public transport and not in terms of walking as the walk mode was not included in the Strategic Model used for the access to work calculations (Wytconsult 1977b, p.56).

Accessibility to work

For accessibility to work the study found that no single measure adequately reflected the conditions in the area (Wytconsult 1977c, p. 31). Altogether nine measures of accessibility to work were considered within the study. Additional complexity is added by the fact that travel costs relate only to those workers that actually are in employment, and that some areas may suffer high unemployment partly as a result of poor accessibility to jobs (Wytconsult 1977c, p. 31). It was concluded that the best single cost measure of the job accessibility problems was the total excess costs and for comparing areas the excess cost per worker (Wytconsult 1977c, p. 31). The excess cost was measured as generalised cost minutes of travel time and fares/ car running costs excess to the set travel cost standard.

The specification of the methodology used for calculating the excess cost measures is somewhat unclear. It seems that the original idea was to include only jobs within a specified travel cost threshold but that this was later abandoned due to the “amount of work involved” (Wytconsult 1977e, p.7.). It is apparent that a number of work trip matrices were produced. The numbers of available jobs for each of the five job categories was established by reclassification of data from the Department for

Employment. The destination of work trips was “divided in proportion to the number of jobs of each type in each zone” making use of the five job categories (Wytconsult 1977b, p. 56.). According to Wytconsult (1977b, p. 56.) the modal split (i.e. how many people that would travel with each mode for each job type) for the residential zone was identified from actual travel data (Home Interview Survey). The modal split from the Home Interview Survey was used to calculate an average travel cost per job type and car availability in each residential zone to each job zone.

In remote areas since a large proportion of the jobs would be far away and in the main urban centres. As the excess cost measure would allocate some trips to these centres it may explain that remote villages like Whetherby and Ilkley were found to have excess cost per worker of 3 to 7 times the ones in more central areas. To relate to this distance a ‘remoteness index’ was presented alongside to represent accessible job opportunities (Wytconsult 1977e, p.7, Wytconsult 1977c, p. 31-32).

Accessibility to schools and colleges

The output was plotted on a map with bars representing “excess cost units” for local, middle, upper and higher education separately for the study zones. It was concluded that many of the problems which appear on this map are in reality solved by the provision of special school buses. The problem of costs therefore was transferred from the individual to the education authority. The study revealed that most of the primary school problems are caused by schools not being well located in relation to housing areas.

The study was based on the travel costs (time + cost components) to the nearest facility although this was recognized as an oversimplification of reality, e.g. due to the nature of school catchments areas. The approach was justified in that it would highlight all potential problems and it would then be possible to later dismiss problems that do not exist. The cost standards (the lower limit of generalised cost minutes from which excess costs is calculated) were set differently for each of the four school types. The cost standard for higher education was nearly quadruple of the one for primary schools. This made the study team conclude that even if the higher education facilities are fewer and more centralised the journey time and cost standards to a large extent allow for this. It was concluded that in terms of total

excess costs there are no high order accessibility problems to these facilities in the County (Wytconsult 1977c, p. 45). The further analysis of accessibility to schools concentrated on the potential problems arising from the use of scheduled buses.

Accessibility to shops

The analysis of shopping facilities was carried out for three different levels; 'local' shops, 'shopping centres' and 'major' shopping centres. In brief 'local' shops were defined to include small shopping parades with at least one so called 'indicator' shop (bank, chemist or butcher). Isolated supermarkets and discount stores were also classified as local shops. 'Shopping centres' were defined as either freestanding centres with eight or more durable goods shops. 'Major' shopping centres included the Leeds and Bradford city centres and other centres having all types of shops.

The study was outlined on a map presenting bars of the exceeded costs per area for the three types of facilities respectively. It was concluded that the accessibility problems to a large extent reflect the assumptions built into the analysis process. Accessibility problems were identified in areas which might not accord well with the general view of local residents. In the Cookridge area there seemed to be a high order problem of accessibility to local shops. However it was found that this problem was of much lower significance than the accessibility measure indicated as shops existed in the area. The shops were scattered around and therefore did not meet the criteria for local shops and residents may therefore suffer some inconvenience due to this. However, not of such magnitude as the first analysis indicated. A similar classification bias was revealed for an area with poor accessibility to a major shopping centre.

In spite of the classification and methodology issues mentioned above, the study was suggested to reveal some useful aspects of shopping accessibility. The accessibility issues identified related as much to land use planning and development policies as to transportation planning (Wytconsult 1977c, p. 53). A number of areas were identified with poor accessibility to local shops, others with poor access to middle order shopping centres. Again it was found that due to the higher cost standard used the County as a whole has fewer problems of accessibility to the major centralised shopping centres (i. e. similar to the access to higher education). The data revealed

was used to discuss the accessibility problems identified and how they related to policy (e. g. the different development policies in Bradford and Leeds and the existence of out-of-town shopping centres) as well as poor public transport links between housing areas and shopping centres (e. g. residential neighbourhoods at the edge of Leeds urban area).

Accessibility to personal business facilities

The journeys made under the term personal business facilities aimed at targeting those made on behalf of an employer, those made to conduct personal business and those made for social reasons. Accessibility measures were calculated for five types of facilities:

- Doctor's Surgery,
- Health Centre,
- Major hospital,
- Post Office, and
- Social Security Office.

The choice of these five types of mainly health and welfare facilities was justified on account of their importance to individuals and the community at large, also bearing in mind that the most frequent users of health and welfare facilities tend to be the disadvantaged groups. In addition it was concluded that social and recreational trips were not suitable for personal accessibility analysis due to the individuality in trip patterns. These trips were therefore not included in the study.

Separate cost standards were calculated for each of the five facilities with the highest for Social Security Offices and major hospitals (based on a survey of actual travel patterns). As for the shopping accessibility study this standard meant that problems normally only arose for public transport users.

Two areas of the county were found to have more general accessibility problems while the Post Offices were found to be the most evenly distributed of all facilities and very few problems were apparent for accessing these. In a similar manner only a few areas with poor accessibility to doctor's surgeries were identified. No areas were

found with severe problems to access health centres, although some areas were found to have significant excess costs. The location of major hospitals was found to require people travelling by public transport to change at least once. Infrequent services were found to cause difficulties for those visiting hospitals. For Social Security Offices several accessibility problems were identified.

Presentation

The output was plotted on maps and also presented as tabulated data. The maps produced were illustrated with a bar for each zone with accessibility problems representing the zone's excess cost units in relation to the applied travel cost standard.

Discussion

The study was significantly disadvantaged by the lack of modern computer facilities. Nevertheless the accessibility measures produced are more advanced in their nature than the current practice in planning, e.g. the PTAL measure. A fact that can be attributed the amount of resources available for the WYTS. Considerable effort was put into the study. The WYTS contained more than 100 reports and studies. However, despite the relatively generous budget it was found that enough resources were not available to develop an accessibility measure for the cycle mode. Neither was walking accessibility included in the work places assessment.

The studies identified that public transport users were the one worst off. In all the non-work related accessibility studies (i.e. accessibility to schools/ colleges, accessibility to shops and accessibility to personal business facilities) the excess costs (above the set standard) were almost entirely limited to public transport users (see Table 1). It is noted in the WYTS technical reports (Wytconsult 1977b, e) that some of the measures are biased and give higher emphasis to public transport, e.g. all walking trips between zones in the access to work study were modelled as more costly public transport trips. It was also found that the exclusion of the cycle mode would make the model exaggerate the trip costs of school children as other modes of walking and public transport available to this group would incur greater costs, i.e. travel time and fares (Wytconsult 1977b, p.31).

