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Modelling and Appraisal of Smarter Choices: Scope for Further Research

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CONTENTS

1. INTRODUCTION

WSP in association with Centre for Transport Studies (CTS) at Imperial College London, Mott MacDonald (MM), and the Denvil Coombe Practice (DCP) have been commissioned by the Department for Transport (DfT) to provide best practice guidance to users of transport models about how to model "Smarter Choices". As part of the work programme, a review was undertaken of the existing literature on the modelling of Smarter Choices and the wider transport and marketing literature. The results of this literature review were presented in detail in Deliverable D2.

The objective of this deliverable is to build on the results of D2 to identify and discuss potential areas for future research to improve the capability to model smarter choices. The document is organised in a number of sections. The next section provides a brief overview of the results of the literature review presented in D2 focusing on the challenges of modelling smarter choices measures and the limitations of existing approaches. Section 3 then outlines a potential modelling framework for smart choices that builds on and extends existing techniques and discusses the research implications. The final section presents some overall conclusions and recommendations.

2. CHALLENGES AND EXISTING APPROACHES

2.1 Conceptual Issues

We argued in D2 that the essence of the challenge associated with modelling smarter choices is that they seek to exploit a much wider range of pathways through which to influence behaviour than to conventional policy measures. In particular, whereas conventional policy measures are largely defined in terms of changes to transport system attributes such as travel time and travel cost, smarter choices measures seek additionally to influence behaviour (and hence outcomes) through changes in travellers' background beliefs, attitudes, perceptions and constraints. Figure 1, adapted from D2, summarises these conceptual differences.
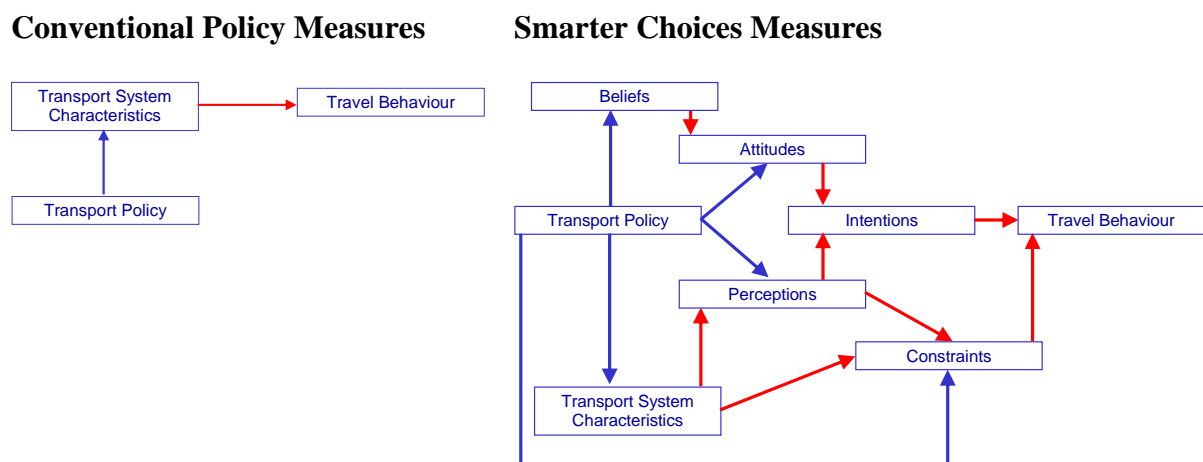

Figure 1: Pathways of Influence Conventional and "Smarter Choices" Measures

Arising from these conceptual and practical differences, there are a number of modelling and analysis challenges, including:

- Dealing with latent quantities: Beliefs, attitudes and perceptions are not directly measurable in the same way that travel times and travel costs are. Generally, the best we can do is to measure various indicators of these latent concepts.

- Dealing with dynamics: There are likely to be strong dynamical affects in the relationship between smart choices policies and changes in beliefs, attitudes and perceptions, indeed advocates of smart choices measures typically emphasis the important of cumulative impacts and reinforcement over time.

