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Innovative Approaches to Option Generation

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Central and local governments often employ sophisticated modelling and appraisal procedures to ensure that the transport strategies and schemes that are selected for implementation meet policy objectives and are economically efficient. But relatively little effort has been made by the profession to develop methods to assist with the generation of appropriate and innovative options which form the core inputs to this whole process.

The paper first summarises UK local authority views about the importance of option generation and their current ability to develop suitable options. It then provides an overview of methods that have been used in a variety of disciplines and policy areas to generate options. Some mainly represent or package existing knowledge, while others encourage 'outside-the-box' thinking, with the aim of developing solutions that have not previously been thought of. Methods range from those that are highly quantitative and replicable, to others that are qualitative and much more subjective in nature.

Four option generation tools developed as part of the DISTILLATE project are described and illustrated with case study examples. Two apply at the strategic level; one is designed to assist in selecting packages of measures that contribute to an urban transport/land use strategy, while the other assists in identifying accessibility problems experienced by different population groups, and in generating a range of potential solutions. The other two apply at the scheme level and are more participatory in nature; they deal with streetspace allocation and with the improvement of community spaces.

Keywords: Option generation; problem solving; transport/land use strategies; transport schemes

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1. Introduction

1.1 Background

This paper is one of a series on a UK research programme, DISTILLATE (Design and Implementation Support Tools for Integrated Local Land use, Transport and the Environment), which carried out research into six barriers deemed of particular importance to UK local authorities, and developed a series of products designed to support local authorities in their decision-making. The DISTILLATE research programme was funded under the UK Engineering and Physical Sciences Research Council's Sustainable Urban Environment initiative, which placed a particular emphasis on research which met the needs of practitioners. It also sought research proposals which were multi-disciplinary, reflecting the complex nature of the problems to be tackled, and multi-institutional, given a concern that no one institution might have the critical mass of research skills needed.

The DISTILLATE programme responded to these challenges by involving local authorities and related actors directly in the research programme and by bringing together the research skills of two interdisciplinary transport research groups, a planning school, a policy-oriented research centre, and a national research establishment. It was designed to help overcome those barriers to decision-making which were judged to be most serious, and most amenable to research-led solutions. It set itself a vision of helping to achieve a step change in the way in which sustainable urban transport and land use strategies are developed and delivered. Further details of the programme as a whole, and of the role of the project reported in this paper, are provided in the overview paper (May, 2009).

1.2 Policy context

In the UK, the Eddington Report (Eddington, 2006) has had a major influence on the UK Department of Transport's policy priorities and procedures. This recommends that "the government should consider what steps it might take to improve option generation in urban areas, so that the right policies can be brought forward". However, while Eddington and various documents generally stress the need to consider a range of potential solutions, there is very little guidance in the UK or elsewhere in the transport literature on how to generate a range of suitable strategy and scheme options.

Authors in other countries have also recognised the importance of improving option generation procedures. For example, in the Netherlands te Brömmelstroet and Bertolini (2008) and Vonk (2006) both stress the importance of participatory development of options as part of the development of comprehensive Planning Support Systems (PSS); while in the USA Couclelis (2005) identifies the use of scenario writing, visioning and storytelling as ways of assisting planning in becoming a visionary and future-oriented process.

However, specific guidance on how to generate options is very limited. In England, local authorities rely heavily on WebTAG guidance when carrying out appraisals. This documentation has a section on 'Developing solutions' which is relatively limited in size and scope; here the main reference is to Unit 2.3, which simply provides a comprehensive list of potential policy instruments, with no guidance on methodologies. The DfT 'Full guidance on Local Transport Plans, Second edition' (DfT, 2006) for English local authorities also encourages the full use of the growing evidence base, but gives no specific guidance on how to select or generate appropriate options for appraisal.

The recently updated Scottish Transport Appraisal Guidance (STAG), published in June 2008, also has a section on option generation. It recommends four sources for generating options (para. 2.3.13):

- "As ideas/outputs from the consultation and participation process;

- Ideas/proposals which have a history and which (or derivations thereof) remain viable options;

- Through the statutory planning and policy process, both for transport initiatives and land-use plans; and

- As ideas/outputs from a structured decision making process followed by the team undertaking the transport planning exercise."

But STAG gives no specific advice on option generation, nor any examples of formal option generation tools that might be used to assist in this process.

Thus, in the UK, option generation is the least considered and developed analytical stage of the transport planning process – and, indeed, is not formally recognised as a distinct stage of the process by many practitioners. The situation seems to be similar in other countries. While considerable efforts have been made (by academics, consultants and local authority practitioners) to develop improved data analysis, modelling and appraisal techniques, very little effort has been put into improving option generation. Yet the recommended strategies and schemes that emerge from a full modelling and appraisal process are heavily dependent upon the quality and range of the options that are input and subject to testing through this process. One of the strands of research in the DISTILLATE project has involved the development of several new option generation tools, at both strategy and scheme levels.

1.3   *Structure of this paper*

This paper first presents in section 2 the results from our canvassing of UK local authority views on the importance of option generation for their own work; section 3 then summarises the findings from a literature review covering a wide range of applications, which investigated the development and use of techniques to identify and diagnose problems, and generate new options. Section 4 introduces the four option generation tools developed by DISTILLATE, which are then described in the following four sections (5 to 8), with material from the case studies where they were applied. The paper ends with an overall assessment of the tools that have been presented, together with some brief conclusions, in section 9.

Further details about the option generation work can be found on the DISTILLATE web site: www.distillate.ac.uk.

2.   Issues raised by local authorities

The eleven local authorities that took part in the final DISTILLATE survey were asked a series of questions about their current approaches to option generation, and whether they would value the provision of better option generation tools (Hull, 2009; Hull and Thanos, 2008).

At the strategy level, most of the authorities reported developing between 2 and 3 options for appraisal. At the scheme level, not surprisingly, the effort expended depended on the size of the scheme: for small schemes (under £100,000), authorities typically developed between 1 and 3 options, whereas for large schemes (over £5m) authorities developed between 2 and 5 options.

Currently, most authorities reported that the use of option generation tools has no influence on their development of a broad range of options, for either small or large schemes; only two considered that they aided the process. Instead, it was national and regional policy guidance, and the need to develop options that contribute to sustainable development that have the greatest positive impacts, while current levels of funding and limited resources for option development were seen as the major hindrances.

When it came to assessing the importance of different sources for generating specific options, professional judgment scored most highly for strategy development, followed by ideas from stakeholder engagement, and national or regional policy guidance. Similar sources were most prevalent when designing medium sizes scheme (i.e. £100,000 to £5m), although to a lesser extent. In both cases, option generation tools were rated as being 'fairly important' or 'makes some contribution'.