Cooper et al. highlighted five main features of the study. Perhaps the main one is the first – the “large difference in travel costs (time and money taken together) incurred between people with and without personal use of a car.” (Cooper et al. 1979, p. 30). The four other main conclusions refer to car ownership as well. The second conclusion refers to how many professional/ managerial workers with cars are able to trade-off longer journeys towards residential amenity or lower housing costs. Number 3-5 refers to how different areas have poor access by public transport to major shopping centres, have a very high public transport dependency/ low car ownership and how low housing density and the location of housing in other areas means poor accessibility by walking, cycling and public transport. For example, the average excess cost per head for people without a car living in Wakefield and Holmfirth were found to be up 70 times higher to reach the specified facilities than for people with a driver’s license and a car (Wytconsult 1977e, p.39). This is a measure perhaps not so much of car-free households’ accessibility to basic services but more of the general disadvantage in terms of the limited opportunities available for those without a car. It was also found that those who will gain use of a car under the planning period to 1991 would have their access costs “substantially reduced”. Those without a personal car and driving license, an estimate share of two-thirds of all people in 1975-77, would experience increased accessibility problems due to anticipated increase in costs and reduced levels of public transport service (Cooper et al. 1977, p.31.).

Appendix 2

Overview of planning approaches used in the South Yorkshire Structure Plan

Introduction

The South Yorkshire Structure Plan involved two main studies of accessibility in the context of land use planning. One study aimed to establish residential zones poorly served by recreation areas and indoor sports centres (Mallett et al. 1977a). A second study was concerned with production of alternative location strategies for housing, industry and recreation developments, including assessment of the suitability of various committed and proposed developments as well as the priorities among them (Mallett et al. 1977b).

Both studies covered an area of 156,000 hectares with a population of 1,317,000 in 1974. The average density was 8.4 persons per hectare. Sheffield had the highest density with 15.3 persons per hectare and was also the largest conurbation in the county with about 560,000 inhabitants. Other major urban areas included in the study were Barnsley, Doncaster and Rotherham. An outline of the accessibility measures used is presented in Table A.2.1.

Theoretical foundation

The main land use planning study (Mallett et al. 1977b) applied a refined sieve map technique to identify and locate sites for specific uses. A sieve map study is essentially a process where types of areas are either removed from a base map as unsuitable or highlighted as suitable for development for a specific usage based on identified planning criteria. The methodology incorporated location and accessibility factors along with other considerations (e.g. water supply costs, pollution) into one index. A weighting system was used to assign each area a development score for each type of development. The initial phase of the study involved a public consultation which brought forward a list of objectives/ criteria for each of the three specific aspects of developments assessed (industry, housing and recreation).

Table A.2.1. Outline of accessibility measures used in the South Yorkshire Structure Plan

| Measure (measure type) | Output | No. of zones | Population | Modes covered | Impedance component | Attractiveness component | Comment |
|---|-------------------|--------------|--------------|-------------------------|---------------------|--|---|
| Accessibility to major outdoor recreation areas and major indoor sport centres respectively (composite index) | Coloured zone map | 230 | 1,317,000 | Public transport Car | Unclear | Selected major facilities and suggested new facilities | Combinations of three measures were used to estimate the accessibility: 1. Areas served approach (direct bus service only, home - destination) 2. Deterrence function approach (car + direct bus) 3. Catchment area approach (car + direct bus) |
| Dependence on Public Transport (other measure) | Coloured zone map | 230 | 1,317,000 | Public transport | - | - | Percentage of population dependent on public transport (i.e. people in households not owning a car and people other than heads of households in households owning one car) |
| Countryside recreation accessibility (gravity model) | Coloured grid map | ~1500 | 1,317,000 | Public transp.* Car | Distance | Population | The purpose of this measure was to site new countryside recreation facilities in close to areas of existing population |
| Job accessibility (gravity model) | Coloured grid map | ~1500 | 1,317,000 | Public transp.* Car | Distance | Number of jobs | The purpose was to describe areas where the maximum choice of jobs could be offered to the workforce of new residential sites |
| Market accessibility (accumulative catchment) | Coloured grid map | ~1500 | >1.3 million | Public transp.* Car | Travel time | Population within 60 min travel time | The measure was created to describe locations where employer's choice of markets and supplies could be maximised. The study included parts of Manchester, West Yorkshire, Derby and Nottingham |
| Shopping accessibility (gravity model) | Coloured grid map | ~1500 | 1,317,000 | Unclear | Distance | Shopping centre floor space (type of facilities unclear) | The measure was created to describe locations where new residential locations could benefit from existing shopping centres |
| Bus accessibility (other measure) | Coloured grid map | ~1500 | 1,317,000 | Public transport | - | Percentage of each zone covered by a bus route corridor | To give the most economic provision of bus services it was considered important to site development near to existing bus routes. A min. route frequency of 2 services per hour was used and a corridor representing 10-15 minutes walking time on either side of these routes |
| Labour accessibility (gravity model) | Coloured grid map | ~1500 | 1,317,000 | Public transp.* Car | Distance | 'Economically active' residents | The purpose of this measure was to find locations that would maximise the choice of labour for employers as the Structure plan identified this as one of the most critical factors for new and re-locating firms. |

It could be questioned to what extent this measure actually describes public transport accessibility as the impedance component is unclear. The study explicitly outline that "travel distance" is the only impedance component used (Mallett et al. 1977b, p.15, p.16, p.18, p.20).

In the studies accessibility took many different meanings and was measured using both accumulate catchment, distance-weighted (gravity) and non-distance weighted measures. See Table A.2.1 for more details.

In general there was only little discussion in the technical reports of the definitions of accessibility used and why the term accessibility was preferred for such disperse objectives as peoples quality of life (e.g. outdoor recreation accessibility) and business competitiveness (e.g. market accessibility). What was clear from the general definition was though that greater mobility was not necessary per se increasing accessibility. Personal accessibility *“depends on mobility and on proximity to work, shops, schools, entertainment and so on. For example, if most people’s daily needs could be satisfied within easy walking distance of their homes, a low level of personal vehicular mobility might be acceptable. If, on the other hand, activities are dispersed for various (economic, environmental or social) reasons, then the need for such mobility is much higher and, once achieved, it tends to encourage further dispersal and longer distance movements.”* (Mallett et al. 1977c, p. 116)

South Yorkshire Accessibility to Recreation Study

The recreation study suggested locations for new recreation facilities and/ or improvements of transport networks based on their accessibility by public transport. An iterative process made use of a combination of three different accessibility measures, each with their advantages and disadvantages acknowledged. The study aimed at identifying so called deficiency areas (i.e. areas with poor accessibility to recreation facilities). The three accessibility approaches used were:

- Areas served by bus services – areas connected to a recreation facility by a direct and frequent bus service.
- Catchment area approach: The cost of travelling to the nearest facility was calculated. Based upon this and an established accessibility standard accessibility ‘deprived’ zones were identified. The standard was established making use of data on the cost of journeys that people are prepared to make. The accessibility deprived zones were identified as where trip costs exceeded those costs that 90% of the population were prepared to make.