- Model specification and estimation: Although the empirical evidence is patchy and its interpretation is contentious, the general picture that emerges from the existing empirical literature is that the impacts of smart choices measures are quite small. This means that there will be significant statistical challenges associated with the identifying relevant parameters and overall effects.

2.2 The Existing Literature

In D2 we reviewed a large number of studies describing existing approaches to modelling the effects of various smarter choices measures. The most commonly used approaches can be broadly classified into three types:

- Approaches based on look up tables: These approaches adjust market shares prior to conventional choice modelling based on a look up procedure operating on an empirical database of the characteristics and effects of existing smarter choices measures. The advantage of this approach is that it is very simple to implement. It is however, purely *ad hoc* and atheoretic in nature and therefore there are significant concerns regarding both its transferability between contexts and its implications for the overall theoretical consistency of the modelling and appraisal process. Moreover, this approach requires large quantities of smarter choices case study data.

- Direct demand approaches: These approaches attempt to predict changes in for example, car trip rates or minority mode market shares, directly as a function of the characteristics of the smarter choices measures being implemented. Techniques such as regression and neural networks have been used to develop these models. Such adjustments are typically applied independently of the main demand modelling activity. In essence therefore, these approaches can be regarded as a refinement of the look up approaches, in which an explicit model replaces the lookup function. As such, many of the concerns regarding transferability and consistency remain.

- Adjusting ASCs: The simplest means by which smarter choices measures can be directly integrated into standard demand modelling procedures is through making adjustments to model alternative specific constants (ASCs). This approach entails assuming that smarter choices measures affect the unobservable attractiveness of different travel alternatives, which can be

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reflected in changes to the ASCs. This approach has a number of problems of both a theoretical and practical nature. Even if the principle of adjustment ASCs is accepted as valid (and many would feel uncomfortable with this principle), the difficulty that arises is in establishing a convincing logic for determining the magnitude of the adjustment that should be made. In practice this is often done by assuming that the smarter choices measures under consideration will have a particular effect on mode shares and then fixing the ASCs to reproduce this assumed effect. This is of course in principle no different to the look up procedure described above, and shares many of the same disadvantages.

Although each of these approaches has certain merits, it is clear that there remains a major task to establish a completely satisfactory approach to modelling smarter choices measures.

3. TENTATIVE MODELLING FRAMEWORK FOR SMARTER CHOICES

In addition to identifying key weaknesses with existing approaches, D2 also highlighted a number of modelling capabilities that we argued are relevant to the development of a more comprehensive and satisfactory treatment of smarter choices measures. These capabilities are:

- Models of relationship between choice and attitudes and beliefs – since smarter choices measures aim in part to influence behaviour indirectly via attitudes and beliefs
- Models of choice set generation – since smarter choices measures aim in part to affect the perceptions of options
- Models of traveller learning – since smarter choices measures aim in part to affect the perceptions of alternative by providing information
- Treatments of the effects of advertising and promotion in consumer choice modelling – since adverting and promotion measures form an important elements of many smarter choices measures.

This section elaborates on these ideas to develop a tentative framework for modelling smarter choices measures and discusses some of the key research challenges that are likely arise in

3.1 Integrating attitudinal and belief data

As argued in D2, a range of different techniques now exist for accommodating the influence of attitudinal and belief data on decision making processes. The most theoretically comprehensive techniques are those based on the characterisation of attitudes and beliefs as latent (e.g., not directly measurable) quantities corresponding to which we can identify a number of indicators.

In conventional applications of these so called latent variable approaches, an individual's underlying attitudes and beliefs are regarded as exogenous quantities, determined by personal and transportation system characteristics. In a potential

