The impact of knowledge integration processes on the individual problem perception

A survey with experts in road pricing from Edinburgh, Stockholm, and London

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Diploma Thesis

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"... in no other major area are pricing practices so irrational, so out-dated, and so conducive to waste as in urban transportation."

(Vickery, 2001), 1996 Noble Prize laureate in Economics
Preface

The present report concludes the diploma thesis of a five-year degree course in environmental sciences at the Swiss Federal Institute of Technology in Zurich (ETH Zürich). The purpose of the thesis is not only to apply adopted skills of the degree course, but also to gather experiences in scientific research. During the thesis results and lessons were learnt which can’t be appropriately reproduced in the context of this report. Therefore, I decided to write some of these results in this preface, particularly with regard to the context of the development of the research questions.

After a long search for an interesting and applied research question, I decided for an offer of the Natural Social Science Interface (NSSI). The goal was to carry out a case study in London on the present congestion charging scheme with one of the partner universities of the ‘International Transdisciplinarity Network on Urban Mobility’. A sustainability analysis of the Londoner Congestion Charging Scheme and the upcoming extension of the charging zone was planned. After one month of preparation and study of the case, Professor R. W. Scholz, Alexander Walter and I travelled to London to finalise the cooperation and the open questions of my research outline. In spite of the detailed preparations, including foregoing meetings, telephones and emails, not until then it became obvious that the interests of the partners diverged too strongly for a successful cooperation.

Consequently, we fell back on with a second option for my diploma thesis, still in an international context with another cooperation partner of the network. A similar case study was planned with partners from the MIT in Mexico City. As a clear and detailed proposal already existed for this case study and I accordingly adjusted my thesis together with the partners from the MIT. The goal was to adapt the lessons learnt from London to the context of Mexico City. The summer vacancies slowed the communication down. After the new research outline of my thesis was written, several problems with the mentioned partner emerged. Intense back and forth communication showed that cooperation was not desired. The reason why is unclear up to now.

After two months trying to arrange the cooperation with the partners from London and Boston, writing two research outlines, I was without any applicable research question and due to the non cooperation of the partners without any professional support on the planned issue of road pricing. In spite of all the disappointments, together with my supervisor Alexander Walter I tried to find a reasonable research question for my diploma thesis. To be able to benefit and receive appropriate support form the core competences of the NSSI, I was obliged to shift to the social sciences with an emphasis on methodological work.
In the context of an upcoming research project, a new research outline for a study of the initial phase of networks fostering sustainable innovations was written. It was planned to study the initial phase of the social networks dealing with road pricing. After this third research outline was drafted, two further barriers made changes to the research questions once more necessary: Either the initial phase was too long ago to be able to compile reliable data or the social networks of the initial phase could not be detected.

After two and a half of the six months available for the diploma thesis were passed, I started with the draft of the fourth research outline. Due to the little remaining time of three and a half months, I was forced to choose a research design, where as few as possible unforeseen barriers could arise. I therefore decided to apply the network analysis method of my supervisor Alexander Walter. A network analyses by comparing at least five networks by a quantitative socio-scientific survey was planned. After the survey was started it became evident that the majority of the foreseen cases were unsuitable because of different reasons (see section Selection of the cases on p. 12). Only three cases turned out to be appropriate for the running survey. At that time, no adaptations of the questionnaire were possible anymore and thus the research question had to be adapted a fourth time. A comparative network analysis was no longer possible and the research subject had to be transformed. To firstly evaluate the questionnaire for another research question and secondly support it by an appropriate theory became very challenging.

Not least because of all the difficulties encountered, this thesis became a claiming and instructive experience, teaching me several of the difficulties which can arise in international interdisciplinary research. I learnt that even with extensive efforts, such as detailed research drafts and several international meetings with declaration of intends, no absolute security on cooperation for a project is obtainable. A second lesson learnt was, that a fall back variant of any project (e.g. as a diploma thesis) should depend on as few as possible external factors, especially not the same factors as the first variant. This was the case for the original theme of my diploma thesis, were the (missing) international collaboration caused a failure of both the first and the fall-back variant.