- Deterrence function approach: A deterrence function based on trip cost distribution was estimated from a survey of public transport and the private car travel patterns. The summation of all likelihoods from one residential zone to all facilities, based on the latter's individual attraction values, were used as measure of the residents accessibility¹.

The essential output of the study was two county-wide maps that identified areas 'deprived of good access' by public transport to indoor sports centres and countryside recreation areas respectively. Six new recreation areas were proposed to improve access for the areas worst of. In addition an assessment was made of the correlation between dependence on public transport and accessibility to the outdoor recreation areas. It was concluded that the problems are most severe where deprivation coincides with high dependency on public transport. A country-wide map of the percentage of population dependent on public transport was provided from 1971. The dependency index varied between 45- 94.9% of the population in about 230 zones (wards/ parishes). The index was calculated based upon the people in households not owning a car and people other than heads of households in households owning one car. The proposed new countryside recreation areas would have reduced the numbers of accessibility deprived wards with about 60 (out of a total of about 230 wards/ parishes). Several relatively large areas deprived of accessibility were still to remain.

South Yorkshire Land Potential Analysis

As previously mentioned a second study was concerned with production of alternative location strategies for housing, industry and recreation developments. Accessibility played an essential part of the identified study objectives:

- Two out of five objectives identified for industrial development location were related to accessibility (labour supply for employers, access to markets)

¹ The technical report does not state if the trip cost included travel time and vehicle/ ticket costs. Neither is the score assessed to each facility's attractiveness presented in the report.

- Three out of seven objectives for housing development were related to accessibility (providing choice of jobs, providing choice of shops, new developments located near to existing public transport routes)
- One out of four objectives for countryside recreation development was related to accessibility (locate new facilities near to areas of existing population).

Methods were devised to measuring each objective. Data was recorded and a scale from one to five (1-5), or one to six (1-6), was used to rank each zones potential for development against the different objectives. In this way the ranking was standardised to enable comparison of the various objectives. The data in the study was based on 1km grid squares (about 1500 zones), a trade-off between data collection and analysis costs on one hand and accuracy and functionality on the other. A total of six different accessibility measures were applied, each presented on a county-wide map with 1km grid squares. This six measures concerned countryside recreation, jobs, market, shopping, bus and labour accessibility. See Table A.2.1 for more details.

In the production of the final “potential surfaces” for new industry, housing and recreation developments the scores of each accessibility measure and other factors were first converted onto a 0-100 scale with the best potential being equated to 100. The factors were then weighted to allow policy considerations and also to test how robust the model was to such considerations. As shown in Tables A.2.2 - A.2.4 , three sets of weightings were used: conservationists, planning officers and developers.

The weights were based on two sources of information. The planning offers’ weights were based on a full scale survey of professional staff within the planning department while the conservationists’ and developers’ weights were interpreted from the views expressed at the initial public consultation.

Table A.2.2. Weights assigned to accessibility related objectives for Industrial Development

| Industrial Development Factors | Conservationists | Officers | Developers |
|---|------------------|----------|------------|
| Labour Accessibility | 20 | 23 | 30 |
| Market Accessibility | 9 | 19 | 30 |
| Average weight of the two accessibility factors | 14.5 | 21 | 30 |
| Average weight of all 6 factors (100/6) | 16.7 | 16.7 | 16.7 |

Table A.2.3. Weights assigned to accessibility related objectives for Housing Development

| Housing Development Factors | Conservationists | Officers | Developers |
|---|------------------|----------|------------|
| Job Accessibility | 13 | 18 | 25 |
| Bus Accessibility | 15 | 11 | 0 |
| Shopping Accessibility | 11 | 9 | 15 |
| Average weight of the three accessibility factors | 13 | 19 | 13.3 |
| Average weight of all 7 factors (100/7) | 14.3 | 14.3 | 14.3 |

Table A.2.4. Weights assigned to accessibility related objectives for Countryside Recreation Development

| Countryside Recreation Development Factors | Conservationists | Officers | Developers |
|--|------------------|----------|------------|
| Recreation Accessibility | 21 | 33 | 55 |
| Average weight of all 4 factors (100/4) | 25 | 25 | 25 |

Labour accessibility was calculated as the number of “economically active” residents in South Yorkshire “by both public and private transport” in all zones divided with the “travel distance” between each zone pair, e.g. a gravity model where workers in a zone far away would have less weight than workers living nearby (Mallett et al. 1977b, p.20). Market accessibility was identified as the accumulate numbers of residents in zones within 60 minutes travel time from the particular zone including residents living in main cities outside the county where applicable (Mallett et al. 1977b, p.17). It is not explicitly mentioned which modes that the latter measure covered but is assumed from the context of the study methodology that all people living within 60 minutes drive from the zone are accounted for even if they do not have a care. See Table A.2.1 for more details of the accessibility measures mentioned in Tables A.2.2, A.2.3 and A.2.4.

The use of the accessibility two analyses

The land potential model, wherein accessibility by car, public transport and to some extent also walking played an important part, was found to contradict the existing strategic planning proposals. The existing plan suggested that the north of the county including Barnsley and Doncaster were growth points for development rather than Sheffield that was highlighted by the model. This was interpreted as the model “did not give much support” for the existing strategic planning proposals (Mallett et al. 1977b, p.72). The model “was a useful guide” in the generation of alternative development strategies. The analysis was used “quite widely” to identify directions of future growth for housing and outdoor recreation (Mallett et al. 1977b, p.73). The major difficulty was however that the particular model was “designed purely to investigate potential, and was hence of limited use in identifying areas of deficiency and social need around which the final plan was constructed.” (Mallett et al. 1977b, p.73) Another problem of the analysis was perhaps related to the relatively large size of the zones used i.e. 1x1km. The model was not able to distinguish between different levels of potential within urban areas (Mallett et al. 1977b, p.73).

The use of different weights by officers, developers and conservationists highlighted an interesting feature for Sheffield in particular. Sites near the motorway were favoured by the weights assigned by industry developers. But the final weights put on accessibility and other objectives by planning officers led to that the study

concluded that areas, closer to the city centre, were seen to have the highest potential for new developments. The planning officers much likely saw a need to balance the request for accessibility against other and softer values and they only had a limited number of points to distribute towards the various development objectives. As earlier mentioned the planning officers assigned the values of conservationists and developers from the views expressed on the public consultation. The developers were assigned higher weights on accessibility for industry purposes. Housing developers were assigned to highly value job accessibility in general while bus accessibility was assigned no value at all (see Tables A.2.2 and A.2.3).

Appendix 3

Local Authority survey questionnaire

To: Local Authorities of England

Attention: X X
Project Manager/ Co-ordinator
Local Transport Plan 2006/7-2010/11

Accessibility Planning Questionnaire

The Government recently published guidance on 'accessibility planning'¹. The new approach to planning is to be incorporated by local authorities in the next round of Local Transport Plans.

This questionnaire forms part of a research study to improve knowledge about the benefits of accessibility planning to local authorities. The results of the study will be shared with the Local Government Association. We are happy to provide all participants with an electronic copy of the results.

The survey is multiple-choice and easy to complete. It should take no longer than 5-10 minutes to fill in.

Your answers will be treated in confidence and in no circumstances will data be presented in any way that would lead to particular organisations being identified.

I urge you to complete the attached questionnaire and return it by post before 25 February 2005.