Asked whether they were satisfied with the inputs currently provided by option generation tools, six authorities reported being 'fairly satisfied' in relation to strategies and five in relation to schemes; in both cases, four were 'not very satisfied'. Finally, respondents were asked how useful they thought it would be to have additional methods to assist with generating options when developing the four types of strategies and schemes covered by the new DISTILLATE tools described later in this paper. Results are shown in Figure 1.
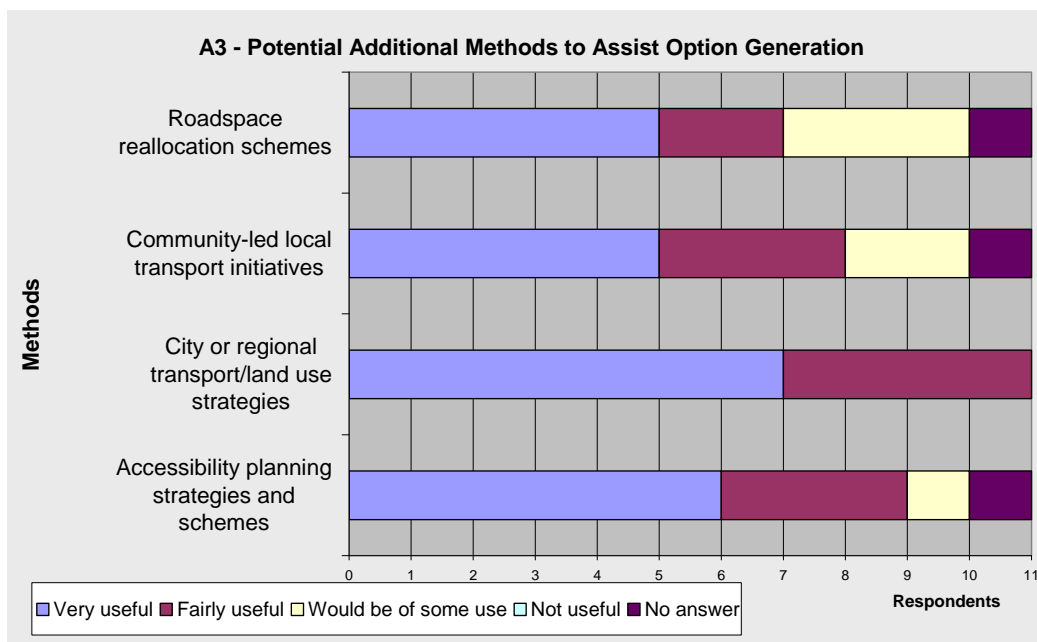

Figure 1. Perceived usefulness of new tools in areas selected by DISTILLATE
Source: Hull and Thanos, 2008, response to Qu. 20.

Here we can see that all of the authorities who responded stated that new option generation tools in each of these areas would be of at least some use, but there was generally stronger support for assistance in developing options for strategies than in the case of schemes – although majorities said that such tools would be 'very useful' or 'fairly useful' in all four cases.

3. Overview of available methods

The DISTILLATE research work began with a review of existing methods for generating options, looking across a wide range of disciplines and application areas (Jones and Lucas, 2005), to see

which methods might potentially be applicable to transport/land use strategy and scheme development.

Figure 2 summarises the generic types of methods that were identified from the review. There is a broad distinction between 'inside-the-box' and 'outside-the-box' methods, with the former based to varying degrees on existing concepts and knowledge, while the latter provides opportunities to generate totally new ideas. Inside-the-box methods are likely to be more structured, quantitative and replicable in nature, while outside-the-box methods are likely to be more qualitative, subjective and non-replicable. There are subdivisions within each of these broad categories, which are briefly discussed below.

METHODS FOR OPTION GENERATION			
"INSIDE" THE BOX		**"OUTSIDE" THE BOX**	
Pre-existing options	Existing parameters, new permutations	Generating new forms of options, including some new parameters	
Select from existing databases/libraries of policy instruments	Morphological Box Analysis: generating (all) combinations	'Systematic' approaches	'Random' approaches
QUANTITATIVE			
		QUALITATIVE	

Figure 2. Different approaches to option generation
Source: derived from Jones and Lucas, 2005, Figure 3

3.1 'Inside-the-box' methods

There is a variety of methods that draw directly from a **library** of existing knowledge. They provide a structured means for the user to access the relevant parts of that assembled information by carefully defining a problem or enquiry. One example from the UK health sector is the Self Help tool on the NHS Direct website (see www.nhsdirect.nhs.uk/). Here the user is asked a series of questions to clarify the set of symptoms they are experiencing and then a set of treatments is recommended. The ELTIS website (www.eltis.org) provides a similar function for professionals wishing to find examples of good transport practice in European cities. The approach thus enables the user to search a comprehensive database of pre-existing information, but does not in itself generate 'new' solutions – although it may encourage applications of existing knowledge in new situations. The tool described in section 5 is based on this approach.

The second type of 'inside-the-box' method can lead directly to new composite solutions, as it takes existing components but encourages them to be combined in new ways. This method is known as **Morphological box analysis**. It requires the definition of a number of design parameters and possible levels or states for each of the parameters. For example, one of the parameters might be fuel type for a bus engine with, say, four possibilities.

The method involves generating potential solutions that comprise sets of the parameters that collectively include all possible permutations of each of their states/levels. So that, if there were four parameters that each had four states, then this would generate 256 possible combinations.

Typically, some of these combinations would already have been used in practice, while others would turn out to be impractical for various reasons - but some are likely to turn out to be novel but feasible. The method has been used in a wide variety of different contexts, from product designs for new electric scooters (Hsiao and Chou, 2004) to option development for the Swedish bomb shelter programme (Richey, 1998).

The basic form of morphological box analysis tends to be rather mechanistic, and can generate a very large number of potential combinations. One way of structuring the outputs of the exercise in a meaningful way is to link it to the Analysis of Interconnected Decision-Areas (AIDA) technique (Luckman, 1967). This provides a systematic method for searching out incompatible combinations of states and also potential dependencies.

In the field of transport planning, the morphological box method has been used by Kocak *et al* (2005) to develop a web based tool to assist in the development of potential road user charging schemes. Here the user builds up a scheme by selecting a state/level for each of a set of parameters covering charging area, charging method, times of operation, types of exemption, technology choices, etc. Some combinations are infeasible (e.g. variable time-of-day charging with a paper-based system), and these are shaded out by the program.

This general approach has been further developed in several applications in transport and elsewhere, by adding an explicit constraint on the generation of potential solutions. The constraint might be a financial limit on the amount that can be spent on putting together a product (e.g. the 'Priority Evaluator', Hoinville, 1971), temporal constraints on how people allocate their time (e.g. the 'Household Activity-Travel Simulator', Jones, 1979), or a spatial constraint, as used in the DISTILLATE tool described in section 7.

3.2 'Outside-the-box' methods

There is a very large body of literature advising on the development and use of methods that can lead to the generation of entirely new kinds of solutions, particularly from the creative industries, and the education and business development sectors. Broadly speaking, a distinction can be made between methods that use structured and systematic processes, and those that encourage a discontinuous leap in thought through the introduction of random stimuli. To our knowledge, there is no documentation of these methods having been widely used in transport planning, although they do feature in some public engagement exercises (e.g. visioning exercises).

Among the **structured** approaches, a wide range of frameworks have been used, from 'mind mapping' techniques, through structured analysis of thought using 'Six Thinking Hats' (de Bono, 1992), to a systematic analysis of problems and solutions using a 'laddering' approach. 'Six thinking hats' encourages thinking processes to be more explicitly separated into their different types; among other things, this allows for both the collection of facts (White Hat) and the expression of feelings and emotions about a particular situation (Red Hat). An example of the laddering approach was a study by Lucas and Psaila (2005) for the Environment Agency, which used a 'snakes and ladders' format to investigate neighbourhood environmental inequalities, by getting people to identifying the underlying causes of problems in their community (descending into detail on a snake) and then building back up to strategic solutions that address detailed causes of the problems.