application to smarter choices measures, we would regard these attitudes and beliefs as being potentially open to influence through the effect of smarter choices measures. This idea is represented graphically in Figure 2.
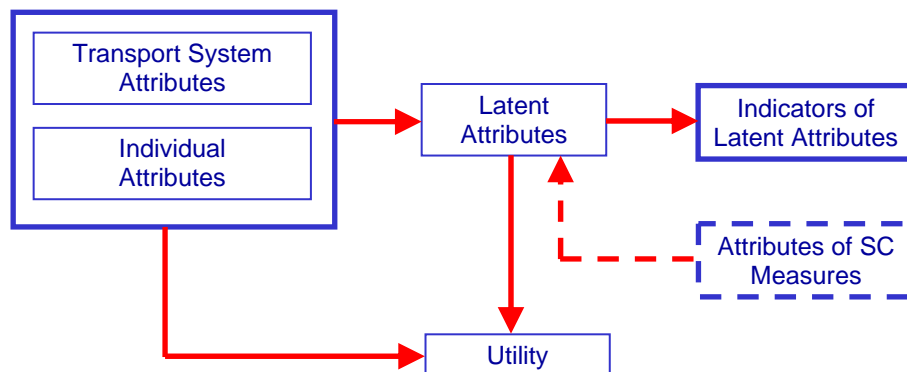

Figure 2: Representation of the Influence of Smarter Choices Measures on Attitudes and Beliefs and hence on Choice

The key innovation in this diagram is the link between latent attitudes and beliefs and the attributes of smarter choices measures (indicated with the dashed lines).

3.2   Integrating an explicit treatment of choice set formation

Whereas it is currently conventional practice for modellers to make *a priori* assumptions regarding the choice sets available to travellers, D2 argued that since smarter choices measures are often concerned with explicitly changing travellers' understanding of and perception of travel alternatives and that such effects are likely to be subject to considerable heterogeneity, such treatments may not be satisfactory in the context of modelling smarter choices measures. Accordingly, D2 presented a number of techniques for the explicit modelling of choice set formation as part of the demand modelling process. In existing applications of these techniques, the formation of choice sets is regarded as being driven largely by observable individual and transport system characteristics. In a potential application to smarter choices measures, we would regard choice set formation as also being influenced directly by smarter choices measures. This idea is represented graphically in Figure 3.
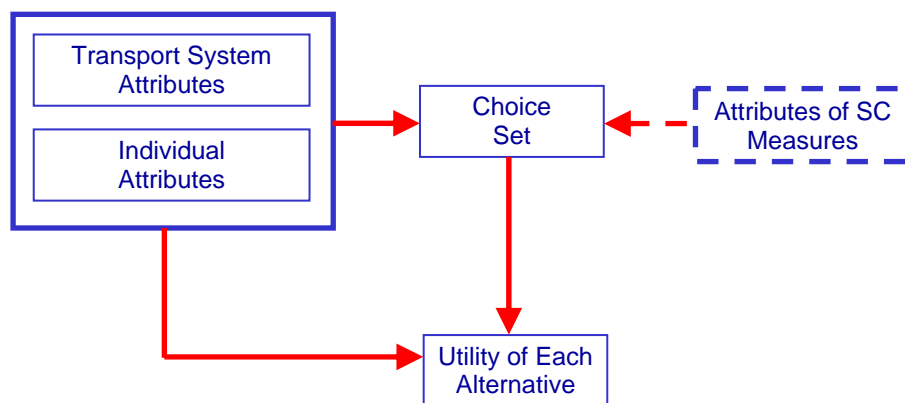

Figure 3: Representation of the Influence of Smarter Choices Measures on Attitudes and Beliefs

The key innovation in this diagram is the link between choice set formation and the attributes of smarter choices measures (indicated with the dashed lines).

3.3   Integrating of learning and adaptation

It is often argued that the effects of smarter choices measures are cumulative over time. As argued in D2, this may imply a need to explicitly accommodate processes of learning and adaptation over time, whereby travellers' beliefs, attitudes and perceptions are changed by experience.