An email version of the questionnaire is available on request. Any questions about the questionnaire can be addressed to Mr Pelle Envall on 07732 399 467 or email p.envall@its.leeds.ac.uk.

If you feel that you are not the appropriate person to complete this questionnaire on behalf of your department, please pass it to a nominated officer.

Many thanks for your assistance.

Pelle Envall
Project Manager

¹ Guidance on accessibility planning in Local Transport Plans. Published 8 December 2004. Available at: <http://www.accessibilityplanning.gov.uk>

QUESTIONNAIRE: USEFULNESS OF ACCESSIBILITY PLANNING

Name of local authority:

Contact name:

Direct phone:

Email:

 Please tick this box if you want results of the study to be sent to your e-mail address.

The contact details will be separated from the questionnaire and your answers will be treated in confidence.

1a). Would you say that the concept of ‘accessibility planning’, as it is presented in the DfT guidance¹, is new to your local authority?

Very new Fairly new Not very new Not new at all Don't know

1b). If ‘not very new’ or ‘not new at all’: in what type of documents have these issues been addressed before?

Tick all boxes below as appropriate.

- Community Strategy
- Local Transport Plan or similar
- Land use/ development plans
- Local Agenda 21 or similar
- Public Transport Accessibility Level (PTAL) maps/ analysis
- Other documents, please state name(s):
- Don't know
- Not applicable

¹ Guidance on accessibility in Local Transport Plans. Published: 8th December 2004.
Available at: <http://www.accessibilityplanning.gov.uk>

2. Has your local authority developed or planned any of the measures below in relation to accessibility planning?

Please tick one box on each line.

| | YES (complete) | YES (planned) or ongoing) | NO, not currently | Don't know |
|---|--------------------------|------------------------------|--------------------------|--------------------------|
| Performed accessibility pilot study or similar | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Contracted a consultant for some or all of the mapping audits (stage 1 & 2) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Contracted a consultant for some or all of the option appraisal (stage 3) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Trained relevant staff | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Employed new staff skilled in this area | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Initiated a partnership with stakeholders (hospitals, schools etc.) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

3. Consider the circumstances in your local authority. How useful do you consider accessibility planning to be with regards to its ability to:

a) describe your specific transport problems in relation to social exclusion?

- Very useful Fairly useful Not very useful Not at all useful Don't know

b) identify your specific need for transport improvements in relation to social exclusion?

- Very useful Fairly useful Not very useful Not at all useful Don't know

c) appraise your specific transport project proposals in relation to social exclusion?

- Very useful Fairly useful Not very useful Not at all useful Don't know

4. Consider the circumstances in your local authority. How useful do you consider accessibility planning to be with regards to its ability to:

a) describe your local authority's general transport problems?

- Very useful Fairly useful Not very useful Not at all useful Don't know

b) identify your local authority's general need for transport improvements?

- Very useful Fairly useful Not very useful Not at all useful Don't know

c) appraise your local authority's general transport project proposals?

- Very useful Fairly useful Not very useful Not at all useful Don't know

5. The process of accessibility planning involves forming partnerships with schools, the NHS etc. **To what extent do you agree that the ability to engage and sustain partnerships is (or will be) a problem?**

- Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree Don't know

Comment:.....

6. New software for accessibility planning was released at the end of 2004 together with new DfT guidance. **To what extent do you agree that the *tools* needed to carry out relevant accessibility analyses are easy to use?**

- Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree Don't know

7. **To what extent do you agree that the *data* needed to carry out relevant accessibility analyses is available?**

- Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree Don't know

8. **To what extent do you agree that the outputs of accessibility planning will *increase* the ability to communicate the transport problems faced by residents to local policy makers?**

- Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree Don't know

9. **To what extent do you agree that the outputs of accessibility analysis will allow *a meaningful comparison* with other transport problems?**

- Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree Don't know

10. **To what extent do you agree that accessibility planning produces an output that enables *a meaningful comparison* with the output of traditional transport models such as SATURN, EMME/2 and TRIPS?**

- Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree Don't know

11. To what extent do you agree that methodologies based only on distance and a notional travel speed are *reliable* for the purpose of transport planning?

a) for walking accessibility indicators?

- Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree Don't know

b) for cycling accessibility indicators?

- Strongly agree Agree Neither agree nor disagree Disagree Strongly disagree Don't know

12. Do you think that the anticipated *accessibility planning measures* in your local authority will result in a relative change in the level of accessibility for the following groups?

a) for children from deprived neighbourhoods?

- Significant positive change Slight positive change No change Slight negative change Significant negative change Don't know

b) for job seekers?

- Significant positive change Slight positive change No change Slight negative change Significant negative change Don't know

c) for those without access to a car?

- Significant positive change Slight positive change No change Slight negative change Significant negative change Don't know

d) for pedestrians in general?

- Significant positive change Slight positive change No change Slight negative change Significant negative change Don't know

e) for cyclists in general?

- Significant positive change Slight positive change No change Slight negative change Significant negative change Don't know

f) for public transport users in general?

- Significant positive change Slight positive change No change Slight negative change Significant negative change Don't know

g) for car users in general?

- Significant positive change Slight positive change No change Slight negative change Significant negative change Don't know

13. Consider the circumstances in your local authority. In your opinion how consistent is accessibility planning with your local:

a) 'green' objectives and environmental policy?

- Conflicts strongly
 Conflicts slightly
 Neither conflicts nor accords
 Accords slightly
 Accords strongly
 Don't know

b) economic policy and economic growth policies?

- Conflicts strongly
 Conflicts slightly
 Neither conflicts nor accords
 Accords slightly
 Accords strongly
 Don't know

c) housing policies and objectives?

- Conflicts strongly
 Conflicts slightly
 Neither conflicts nor accords
 Accords slightly
 Accords strongly
 Don't know

d) urban development polices and objectives?

- Conflicts strongly
 Conflicts slightly
 Neither conflicts nor accords
 Accords slightly
 Accords strongly
 Don't know

e) educational policies and objectives?

- Conflicts strongly
 Conflicts slightly
 Neither conflicts nor accords
 Accords slightly
 Accords strongly
 Don't know

f) health and social care policies and objectives?

- Conflicts strongly
 Conflicts slightly
 Neither conflicts nor accords
 Accords slightly
 Accords strongly
 Don't know

Comment:.....

14. To what extent do you agree that accessibility planning fits into the context of transport planning and its culture?

- Strongly agree
 Agree
 Neither agree nor disagree
 Disagree
 Strongly disagree
 Don't know

Comment:.....

.....

15. What are your own expectations of the accessibility planning strategy's impact on your LTP submission's ability to attract funding?

- Significant positive impact
- Slight positive impact
- No change
- Slight negative impact
- Significant negative impact
- Don't know

Comment:.....

16. How would you characterise your own expectations of the impact of accessibility planning on your local authority with regards to infrastructure projects?

Please tick one box.

- Higher priority will be given to major physical infrastructure projects than previously
- Lower priority will be given to major physical infrastructure projects than previously
- No significant change of priority will be given to major physical infrastructure projects than previously
- Don't know

Comment:.....
.....

17. In your opinion do you agree or disagree that the guidance on accessibility planning is consistent with other policies coming from the DfT?