The **unstructured** approaches rely on the use of visual stimuli or verbal stimuli to encourage innovative thinking, by confronting people with new and unexpected information, as a fresh starting point to consider possible solutions. In the former case this involves the use of carefully selected sets of photographs or pictures, which people are asked to relate in some generic way to the issue at hand; while in the latter case random words may be selected from a dictionary.

Both these approaches have been built into some of the methods developed as part of the DISTILLATE project.

4.   Tools developed by DISTILLATE

The DISTILLATE consortium has developed four option generation tools in response to the users' needs identified in Section 2. Two apply at the strategic level and two at the scheme level. Two draw exclusively on existing knowledge and concepts, using both Library and Morphological Box 'inside-the-box' methods to generate solutions; while the other two incorporate techniques to assist in 'outside-the-box' thinking, which opens up the possibility of generating new types of solutions, using both Structured and Unstructured approaches.

These four tools fill the cells in the two-by-two matrix illustrated in Figure 3, which in three cases also records the area of the country where the relevant case study was carried out. Each tool is presented in its own section below, in the order shown in the figure.

Coming up with appropriate solutions is assisted by a sharpening of the process of problem identification, which helps to diagnose problems more clearly and to look at problems from fresh perspectives. So the tools developed as part of the DISTILLATE project all include a formal problem identification or specification component.

	Strategies	**Schemes**
'Inside' the box	1: Packages of urban measures [KonSULT]	3: Streetspace main road redesign (Bloxwich)
'Outside' the box	2: Accessibility Planning strategies (Barnsley Dearne)	4: Community space design (Blackpool)

Figure 3. DISTILLATE option generation tools

5.   Identifying potential policy packages

This option generation tool was developed as an extension of the KonSULT web-based tool **(K**nowledgebase **on Su**stainable **U**rban **L**and–use and **T**ransport), which has been under development at the Institute for Transport Studies at the University of Leeds for several years (see www.konsult.leeds.ac.uk). It is designed to provide guidance to decision makers on developing packages of land use and transport measures that best meet local requirements, and has been tested with several local authorities, as part of DISTILLATE. Full details are provided in Kelly et al (2008b).

KonSULT itself is a Library tool, which currently contains information on 42 policy instruments, in six broad categories: land use, infrastructure, management and service, information, awareness and pricing. The individual policy instruments included range from Car Clubs to Road User Charging. For each one there is an assessment of (i) its likely contribution to addressing each of a standard set of objectives and problems, (ii) its likely contribution to a set of potential strategies which might be adopted and (iii) its relevance to specified user groups and contexts. Each assessment uses a standard score ranging from +5 to -5 with a zero midpoint, and is based

initially on a professional assessment from first principles. Subsequently a more detailed description is provided of case study applications, so that users can learn about how the instrument has been applied in different countries and with what results. The case study results are also assessed on the same 11-point scale. Assessments are made initially by invited authors, based on their experience of the policy instrument. The Knowledgebase editor then checks these assessments and adjusts them as appropriate to ensure internal consistency within the description of each instrument and external consistency with the assessments of other policy instruments. A description of its development can be found in Jopson et al (2004), and May and Taylor (2002).

The main tool, which was developed at the Institute for Transport Studies, builds on the Library approach of KonSULT. Users can specify their requirements in any one of three ways (see Figure 4): in terms of their policy objectives, the kinds of problems that they face or the indicators that they wish to improve. The lists of possible objectives and problems are those which were already included in KonSULT, but were checked for consistency with current needs. The category of 'Indicators' was added in response to the growing emphasis which local authorities were being asked to place on indicators and targets, and the resulting work described in Marsden and Snell (2009). The indicator list was developed using the principles in Marsden and Snell, and each of the 42 instruments was scored, based on professional judgment, in terms of its likely contribution to improving each indicator.

Figure 4. User selection of objectives, problems or indicators
Source: Kelly et al (2008a), Figure 4

Users initially decide whether to base the search on either local objectives, or problems or indicators, to reduce the risk of double counting. The specific objectives, or problems, or indicators, are then selected, and in each case, a degree of importance can be assigned, from 1 (lowest) to 5 (highest). Users also provide details of the type of area they are concerned with

(corridor, town centre, conurbation, etc.), the nature of their organisation and, if they wish, the types of strategy that they envisage adopting. These strategies are also selected from the categories in KonSULT, and include reducing the need to travel, reducing car use, and improving selected modes. Again users can specify the degree of importance to be assigned to each selected strategy.

Once the inputs have been provided, the option generation tool uses the KonSULT scores and the user's weightings to rank the policy instruments in order of their potential relevance to the policy being developed. Users can specify whether they want an ordered list of all 42 instruments, or only, say, the top ten, or only those achieving at least a given score, or only those of a particular type. The output also provides a broad indication of the cost of implementation for each instrument, and provides a direct link to the fuller information on each instrument in the KonSULT library. The KonSULT option generator thus provides an innovative approach, which stimulates the user to specify his or her requirements, and to consider a wider range of solutions. It is, however, left to the user to decide whether to pursue any of the shortlisted solutions. An example of the output is shown in Figure 5.
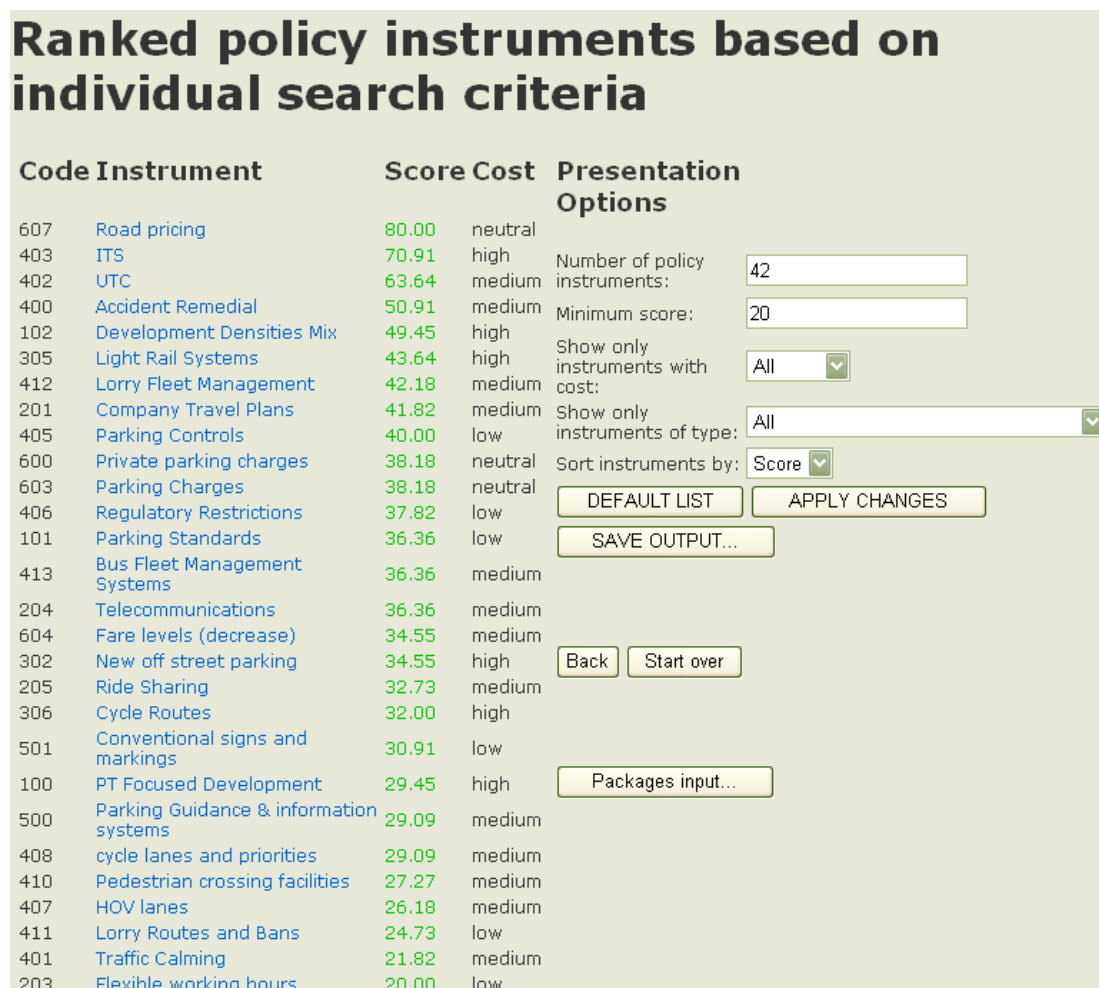
Ranked policy instruments based on individual search criteria