In the conventional analyses of learning reviewed in D2, the process of learning is regarded as being driven principally by feedback from experience. In the presence of smarter choices measures, such experiential learning will continue, but may be influenced by smarter choices measures themselves. This idea is represented graphically in Figure 4.
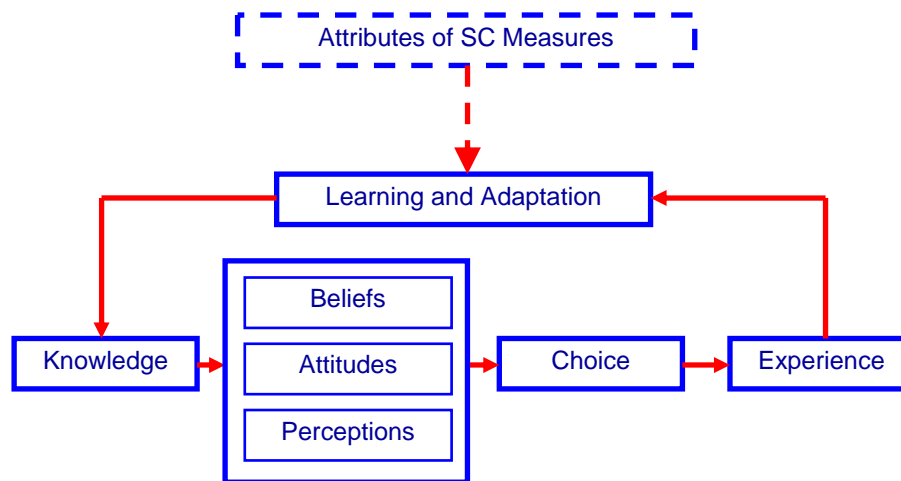

Figure 4: Representation of the Influence of Smarter Choices Measures on Travellers' Learning and Adaptation

The key innovation in this diagram is the influence of (the attributes of) smarter choices measures on the process of learning and adaptation.

3.4   Integrating the influence of advertising and promotions

Closely relate to the issue of learning and adaptation is that of the effect of advertising and promotion campaigns, which form an important part of many packages of smart choice measures. These effects have been extensively studied in the marketing literature, which was reviewed in D2. In this literature, interest focuses principally on how advertising changes individuals' tastes and a number of techniques have been developed to model these effects.

Conventionally in transport models, taste parameters such as ASCs and attribute valuations are regarded as fixed and exogenously determined. In the presence of advertising and promotion campaigns the possibility exists that these tastes may be changed (indeed it is often the explicit objective of such campaigns). The nature of

this change will of course depend on the relevant characteristics of the smarter choices measures. This idea is represented graphically in Figure 5.
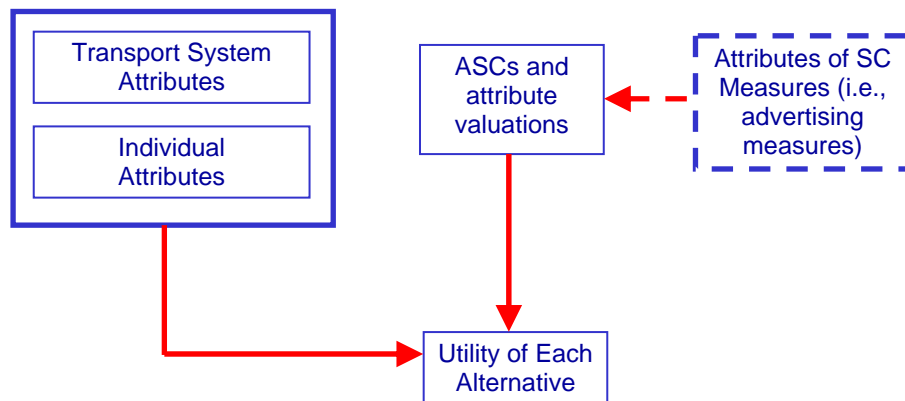

Figure 5: Representation of the Influence of Smarter Choices Measures on Travellers' Tastes

The key innovation in this diagram is the link between travellers' tastes and the attributes of smarter choices measures (indicated with the dashed lines).

4.   CONCLUSIONS

In this document we have considered in more detail a number of the key themes that emerged from the extensive literature review presented in D2 and identified four key modelling challenges associated with the development of a more comprehensive framework for the modelling of smarter choices measures. This framework builds of state of the art discrete choice modelling techniques together with relevant concepts from the marketing literature.

At present this framework is only sketched in very broad terms. A considerable amount of work would be entailed in developing and implementing these ideas in practice. However, the theoretical and practical limitations that characterise existing modelling treatments of smarter choices measures are such as to heighten the importance of making a serious commitment to address this challenge.