- Strongly agree (accessibility planning is consistent with other policies)
- Agree
- Neither agree nor disagree
- Disagree
- Strongly disagree (accessibility planning is inconsistent with other policies)
- Don't know

Comment:.....

18. What difficulties, if any, do you think will have to be overcome in order to meet the expectations of the recent DfT accessibility planning guidance?

Main difficulty/ obstacle:
.....
.....
.....

19. What do you see as the main advantages and disadvantages of accessibility planning?

Main advantage:

.....
.....
.....

Main disadvantage:

.....
.....
.....

20. Do you have any other comments about accessibility planning that you would like to add?

If you have (further) comments related a specific question please state number.

.....
.....
.....
.....

Thank you for your participation.

Pelle Envall
Email. p.envall@its.leeds.ac.uk
Tel. 07732 399 467

Please use enclosed envelope and return the questionnaire before 25 February 2005 to:

"Accessibility Planning Survey",
Institute for Transport Studies, University of Leeds,
Leeds LS2 9JT.

Fax: 0113 343 5334

Appendix 4

Do transport planners think that Accessibility Planning fits into the culture and context of transport planning?

This appendix presents comments made in response to one of the questions in the local authority survey (see Chapter 8, Section 8.3.1). The main question was multiple-choice (n 103) and examined whether transport planners thought Accessibility Planning fitted into transport planning. It was formulated as follows: To what extent do you agree that Accessibility Planning fits into the context of transport planning and its culture? A line below the question allowed respondents to provide comments, with 21 respondents choosing to do so.

"It should fit strongly into this context."

Planning Officer, Non-LTP authority (answered *strongly agree*)

"[Accessibility Planning] looks useful as a bus network planning tool, but [it] doesn't take account of environmental and severance/ safety issues in cycling/ walking."

Planning Officer, LTP authority, (answered *agree*)

I think that there is a general trend from too great reliance on 'engineering' solutions to transport problems to a greater understanding of the benefits of 'soft' measures.

Planning Officer, LTP authority (answered *agree*)

"However, it may have been better lead by the 'corporate centre' with transport as a key stakeholder and corporate centre as the co-ordinator or in a lead role. However, Transport [planning] is well suited to problem solving ethos."

Planning Officer, LTP authority (answered *agree*)

"Should do anyway!"

Planning Officer, LTP authority (answered *strongly agree*)

"We should be working at intervention not engineering solutions."

Planning Officer, LTP authority (answered *agree*)

“But 'softer' measures & local circumstance need to be taken into account, partnerships, travel planning, information, cost, availability.”

Planning Officer, Non-LTP authority (answered agree)

“Many wider issues are driven by the need to provide choice and save money in service delivery. Accessibility planning will provide no revenue funding to make any improvements to the availability of bus services. Accessibility Planning will not enable any improvements to be made.”

Planning Officer, LTP authority (answered agree)

“DfT defines accessibility far too narrowly - public transport is not the only aspect.”

Planning Officer, LTP authority (answered agree)

“I feel that it [Accessibility Planning] would be better to deal with from [a] planning and development angle as solutions are not necessarily transport based.”

Planning Officer, LTP authority (answered neither agree nor disagree)

“It is too early in the process for accessibility planning to fit into the culture of transport planning.”

Planning Officer, LTP authority (answered neither agree nor disagree)

“Accessibility planning offers a standard way of judging what is needed. It forces people to think beyond - doing/ re-doing what was there in the past.”

Planning Officer, LTP authority (answered neither agree nor disagree)

“Accessibility planning covers a wider spectrum than transport planning since access to goods, services and facilities can often be better implemented in ways which minimise or even eliminate altogether the need to travel. Transport planning therefore represents only one specific approach to addressing issues of accessibility.”

Planning Officer, Non- LTP authority (answered neither agree nor disagree)

“There is a strong culture based on 'silos' e.g. new road schemes, new bus stations that will be hard to break down.”

Planning Officer, LTP authority (answered neither agree nor disagree)

"[Accessibility planning] is seen very much in respect of social exclusion but should be seen in its broader context of increasing access (and alternatives to the car). For all."

Planning Officer, LTP authority (answered *neither agree nor disagree*)

"To make this work effectively will require a willingness to look at transport issues in a different way."

Planning Officer, Non-LTP authority (answered *disagree*)

"I am not sure the transport policy team is the best lead in this work. More of a role for the corporate team/ community strategy as many actions will be outside our control."

Planning Officer, LTP authority (answered *disagree*)

"It's a new area that requires a different way of thinking."

Planning Officer, LTP authority (answered *disagree*)

"It is too early to judge what impact accessibility planning will have upon transport planning but it will require a major change of focus in the culture of transport planning."

Planning Officer, LTP authority (answered *disagree*)

"In my opinion, Accessibility Planning is generally still a bit in advance of transport planning and its culture. There is a strong tendency to concentrate on mobility. Where mobility measures are not thought feasible the tendency is to see accessibility as someone else's problem. The problem is compounded by the role of local authorities still being perceived as providing transport infrastructure and supplementary transport services only, both within the local authority and outside agencies."

Planning Officer, LTP authority (answered *disagree*)

"[Accessibility planning] does not fit [the] transport planning culture at present. Clearly [it] has benefits in the future."

Planning Officer, LTP authority (answered *disagree*)

Appendix 5

Route choice survey questionnaire



Headingley and Burley wards

Pedestrian questionnaire

Have your say about walking and the street environment in your area.

Answer this questionnaire and you could win a prize of £25.

The survey is mainly multiple-choice and easy to answer. It should take no longer than 10 minutes to complete.

This questionnaire should be filled in by one member of the household who is over 16.

Return the questionnaire in the enclosed prepaid envelope. Please do so before 11th October 2005.

The survey is part of a research study about how street management best can be improved.

Your answers will be treated in confidence and in no circumstances will data be presented in any way that would lead to individuals being identified.

Any queries can be addressed to Mr Pelle Envall on 0113 – 343 73 25 (weekdays 9am – 6pm) or email p.envall@its.leeds.ac.uk.

Many thanks for your assistance.

Mr Pelle Envall
Project Manager

SECTION 1. WHAT DO YOU THINK ABOUT WALKING IN YOUR AREA?

1. How often do you walk in the Headingley/ Burley area?

Please tick one box on each row.

| | 5 times a week or more | 2-4 times a week | Once a week | Once a month | Less than once a month |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| a) Walking to local shops, services, bus stops or your work place. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Walking purely for leisure. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

2. Do you agree that the streets in the Headingley/ Burley area are well designed for pedestrians?

- Strongly agree
 Agree
 Neither agree nor disagree
 Disagree
 Strongly disagree
 Don't know
-

3. Do you agree that the streets in the Headingley/ Burley area are well maintained for pedestrians?

- Strongly agree
 Agree
 Neither agree nor disagree
 Disagree
 Strongly disagree
 Don't know
-

4. Do you, for any reasons to do with the street environment or personal security, avoid walking to a particular local shop, service, bus stop or other place?

Please tick the most appropriate box.

- Yes
 No

If yes, which shop/ service/ bus stop/ or work place do you avoid walking to?

Shop name/ Street name/ location:

If yes, why?

.....

5. What improvements, if any, do you think are the most important in order to make more local journeys on foot possible for you?

.....