Code	Instrument	Score	Cost	Presentation Options
607	Road pricing	80.00	neutral	
403	ITS	70.91	high	Number of policy instruments: 42
402	UTC	63.64	medium	
400	Accident Remedial	50.91	medium	Minimum score: 20
102	Development Densities Mix	49.45	high	
305	Light Rail Systems	43.64	high	Show only instruments with cost: All
412	Lorry Fleet Management	42.18	medium	
201	Company Travel Plans	41.82	medium	Show only instruments of type: All
405	Parking Controls	40.00	low	
600	Private parking charges	38.18	neutral	Sort instruments by: Score
603	Parking Charges	38.18	neutral	
406	Regulatory Restrictions	37.82	low	DEFAULT LIST APPLY CHANGES
101	Parking Standards	36.36	low	
413	Bus Fleet Management Systems	36.36	medium	SAVE OUTPUT...
204	Telecommunications	36.36	medium	
604	Fare levels (decrease)	34.55	medium	
302	New off street parking	34.55	high	Back Start over
205	Ride Sharing	32.73	medium	
306	Cycle Routes	32.00	high	
501	Conventional signs and markings	30.91	low	
100	PT Focused Development	29.45	high	Packages input...
500	Parking Guidance & information systems	29.09	medium	
408	cycle lanes and priorities	29.09	medium	
410	Pedestrian crossing facilities	27.27	medium	
407	HOV lanes	26.18	medium	
411	Lorry Routes and Bans	24.73	low	
401	Traffic Calming	21.82	medium	
203	Flexible working hours	20.00	low	

Figure 5. KonSULT Option Generation Output Example (presented for scores> 20)
Source: Kelly et al (2008a), Figure 5

This information on the suitability of individual policy instruments has been augmented by the development of a Morphological Box component by the Transport Studies Group at the University of Westminster, which ranks pairs of policy instruments. Before this exercise is carried out, users are invited to determine which of the ranked instruments from the initial KonSULT

output are suited to their area, and whether there are others that should be added to the list. The ranking uses the individual scores from the initial stage of the process, together with an interaction score. The user can select one of two interaction scores based either on the synergies that might be achieved or on the potential of the pair of instruments to overcome the barriers to their implementation. For example, increases in light rail patronage are likely to be greater if this instrument is combined with road user charging, and the provision of light rail will help make road user charging more acceptable. The basis for this scoring is described more fully in Kelly et al (2008b). An example of part of an output listing is shown in Figure 6.

New Rank	Combin- ations	Instrument1	Score1	Cost1	Rank1	Category1	Instrument2	Score2	Cost2	Rank2	Category2	Combin- ed Score	Matrix Score	Total Score
1	306&400	Cycle Routes	22.8	high	4	Infrastructure	Accident Remedial	44.8	medium	1	Management	67.6	-10	57.6
2	400&607	Accident Remedial	44.8	medium	1	Management	Road pricing	14.4	neutral	6	Pricing	59.2	-5	54.2
3	102&400	Development Densitie	26.88	high	2	Land Use	Accident Remedial	44.8	medium	1	Management	71.68	-20	51.68
4	305&400	Light Rail Systems	16	high	5	Infrastructure	Accident Remedial	44.8	medium	1	Management	60.8	-10	50.8
5	400&502	Accident Remedial	44.8	medium	1	Management	Variable Message Sig	7.2	medium	10	Information	52	-5	47
6	400&401	Accident Remedial	44.8	medium	1	Management	Traffic Calming	25.2	medium	3	Management	70	-30	40
7	306&401	Cycle Routes	22.8	high	4	Infrastructure	Traffic Calming	25.2	medium	3	Management	48	-10	38
8	100&400	PT Focused Developr	12	high	8	Land Use	Accident Remedial	44.8	medium	1	Management	56.8	-20	36.8
9	401&607	Traffic Calming	25.2	medium	3	Management	Road pricing	14.4	neutral	6	Pricing	39.6	-5	34.6
10	102&401	Development Densitie	26.88	high	2	Land Use	Traffic Calming	25.2	medium	3	Management	52.08	-20	32.08
11	305&401	Light Rail Systems	16	high	5	Infrastructure	Traffic Calming	25.2	medium	3	Management	41.2	-10	31.2
12	102&306	Development Densitie	26.88	high	2	Land Use	Cycle Routes	22.8	high	4	Infrastructure	49.68	-20	29.68
13	400&411	Accident Remedial	44.8	medium	1	Management	Lorry Routes and Bar	13.6	low	7	Management	58.4	-30	28.4
14	401&502	Traffic Calming	25.2	medium	3	Management	Variable Message Sig	7.2	medium	10	Information	32.4	-5	27.4

Figure 6. Output file showing most highly ranked combinations
Source: Kelly et al (2008b), Figure 9

Unlike the other tools described below, the KonSULT tool was not designed in association with a particular case study, but was formulated to be generally applicable. It was tested by English local authorities involved in a multi-authority Transport Innovation Fund bid, and also by Leeds City Council. In both cases it was judged to be easy to use, and to have helped identify relevant policies which would not otherwise have been considered. Its strengths are that it provides a simple means of identifying those policy instruments which are most likely to be of relevance in each of a wide range of specified contexts, that it is easy and quick to use, that it stimulates new ideas and that it links these to the Knowledgebase's background information on the suggested policy instruments. It is inevitably dependent on the validity of the scores used in KonSULT and on the range of policy instruments which KonSULT covers; unlike the "outside the box" methods it is not designed to stimulate novel approaches on which there is limited information. It is also at present limited to the selection of single policy instruments and pairs of complementary instruments. However, work is in hand to extend this to packages of several instruments.