SECTION 2. WALKING TO PARTICULAR DESTINATIONS

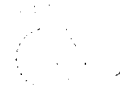
6. How often do you go to Arndale Centre or the facilities immediately nearby *to/ from your home?*

The shops in Arndale Centre include Somerfield, Wilkinson, Blockbuster and Superdrug amongst others. Immediately nearby are Natwest and Barclay banks, Headingley Library and many small shops.

Please tick one box on each row.

| | 5 times per week or more | 2-4 times per week | Once a week | Once a month | Less than once a month | Never |
|---|--------------------------------|--------------------------|--------------------------|--------------------------|---------------------------------|--------------------------|
| On foot | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| By car (driver or passenger) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| By taxi | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| By bus | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| By bicycle | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| By another mode, please specify: | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Please go to next page.



In daytime

8. Which of the following reasons are important in choosing the particular walking route that you marked on the map?

Please tick one box on each row.

| | Very important | Fairly important | Not very relevant | Not at all relevant | Don't know |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| The marked route is the most direct | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is the quickest | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is the safest in terms of traffic | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is the most pleasant | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is the safest in terms of assault | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route has enough other pedestrians visible | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is uncrowded | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route avoids steep gradients | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is the only one I know | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is easy to navigate without getting lost | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Other reason, please specify: | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



In daytime

9. Do you sometimes use routes other than the one you marked on the map when walking from your house to Arndale Centre *in daytime*?

Please tick the most appropriate box.

Yes No

If yes, why/ when do you choose a different route?

.....

.....

.....



When dark

11. Which of the following reasons are important in choosing the particular walking route that you marked on the map?

Please tick one box on each row.

| | Very important | Fairly important | Not very relevant | Not at all relevant | Don't know |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| The marked route is the most direct | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is the quickest | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is the safest in terms of traffic | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is the most pleasant | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is the safest in terms of assault | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is the most well lit | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route has enough other pedestrians visible | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is uncrowded | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route avoids steep gradients | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is the only one I know | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| The marked route is easy to navigate without getting lost | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Other reason, please specify: | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



When dark

12. Do you sometimes use routes other than the one you marked on the map when walking from your house to Arndale Centre *when dark*?

Please tick the most appropriate box.

- Yes No

If yes, why/ when do you choose a different route?

.....

.....

.....

SECTION 3. SOME QUESTIONS ABOUT YOURSELF

13. How long have you lived in the Headingley/ Burley area?

- more than 10 years
 4 - 9 years
 1- 3 years
 3 -12 months
 1- 3 months
 less than 1 month
-

14. Are you male or female?

- Male
 Female
-

15. What is your age group?

- 16-24 years
 25-49 years
 50-65 years
 over 65 years
-

16. Do you experience any difficulties walking?

- Yes (health issues/ walking stick/ wheel chair / walking frame user)
 No
-

17. Are you a student, working or retired?

Please tick the most appropriate box.

- Student
 Retired
 Working
 Currently unemployed

If working or a student, where do you work/ study?

Please write full work/ study place post code. If post code is unknown write address/ location on the line below (for example Beckett Park Campus):

Work/ Study Post Code:

18. Do you have any children under the age of 5 years?

- Yes
 No
-

19. Does anyone in your household own a car?

- Yes
 No

20. Would you be prepared to take part in an interview to help us find out more about how the walking environment in your area can be improved?

- No
- Yes

Please provide your contact details if you wish to be entered into the prize draw.

Name:

Address:

Postcode:

Phone:

Use the prepaid envelope and post the questionnaire to:

Institute for Transport Studies
University of Leeds
P. Envall
FREEPOST NEA 15353
LEEDS LS2 3YY

Thank you for your participation.

Pelle Envall
Project Manager

Phone. 0113 343 73 25
Email. p.envall@its.leeds.ac.uk

Appendix 6

Environmental attributes priority list

Table A.6.1. Environmental attributes priority list

| No. | Attribute | Type of measure | Data source | Cost estimate | Estimate of relevance | Comment |
|-----|---|------------------|-------------|---------------|-----------------------|---|
| 1 | Distance | Count | OS Landline | * | * * * * | GIS desk study |
| 2 | Motorised traffic flows above 10,000 vehicles on link | Binary | Survey data | * | * * * | Data available from Leeds City Council (24h, 7 day average) |
| 3 | Link through park or forest | Binary | OS landline | * | * * | GIS desk study |
| 4 | Link not within 25m from buildings | Binary | OS Landline | * | * | GIS desk study |
| 5 | No pavement on link | Binary | OS Landline | ** | * * * | GIS desk study |
| 6 | Motorised traffic volume estimate | Ordinal (levels) | Survey data | ** | * * * | Data available from Leeds City Council (some site visits needed to fill gaps) |
| 7 | Gradients above 6% | Binary | Site Visit | ** | * * | May be difficult to calculate because of data limitations |
| 8 | Street lighting quality | Ordinal (levels) | Survey data | ** | * * | Data available from Leeds City Council (some site visits needed to fill gaps) |
| 9 | Lines of sight shorter than 5m <i>along</i> link | Binary | Site Visit | ** | * * | Walkthrough survey (for parts of network only) |
| 10 | Un-sealed pavement surface | Binary | Site Visit | ** | * * | Walkthrough survey (for parts of network only) |
| 11 | Difference in elevation on link | Count | OS landline | ** | * * | GIS desk study (i.e. climb in metres) |
| 12 | Path shared by pedestrians and cyclists | Binary | Site Visit | ** | * | Shared link may only be used by few cyclists (low level of cycling in area) |
| 13 | Pavement on link narrower than 1.5m. | Binary | OS Landline | ** | * | Not always relevant due to obstructions |
| 14 | Link <i>not</i> traffic calmed | Binary | Site Visit | ** | * | Difficult to assess and not always relevant (i.e. 20mph speed) |
| 15 | Type of signalised crossing facilities | Nominal | Site Visit | ** | * | Limited relevance (green time for pedestrians more important) |
| 16 | Barb wire on top of walls/ fences adjoining link | Binary | Site Visit | ** | * | i.e. security measures signalling that there is a high level of crime |
| 17 | Boarded up buildings | Binary | Site Visit | ** | * | May be difficult to assess (e.g. construction work) |
| 18 | No frequent serviced bus stops on link | Binary | Site Visit | ** | * | e.g. > 15 min headway daytime |
| 19 | Noise estimate | Ordinal (levels) | Site Visit | ** | * | e.g. no noise/ interrupted noise/ severe constant noise |