6.   Accessibility planning strategies

This tool is designed to complement existing accessibility planning methods used in the UK, such as the GIS-based Accession software funded by the Department for Transport (see www.accessiongis.com) or Transport for London's 'CAPITAL' tool (Hopkins et al, 2001), by focusing more on the non-spatial aspects of accessibility planning. It was developed at the Centre for Transport Studies, at UCL. In particular, it identifies temporal constraints on accessing services and a wide range of physical, financial, informational and psychological constraints that may restrict opportunities to access services. This information is used to suggest possible solutions, using both an inside-the-box Library method and an outside-the-box 'Unstructured' component which is based on random combinations of pictures.

The tool has been developed in Excel, drawing extensively on information gained from a series of focus groups with local residents in the Barnsley Dearne area of South Yorkshire, and two

workshops bringing together people from various service delivery agencies. Full details are provided in Jones and Paskins (2008); further working papers are referenced there, and only some aspects are described here.

Figure 7 summarises the four main components of the spreadsheet tool, which starts with the definition of current service delivery patterns and ends with the generation of solutions.
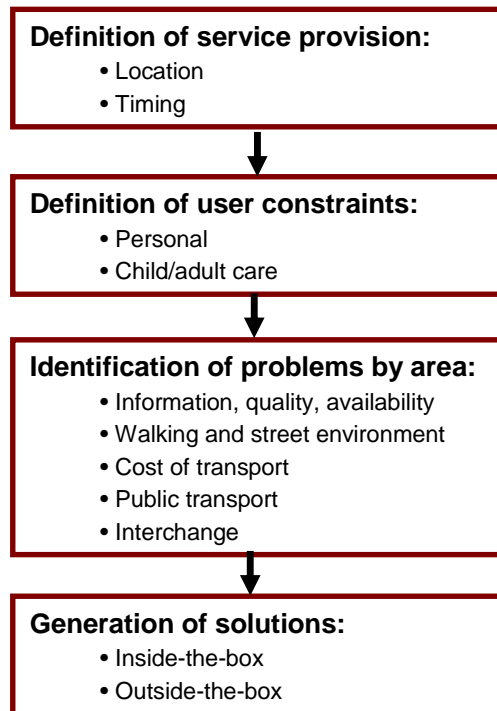
Definition of service provision:
- Location
- Timing

↓

Definition of user constraints:
- Personal
- Child/adult care

↓

Identification of problems by area:
- Information, quality, availability
- Walking and street environment
- Cost of transport
- Public transport
- Interchange

↓

Generation of solutions:
- Inside-the-box
- Outside-the-box

Figure 7. The main components of the spreadsheet tool
Source: Jones and Paskins (2008), Figure 1

Figure 8 illustrates the use of the 'definition of user constraints' summary sheet (the second component in Figure 7). Using a hospital outpatients department as an example, with opening hours between 9am and 6pm on weekdays [displayed in blue], it shows the kinds of timing constraints that might typically be faced by a lone parent with young dependent children, and how these (together with the restricted timings of local bus services) limit the times of day at which appointments can easily be accommodated [as shown in green]. In this case, the adult is constrained by having a part-time job, and the need to ensure that children are dropped off at school in the morning and collected in the afternoon, at set times. They also do some volunteer work, but this is easier to adjust, when necessary.

It is possible to experiment with supplier strategies, in the form of different opening hours and bus service timetables, to see the likely impacts of such changes on increasing or reducing the accessibility of different user groups. This presentation also encourages the analyst to look at the personal and household constraints that a particular group faces, to consider whether reducing accessibility constraints might be achieved through policy initiatives in these areas (e.g. by providing childcare at the end of the school day).

Figure 9 shows how the various kinds of non-timing access problems faced by individuals are recorded in the spreadsheet (component 3 in Figure 7) and then addressed, for each village or part of an urban area. These access problems have been grouped under five broad headings, ranging from 'Information, quality and availability' to 'Interchanges'. Which of these five problem types are applicable depends on where the service is provided (as shown by the grey

hatched cells); this can range from in home or the local area/village, where public transport services are of limited relevance, to nearby market towns or larger cities. Under each of the five headings there is a pre-defined list of potential problems, based on fieldwork among disadvantaged groups in ex-coalmining areas of South Yorkshire, which the user can select from or add to, in order to document problems experienced by residents (as shown in the boxes on the right hand side of Figure 9). This checklist provides a way of codifying qualitative information provided by the community and is intended to get the professional user to think systematically and comprehensively about the kinds of problems that might be faced by residents in different areas.
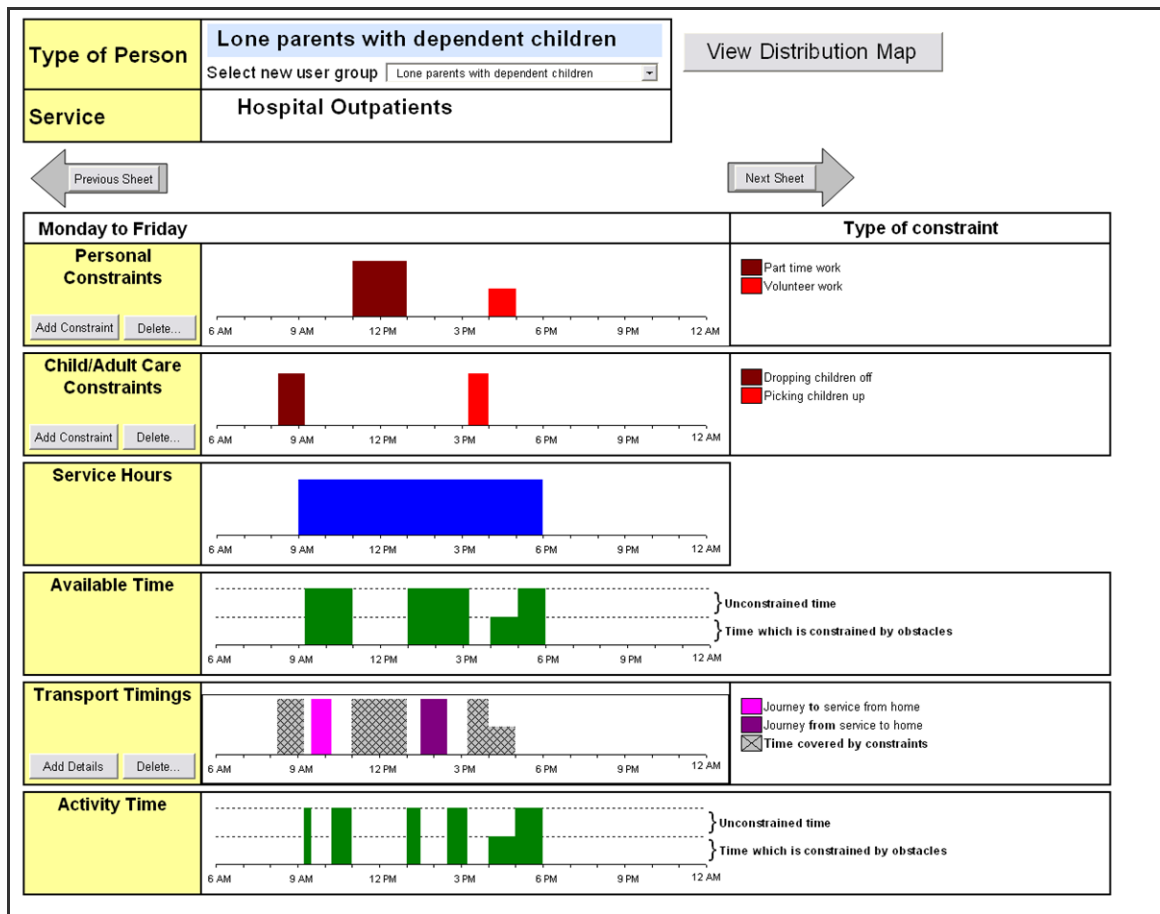
Figure 8. Typical user constraints sheet for a lone parent
Source: Jones and Paskins (2008), Figure 5

Solutions can be identified in one of two ways (component 4 in Figure 7). Firstly, by clicking on the green 'Suggested solutions' buttons in Figure 9, the user is shown a set of potential (known) solutions linked to each specific problem that has been identified. The solutions have been derived both from the literature and from suggestions that arose during the resident focus groups and professional workshops. The format of this solutions sheet is shown in Figure 10, illustrating three potential solutions to one problem from the 'Walking and street environment' set of problems.

Second, solutions can be generated by clicking on the 'Start Generating New Options' button, when the user is shown a set of three random pictures, which provide a stimulus for thinking about developing new, 'outside-the-box' solutions to that particular problem. This process is

most effective if carried out with the aid of a facilitator working with a small group of people. Space is provided to record up to six ideas that have been stimulated by each set of pictures.

The study of accessibility problems in the Barnsley Dearne area of South Yorkshire was overseen by a Steering Group comprising representatives of the local authorities and various agencies involved in local service provision. The spreadsheet tool has been developed as part of this study, and is helping to inform the development and testing of local accessibility solutions. It is also being applied in other parts of South Yorkshire.

Figure 9. Access problems sheet
Source: Jones and Paskins (2008), Figure 14

Figure 10. Examples of suggested, 'inside-the-box' solutions
Source: Extracted from Jones and Paskins (2008), Figure 19

The main advantages of the method are that it provides a means of summarising and bringing together a wide range of information from various sources, most of which is qualitative in nature, and can easily be added to or modified in discussions with members of the local community and

in professional workshop sessions. The highly visual nature of the format makes it easy to assimilate the relevant information, most of which is only displayed where it is of relevance. The main limitation of the tool at present is in the incorporation of the spatial dimension, which is based on imported maps showing the locations of facilities, different groups of residents and public transport routes.

7.   Streetspace main road redesign

The third DISTILLATE tool is designed to assist in the generation of new designs for the allocation of a limited amount of streetspace where there are strong competing demands, taking into account both physical and regulatory constraints on the provision of facilities on the highway. It is based on a Morphological Box approach, but with a spatial constraint on the outcomes. It was developed at the Centre for Transport Studies at UCL, with inputs from Buchanan Computing. Full details are provided in Jones and Thoreau (2007).

The ways in which streetspace can potentially be used and the associated space requirements are generally prescribed in traffic regulations (e.g. determining the location and sizes of traffic lanes, bus lanes, parking bays), or involve the provision of known types of street furniture (e.g. benches, street lighting), so that there is little scope to develop entirely new street elements. The scope for novelty and innovation lies in the ways in which such elements are selected and combined within a local street environment.

There are two components to this option generation tool, which are designed as sequential, interactive stakeholder engagement aids. The first is physical in form and uses coloured, scale blocks and acetates to represent the different uses to which space in the street can be put; the second is a GIS computer-based tool, which records information on space use electronically and then automatically transforms the traffic components of street space into official road markings. Both components were tested as part of a Walsall Council street redesign exercise on Bloxwich High Street in the West Midlands.

Figure 11 shows some of the street design components used in the physical design exercise in their display box and how, by being made to scale, they give a clear indication of the amount of space required when placed on a local street plan (in this case using a 1:250 scale).

Figure 11. Use of blocks and acetates to redesign space use on a high street
Source: Jones and Thoreau (2007), Figure 6

The types of street space provided for include parking and loading bays, bus, cycle and general traffic lanes, and street furniture on the footway (e.g. bus stops and shelters, cycle stands, and seating). Minimum levels of provision are specified for some types of street elements (e.g. bus stops, disabled parking bays), and participants add to this basic design brief by considering how

they would like the street to be improved in the future. Participants are also encouraged to decide what else to provide by examining the set of street elements on offer, and to consider different options as to where to locate the relevant blocks and acetates – while ensuring sufficient space for moving traffic.

Figure 12 illustrates the physical tool being used in a street redesign exercise by a group of local traders, residents and councillors from the Bloxwich area. In this exercise, two design groups worked in parallel, each developing its own proposals. The blocks and acetates are subsequently replaced by stickers of equivalent shape and colour, to provide a permanent record of what has been proposed.

Figure 12. Participants redesigning their high street
Source: Jones and Thoreau (2007), Figure 8

The second part of the exercise first involves translating the physical streetspace outputs from the design workshops into a computer package using a GIS computer-based format. Having done this, the design options can be shown to larger groups of stakeholders on a big screen, and edited on line in response to comments received in a second community workshop session. For the design features that have been introduced on the carriageway (e.g. bus lanes, loading or parking bays), the colour block representation can automatically be translated into the equivalent UK regulatory white road markings. A modification of Buchanan Computing's 'Linemap' software was used for this purpose, as illustrated in Figure 13 (see www.buchanancomputing.net/Brochures/LineMap.pdf).

Working with traffic engineers from Walsall MBC, the application of this two stage streetspace design process led to an agreed solution for Bloxwich High Street which achieved a high degree of public support, and minimal objection at the formal Traffic Regulation Order making stage – in a situation where previous, more conventional attempts, to develop a design solution had encountered considerable local hostility. A similar success was achieved when using an earlier version of the method in the Coventry area of the West Midlands. Walsall MBC has now obtained copies of the hardware and software and is using this two-stage process in other parts of their area.
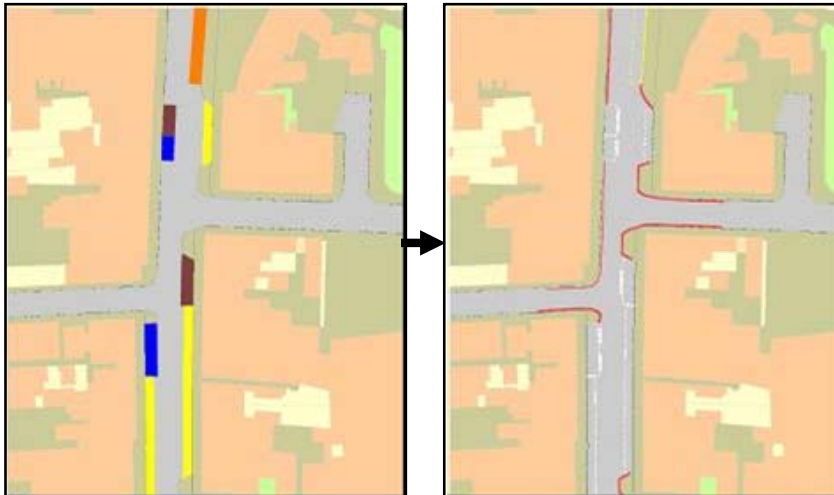
Figure 13. GIS representation of block markings and conversion to road markings
Source: Jones and Thoreau (2007), Figure 9

8.   Community space design

The fourth tool was developed at the Stockholm Environment Institute, at York. It is a largely outside-the-box qualitative, structured engagement tool that is intended to be used with local residents to explore their concerns about their local community environment, and to encourage them to think innovatively about possible solutions. The tool, named Rapid Appraisal Participatory Geographic Information Systems (RAP-GIS), builds upon previous participatory GIS methods developed at SEI to encourage wider stakeholder involvement in urban design and environmental decision making (Cinderby, Snell and Forrester, 2008; Cinderby, 2007; Cinderby and Potts, 2007; Cinderby and Forrester, 2005).