| No. | Attribute | Type of measure | Data source | Cost estimate | Estimate of relevance | Comment |
|-----|---|------------------|-------------|---------------|-----------------------|---|
| 20 | Likelihood of <i>not</i> seeing another pedestrian on link | Ordinal (levels) | New survey | * * * | * * | No established methodology known (also correlated with route choice) |
| 21 | Level of service of signalised crossings | Ordinal (levels) | New survey | * * * | * * | |
| 22 | Vertical projections above 13mm | Binary | Site Visit | * * * | * * | i.e. defects or non-flushed kerbs |
| 23 | 85 percentile traffic speed | Ordinal (levels) | New survey | * * * | * * | Very little existing data available. |
| 24 | Permanent obstructions reducing the effective width of pavement to <1.5m | Binary | Site Visit | * * * | * * | e.g. sign posts or utilities |
| 25 | Average pavement width | Ordinal (levels) | OS Landline | * * * | * | Not always relevant due to obstructions |
| 26 | Kerb-side litter estimate | Ordinal (levels) | Site Visit | * * * | * | e.g. no litter/ some litter / semi-permanent litter, fly-tipping (may vary significant in area near stadia) |
| 27 | Narrow sections longer than 20m where you cannot avoid a potentially threatening person ahead | Binary | Site Visit | * * * | * | i.e. fences on either sides of a path or sections of pedestrian railings |
| 28 | Kerb-side vegetation or niches where potentially threatening people can hide. | Binary | Site Visit | * * * | * | Difficult to assess |
| 29 | Security gates for windows or doors at adjoining buildings | Binary | Site Visit | * * * | * | Difficult to assess |
| 30 | Presence of graffiti estimate | Binary | Site Visit | * * * | * | i.e. clearly visible, minimum Ø 0.3m (could constitute positive feature) |
| 31 | No grown-up trees visible within 25m of link. | Binary | Site Visit | * * * | * | Difficult to assess |
| 32 | No gardens adjoining the link | Binary | Site Visit | * * * | * | Gardens not always positive factor (may be full of litter) |
| 33 | Pavement surface defects | Binary | Site Visit | * * * | * | i.e. broken flags, depressions above 30mm or 'ponding' |
| 34 | Estimate of no. of shops and restaurants adjoining link | Ordinal (levels) | Site Visit | * * * | * | e.g. based on length of shop fronts |
| 35 | No front doors visible within 25m of link | Ordinal (levels) | Site Visit | * * * | * | |

Appendix 7

Further results of the network model

Introduction

This section describes the full results obtained from running the network model presented in Chapter 9, Section 9.5.6. All analyses are carried out for trips made *when dark* for the full sample ($n = 192$) as well as for a subset of the sample, i.e. those taking significant detours ($n = 81$).

The role of natural surveillance

Table A.7.1 presents the results for networks with different levels of natural surveillance. The impact on pedestrian route choice was explored by omitting links which had sections more than a certain distance from building outlines, using buffer distances of 15, 20, 25, 30, 40 and 50m.

Table A.7.1. Results for networks with different levels of natural surveillance

| Network model description | Model results | | | |
|---|----------------------------------|--------------------|--|--------------------|
| | All respondents ($n = 192$) | | Those with routes >5% longer than shortest path in unrestricted network ($n = 81$) | |
| | Successful prediction | Prediction rate | Successful prediction | Prediction rate |
| Links further than 15m from buildings omitted | 28 | 14.6% | 5 | 6.2% |
| Links further than 20m from buildings omitted | 29 | 15.1% | 6 | 7.4% |
| Links further than 25m from buildings omitted | 105 | 54.7% | 1 | 1.2% |
| Links further than 30m from buildings omitted | 105 | 54.7% | 1 | 1.2% |
| Links further than 40m from buildings omitted | 111 | 57.8% | 3 | 3.7% |
| Links further than 50m from buildings omitted | 110 | 57.3% | 2 | 2.5% |
| Unrestricted network (full network without barriers) | 111 | 57.8% | 0 | 0% |

In as much as the length of the predicted paths were within 5% of the chosen path excluding links more than 20m from buildings achieved the best result, explaining 6

out of 81 trips. But this restriction meant that only 15% of all route choices were successfully predicted. Simply omitting links away from buildings therefore did not provide a robust explanation to pedestrian behaviour.

The role of vehicle flow

A second set of networks analysed the role of motorised traffic for pedestrian route choice, investigating to what extent pedestrians avoided heavily trafficked routes or segregated footpaths. The results are presented in Table A.7.2. This group of networks achieved some interesting results. Removing segregated footpaths (links where vehicle traffic is prohibited) increased the prediction rate to 67% (compared with 58% for the unrestricted network, based on shortest distance only). Removing both segregated footpaths and links with less than 500 vehicles per day (links with traffic flow below 500 vehicles omitted) reduced the successful prediction rate to 25%.

Table A.7.2. Results for networks with different levels of vehicle flow

| Network model description | Model results | | | |
|--|-----------------------------|--------------------|--|--------------------|
| | All respondents (n= 192) | | Those with routes >5% longer than shortest path in unrestricted network (n = 81) | |
| | Successful prediction | Prediction rate | Successful prediction | Prediction rate |
| Segregated footpaths omitted | 129 | 67.2% | 29 | 35.8% |
| Links with traffic flow below 500 vehicles omitted | 48 | 25.0% | 8 | 9.9% |
| Links with traffic flow below 3,000 vehicles omitted | 14 | 7.3% | 5 | 6.2% |
| Links with traffic flow below 5,000 vehicles omitted | 14 | 7.3% | 5 | 6.2% |
| Links with traffic flow below 10,000 vehicles omitted | 9 | 4.7% | 0 | 0% |
| Unrestricted network (full network without barriers) | 111 | 57.8% | 0 | 0% |

The role of street lighting and surfacing

The third group of networks investigated the role of street lighting, if the links were sealed or not and if they contained short sightlines, shown in Table A.7.3.

Table A.7.3. Results for networks with different levels of lighting or surfacing

| Network model description | Model results | | | |
|---|-----------------------------|--------------------|--|--------------------|
| | All respondents (n= 192) | | Those with routes >5% longer than shortest path in unrestricted network (n = 81) | |
| | Successful prediction | Prediction rate | Successful prediction | Prediction rate |
| Unsealed links omitted | 128 | 66.7% | 17 | 21.0% |
| Links with sightlines shorter than 5m omitted | 108 | 56.3% | 5 | 6.2% |
| Unlit links omitted | 128 | 66.7% | 17 | 21.0% |
| Links with average street light level below 10 lux omitted | 17 | 8.9% | 6 | 7.4% |
| Links with average street light level below 15 lux omitted | 10 | 5.2% | 0 | 0% |
| Unrestricted network (full network without barriers) | 111 | 57.8% | 0 | 0% |

Omitting unsealed link (Table A.7.3) achieved a result similar to that of excluding segregated footpaths (Table A.7.2). This is not surprising since several segregated paths in the study area were unsealed. Simply removing unlit links achieved the same results as for omitting unsealed links as these two networks were almost identical. Omitting links with sightlines shorter than 5m reduced the overall prediction rate somewhat, from 58% to 56%. Removing links where street lighting had an average horizontal illuminance of less than 10 lux (Eav 10 lux) and 15 lux (Eav 15 lux) respectively reduced the overall prediction rate to less than 10%.

The role of multiple environmental attributes including vehicle flow

Table A.7.4 presents the results of the fourth group of networks. The two first networks investigated the impact of removing links a certain distance from buildings and specified vehicle flows. Removing links with little vehicle traffic more than 30m from buildings in several cases achieved a prediction rate of around 73%. Omitting segregated footpaths more than 30m from buildings achieved an almost identical network to those where links with less than 3,000 vehicles were excluded (<500 vehicles, <3,000 vehicles).