This particular tool is designed especially to encourage the participation of 'hard-to-reach' groups, as defined by local authorities, and was trialled in a poorer area of Blackpool, in North West England. As such the tool differs from other option generation techniques such as the co-design techniques developed in Vancouver (King, 1989). Defining these 'hard-to-reach' groups is obviously problematic, contentious and possibly divisive; however, across numerous local authorities the types of people they have struggled to engage with include:

- People from Black Minority Ethnic groups

- Asylum seekers

- People with disabilities

- Young people

- Older people

- People living in areas of deprivation or on a low income.

RAP-GIS attempts to overcome some of the barriers to engagement experienced by these groups (see Bickerstaff and Walker (2005), IPPR (2004)) through the use of a rapid, multi-temporal, multi-location, in-situ tool. It is an example of an outside-the-box technique that uses a combination of iterative structured queries to encourage individual participants to think in depth about the nature and causes of the problems they experience, and local maps/aerial photographs to capture this information and identify spatially the kinds of solutions that the person judges might work locally.

Respondents are intercepted on street and invited to take part in an exercise to improve their local area. They are first asked to identify any problems and concerns they have about their area (particularly in relation to transport infrastructure and land use facilities), by explaining what they are concerned about and annotating the location and nature of their concerns on a large scale map of their area. Using GIS software, these individual concerns can then be combined to visualise spatially the hot spots of concern, as illustrated in Figure 14 for the Blackpool study. The application of digital spatial analysis (rather than just data storage and visualisation) marks out one of the key differences between RAP-GIS as an option generation technique and other community engagement methods including Planning for Real (see www.communityplanning.net/methods/planning_for_real.php).
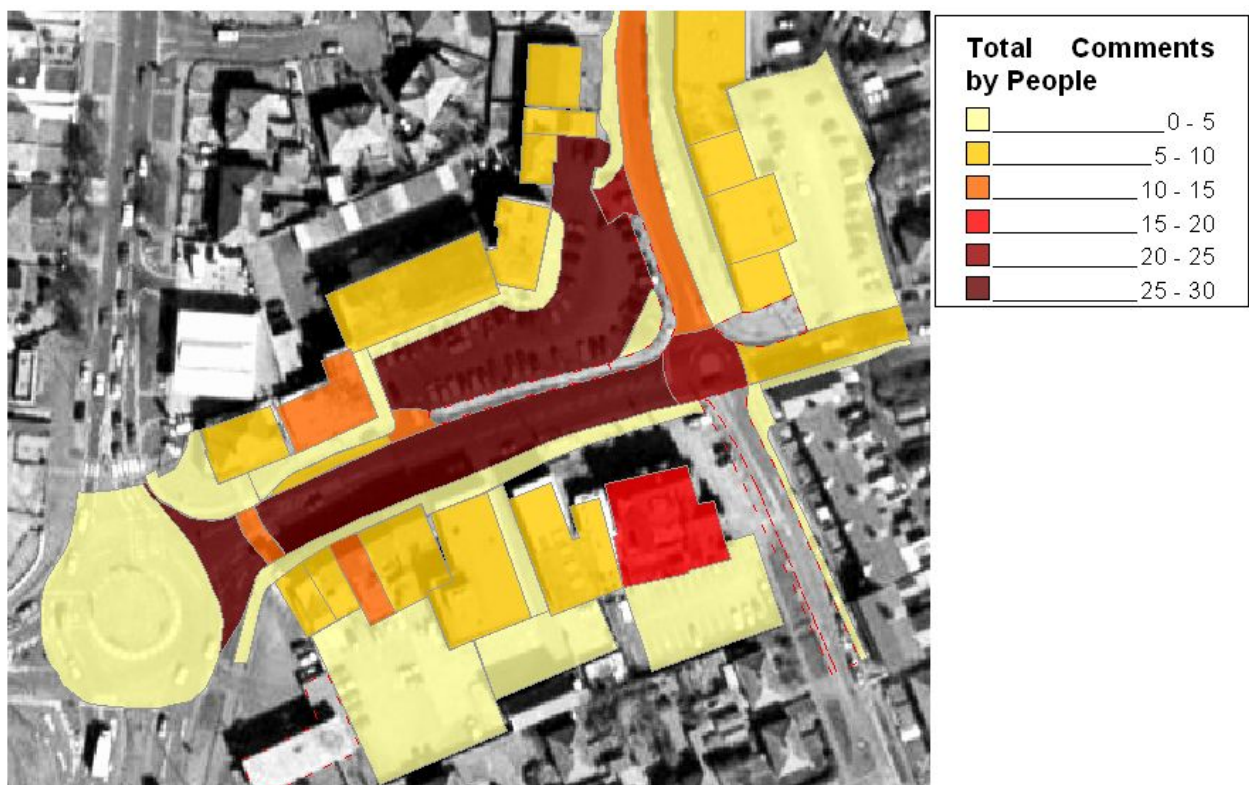

Figure 14. Intensity of problems by area in the local community
Source: Cinderby and Forrester (2008), Figure 2

Participants are next invited to consider in more detail the nature of the problems that they have identified, and to explore the kinds of solutions that might be appropriate, using the structured probing method illustrated in Figure 15.

This type of iterative probing encourages participants to think more deeply about the nature and causes of the problems that concern them, and hence more thoughtfully about the possible solutions. This is a form of the 'laddering' technique described in section 3.2 of the paper. In some cases this structured process can lead to suggested solutions that are very different from a participant's initial, 'knee-jerk' reactions. For example, in one case probing of a participant found that an initial request to "improve the car park" was actually linked to concerns about personal security; after adopting the approach shown in Figure 15, this led to proposals to improve facilities for local teenagers, so that they would not hang around the area and intimidate older people.

The tool is more fully described in Cinderby and Forrester (2008), and has proved successful for generating considerable community participation. In total 151 people commented during three

different in situ mapping activities in one area of Blackpool. The research team was particularly directed by Blackpool Council to engage with young people and those with mobility issues. Of the people who participated, 31 were under the age of twenty years (approximately 21% of participants). These corresponded to a group who would typically not attend conventional consultation exercises and meetings held by the council. The RAP-GIS approach appeared to overcome barriers to participation due to the benefits of being in-situ and also through the novelty of the mapping approach. The on-street mapping exercise proved particularly successful in engaging with school age children, as sessions were held during the early morning school commute and late afternoon as the pupils came out of school. For the older teenagers the sessions that extended into the early evening proved particularly useful as this was when these residents started to make use of the public spaces.
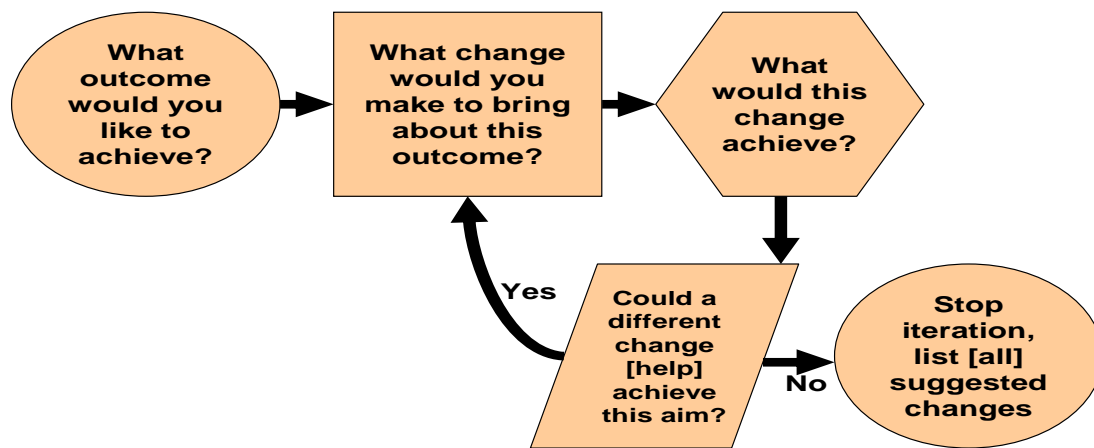

Figure 15. Systematic exploration of problems and solutions
Source: Cinderby and Forrester (2008), Figure 1

Seven people participated (5% of the total sample) who clearly had mobility issues (as manifested through the use of walking aids or wheelchairs). These included older people (in the 65+ age range) alongside younger people with disabilities. In addition to the direct participation from this group, a number of other participants made reference to family members who had mobility issues and described the problems that they experienced in the local area.

The outputs from the RAP-GIS option generation tool were presented to the Blackpool City Council Transport Planning Group as a series of individual thematic maps of problems and solution options. Also presented were 2D visualisations of how schemes of amalgamated options might appear if implemented by the Council. This process proved useful to the Council in terms of understanding the options generated by the community and to assist in grounding the options in terms of their suitability from an engineering viewpoint. For example, the style of traffic calming identified as an option by the public was not current practice within the Council and so could be changed on the visualisation. This did not modify the goal of the option, but rather improved the communication and understanding of how it could be implemented. In general, the options and schemes identified by the RAP-GIS tool proved useful and useable by the Council officers. The outputs are being used by Blackpool Council as the starting point for further engagement with the community in relation to detailed scheme planning.

9.   Conclusions

The amount of time and effort that academics and the profession have put into developing formal techniques for generating solutions to problems is miniscule compared to the resources devoted to data analysis, modelling and evaluation. Yet these various analytical processes are dependent on the options that are generated for testing; the set of strategies and schemes developed for an area is more fundamentally influenced by the options that are generated than by the subsequent appraisal process.

As the policy environment becomes more challenging and multi-faceted, with a growing need to meet multiple policy objectives across several government departments and public and private sector agencies, there is a need to generate more innovative and encompassing options that are able to gain a broad base of stakeholder support. The review carried out at the start of this project revealed the existence of a wide range of generic techniques – both 'inside and 'outside' the box - that could assist the transport planning profession in developing more sustainable solutions, with stakeholder involvement. But, prior to DISTILLATE, very few of these had been adapted to address transport-related problems.

DISTILLATE has added four new option generation tools to the transport planner's armoury, two at the strategy level and two at the scheme level. Between them they illustrate a practical application within transport of the main kinds of methods identified in the literature review. The 'inside-the-box' Library technique is at the core of KonSULT (section 5) and also forms part of the Accessibility Planning tool (section 6), while the Morphological Box Analysis technique is used in KonSULT to look at synergies between pairs of policy instruments, and in a physical form lies at the core of the Streetspace Reallocation tool (section 7), where a spatial constraint is added. Structured 'outside-the-box' methods form the basis for the Community Space design tool described in section 8, both through the use of maps and structured probing, and unstructured 'outside-the-box' methods are incorporated into the part of the Accessibility Planning tool that uses triplets of random pictures to stimulate new thinking.

Two of these tools are quite generic in nature, while the other two are particular applications of a general approach. KonSULT is very broadly based and now incorporates most of the policy instruments that are relevant to European transport and land use authorities; remaining gaps are currently being filled. The Community Space design tool is also very widely applicable, as the recruitment and probing techniques could be applied to any set of problems, and the mapping component of the tool uses readily available commercial software. Conversely, the Accessibility Planning tool is tailored specifically to that kind of issue, although the spreadsheet can easily incorporate new information and solutions. Similarly, the Streetspace Reallocation tool has been designed to look at a particular subset of highway schemes, although the same principle could be applied to other transport situations (e.g. developing a residential housing scheme, routing a light rail scheme, or junction design).

The four tools have been developed in conjunction with local authority partners, in practical contexts. Based on feedback received from local authorities, all have proved to be of value to the professional clients and participants, usually drawn from the engineering and planning professions; in addition, the scheme-level Streetspace Reallocation and Community Space tools have both proved to be very popular with local residents, businesses and politicians.

All the tools seem to have been successful in enhancing the option generation process. At a strategic level, KonSULT led to consideration of a wider range of policy options than would otherwise have been the case, and the Accessibility Planning tool provided a means of capturing community concerns while alerting practitioners to the multi-faceted nature of accessibility problems, and the role played in this by agencies with different – and sometimes conflicting - policy objectives. At the scheme level, both the Streetspace Reallocation tool and the Community

Space design tool were successful in engaging a range of local communities in developing design options; here the main benefits came from producing solutions that were community 'owned', with high levels of community support, in contrast to the low levels of support traditionally associated with professional generated solutions in contested situations. The main drawback to using such tools lies in the amount of time required to effectively engage with local communities. This implies that they should be reserved for situations where engagement is difficult, or where no clear consensus has emerged from more traditional consultation procedures.

Three of the tools have also contributed to the development of products in other DISTILLATE projects. The KonSULT option generator provided one of the conceptual inputs to the sketch planning model (Shepherd et al, 2009), while the Accessibility Planning tool and the Streetspace Reallocation tool provided inputs to the development of new methods for the appraisal of distributional impacts (Page et al, 2009).

The challenge now lies in getting central and local governments across Europe to recognise the existing deficiencies in the ways in which strategy and scheme options are generated, and to encourage wider use of formal option generation methods to ensure that the most appropriate alternatives are input to the appraisal process. The work carried out as part of DISTILLATE provides a start and illustrates what can be achieved, but there remains considerable scope for developing additional kinds of option generation tools, both generic and specific in nature.

Acknowledgements

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