Table A.7.4. Results for selected networks with multiple attributes including vehicle flow

| Network model description | Model results | | | |
|--|-----------------------------|--------------------|--|--------------------|
| | All respondents (n= 192) | | Those with routes >5% longer than shortest path in unrestricted network (n = 81) | |
| | Successful prediction | Prediction rate | Successful prediction | Prediction rate |
| Segregated footpaths omitted where these are >15m from buildings | 135 | 70.3% | 33 | 40.7% |
| Segregated footpaths omitted where these are >25m from buildings | 140 | 72.9% | 32 | 39.5% |
| Segregated footpaths omitted where these are >30m from buildings | 140 | 72.9% | 32 | 39.5% |
| Segregated footpaths omitted where these are >50m from buildings | 110 | 57.3% | 2 | 2.5% |
| Links with <500 vehicles omitted where these are >15m from build. | 104 | 54.2% | 12 | 14.8% |
| Links with <500 vehicles omitted where these are >25m from build. | 136 | 70.8% | 29 | 35.8% |
| Links with <500 vehicles omitted where these are >30m from build. | 140 | 72.9% | 32 | 39.5% |
| Links with <500 vehicles omitted where these are >50m from build. | 110 | 57.3% | 2 | 2.5% |
| Links with <3,000 vehicles omitted where these are >15m from build. | 48 | 25.0% | 10 | 12.3% |
| Links with <3,000 vehicles omitted where these are >25m from build. | 136 | 70.8% | 29 | 35.8% |
| Links with <3,000 vehicles omitted where these are <30m from build. | 140 | 72.9% | 32 | 39.5% |
| Links with <3,000 vehicles omitted where these are >50m from build. | 110 | 57.3% | 2 | 2.5% |
| Links with <5,000 vehicles omitted where these are >15m from build. | 47 | 24.5% | 10 | 12.3% |
| Links with <5,000 vehicles omitted where these are >25m from build. | 135 | 70.3% | 29 | 35.8% |
| Links with <5,000 vehicles omitted where these are >30m from build. | 139 | 72.4% | 32 | 39.5% |
| Links with <5,000 vehicles omitted where these are >50m from build. | 110 | 57.3% | 2 | 2.5% |
| Links with <10,000 vehicles omitted where these are >15m from build. | 37 | 19.3% | 1 | 1.2% |
| Links with <10,000 vehicles omitted where these are >25m from build. | 105 | 54.7% | 1 | 1.2% |
| Links with <10,000 vehicles omitted where these are >30m from build. | 139 | 72.4% | 32 | 39.5% |
| Links with <10,000 vehicles omitted where these are >50m from build. | 110 | 57.3% | 2 | 2.5% |
| Unrestricted network (full network without barriers) | 111 | 57.8% | 0 | 0% |

The role of multiple environmental attributes including lighting

A fifth group of networks combined the role of attributes from the first four sets, for example links with poor street lighting quality and sightlines shorter than 5m, as shown in Table A.7.5.

Table A.7.5. Results for selected networks with multiple attributes including lighting

| Network model description | Model results | | | |
|---|-----------------------------|--------------------|--|--------------------|
| | All respondents (n= 192) | | Those with routes >5% longer than shortest path in unrestricted network (n = 81) | |
| | Successful prediction | Prediction rate | Successful prediction | Prediction rate |
| Segregated footpaths omitted where street lighting <10 lux. | 129 | 67.2% | 29 | 35.8% |
| Segregated footpaths omitted, links with sightlines <5m omitted. | 129 | 67.2% | 29 | 35.8% |
| Links with sightlines <5m omitted, segregated footpaths omitted where these are >30m from buildings | 139 | 72.4% | 36 | 44.4% |
| Links with sightlines <5m omitted, links with <500 vehicles omitted where these are >30m from buildings | 139 | 72.4% | 36 | 44.4% |
| Links with sightlines <5m omitted, links with <3,000 vehicles omitted where these are >30m from buildings | 139 | 72.4% | 36 | 44.4% |
| Unrestricted network (full network without barriers) | 111 | 57.8% | 0 | 0% |

Omitting links with sightlines shorter than 5m along routes, in combination with removing segregated footpaths, links with vehicle flow below 500 and 3,000 vehicles respectively where these were further than 30m from buildings again resulted in prediction rates of around 72% for the whole sample. These three networks also performed well in predicting the route choices of those taking detours, with a prediction rate of 44% for this subgroup.

No route possible

It was found that some of the networks described in this appendix that achieved fairly good prediction rates had numbers of respondents for whom no route was

possible. Obviously no route choice prediction could be made where all links were omitted to the destination, i.e. an 'island effect' arose. A further analysis was carried out to investigate the extent to which this was happening. This was done for the best performing networks, i.e. those with a prediction rate above 65% for the full sample when dark.

Table A.7.6. Respondents using a route for which some links are omitted

| Network model description | Model results | | | |
|--|-------------------------|-----------------------|--|-----------------------|
| | All respondents (n 192) | | Respondents taking routes >5% longer than shortest path (n 81) | |
| | Had no route possible | Successful prediction | Use a route for which some links are omitted | Had no route possible |
| Segregated footpaths omitted where these are >30m from buildings | 0 | 140 (73%) | 5 | 0 |
| Links with <500 vehicles omitted where these are >30m from build. | 0 | 140 (73%) | 5 | 0 |
| Links with <3,000 vehicles omitted where these are <30m from build. | 0 | 140 (73%) | 5 | 0 |
| Segregated footpaths omitted where these are >25m from buildings | 0 | 140 (73%) | 6 | 0 |
| Links with sightlines <5m omitted, segregated footpaths omitted where these are > 30m from buildings | 0 | 139 (72%) | 5 | 0 |
| Links with sightlines <5m omitted, links with <500 vehicles omitted where these are >30m from build. | 0 | 139 (72%) | 5 | 0 |
| Links with sightlines <5m omitted, links with <3,000 vehicles omitted where these are >30m from build. | 0 | 139 (72%) | 5 | 0 |
| Links with <5,000 vehicles omitted where these are >30m from build. | 0 | 139 (72%) | 15 | 0 |
| Links with <10,000 vehicles omitted where these are >30m from build. | 0 | 139 (72%) | 15 | 0 |
| Links with <500 vehicles omitted where these are >25m from build. | 0 | 136 (71%) | 9 | 0 |
| Links with <3,000 vehicles omitted where these are >25m from build. | 1 | 136 (71%) | 19 | 1 |
| Segregated footpaths omitted where these are >15m from buildings | 0 | 135 (70%) | 9 | 0 |
| Links with <5,000 vehicles omitted where these are >25m from build. | 4 | 135 (70%) | 30 | 3 |
| Segregated footpaths omitted | 11 | 129 (67%) | 12 | 9 |
| Segregated footpaths omitted where street lighting <10 lux. | 11 | 129 (67%) | 12 | 9 |
| Segregated footpaths omitted, links with sightlines <5m omitted. | 11 | 129 (67%) | 12 | 9 |
| Unsealed links omitted | 3 | 128 (67%) | 3 | 3 |
| Unrestricted network (full network without barriers) | 0 | 111 (58%) | 0 | 0 |

The results of the analysis are shown in Table A.7.6, distinguishing between the full sample (n=192) and a subset of those taking detours (n=81). In addition the frequency with which a respondent's preferred route made use of an omitted link was analysed.

As shown in Table A.7.6, only 5 out of 81 of those taking detours used any section of a segregated footpath or road with <500 vehicles where these were further away than 30m from buildings. Moderately and heavily trafficked streets, where these were further than 30m from buildings, were used by between 15 and 30 of those taking detours. Segregated footpaths were used by 12 of those taking detours. Omitting any section of segregated footpath meant that 11 out of 192 respondents in the sample had no route possible. This was the highest figure for any of the higher performing networks.