In spite of all the difficulties, I am confident that a satisfactorily result could be achieved and hope the reader enjoys the following report.
Abstract

Several research projects all over the world have considered road pricing as promising attempts to solve urgent transport problems in urban areas. Many different agents as transport planners, politicians, and representatives of various interest groups collaborate in the planning process for the implementation of a road pricing scheme. The problem perceptions of these agents differ connotatively and it is considered to have an aggravating influence on the collaboration. Based on a theoretical model of (Berthon, Pitt, & Morris, 1998) it is postulated that communication and knowledge integration process increases the consent on problem perception of these agents. A quantitative online survey in Edinburgh (n = 11), Stockholm (n = 12) and London (n = 7) gathered data on the individual problem perception and the knowledge integration processes of these agents. The individual problem perception was asked by a pair-wise comparison of the problem domains which can be tackled by road pricing – environment, congestion, and lack of finances. The knowledge integration was quantified according to the frequency and the type of communication of the last 12 months. No correlation could be found between the knowledge integration processes and the individual problem perception. Additionally, the objectives of the three different road pricing schemes were asked. It could be shown that the priorities of the objectives tackle appropriate the perceived problems of the three different problem domains. According to the asked agents, the road pricing schemes of London and Stockholm focus too strong on the congestion problem.
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First of all I want to extend my gratitude to my supervisors Alex Walter and Professor Roland W. Scholz who made many important and indispensable comments regarding my thesis. Numerous other persons supported me with the realisation of this thesis. Only with their support and assistance, remarks, references and recommendations I was able to complete this diploma thesis. Thanks go to all UNS-workers, especially to Michael Stauffacher and Arnim Wiek for their constructive advises for the finding of the research question, the questionnaire and the statistical analysis. Invaluable was the help of Sabine Perch-Nielsen, the best MS-Word expert. Special thanks go to Stefan Zemp, John Dickinson and Sabine Perch-Nielsen for their corrections concerning my English language.

I owe deep gratitude to my parents and to Iris and Harold Klinger, who supported my studies generously and made it possible for me to have a great time as a student. A big hug goes to my Darling Christina for all help and support during the busy time of this thesis.
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Abbreviations

ANPR  Automatic Number Plate Recognition
CEC  City of Edinburgh Council
OECD  Organisation for Economic Cooperation and Development
TIE  Transport Initiative of Edinburgh
TfL  Transport for London
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1 Introduction

Problems related to urban road transport and the associated challenges are immense (European Commission, 2001). The needs for funds to provide transport infrastructure continue to increase, while the limits of public budgets are largely reached (Schade & Bernhard, 2003). Road transport is the major contributor to urban air and noise pollution (OECD, 1995). The increasing amount of traffic intensifies the existing environmental problems. The congestion problems in many large cities cause severe economic costs. Estimates of the economic cost burdened on the city of London, notably in lost time, wasted fuel and increased vehicle operating costs, range between 2% and 4% of its gross domestic product (National Centre for Policy Analysis, 2003).

Several research projects have considered road pricing to solve transport problems in urban areas (EU Framework Programs, 1995-2004). Road pricing is used as a general term for a pricing system that charges road users a fee for their right to use a certain road or to drive in a certain area. This terminology excludes parking fees as well as fuel and vehicle taxes from being seen as a kind of road pricing (Mattson, 2004). Although urban road pricing is considered promising, there are only very few cities which were able to implement a road pricing scheme successfully. Several factors and barriers hinder the implementation of urban road pricing schemes. Due to advances in the IT sector most technological problems have been overcome (Jones, 2003). Most research results acknowledge that the main barriers to the implementation of road pricing are now a lack of public and political acceptance (Jones, 2003).

Whatever the barriers are, urban mobility problems in general (Walter & Scholz, submitted) and the implementation of road pricing in particular are considered to be complex and ill-defined problems (Scholz & Tietje, 2002). In order to solve these problems asks for a collaborative and transdisciplinary approach will be inevitable. In a transdisciplinary approach, many different stakeholders e.g. from science, politics and representatives of various interest groups, work together in the planning process. The planning process not only encompasses here the engineering planning, but a broad span of processes ranging from political lobbying and decision making, through public consultation and objections to the evaluation of the scheme. All these stakeholders have their own problem perception, which makes it difficult to find a common and widely accepted solution. Communication and the integration of knowledge (Scholz & Tietje, 2002) are identified as an important variable for the individual problem perception of the individual stakeholder.
This thesis studied the influence of knowledge integration on the individual problem perception among these stakeholders, who are involved in the planning process of urban road pricing. An online survey in Edinburgh, Stockholm, and London studies these stakeholders’ individual problem perceptions of the transport problems and the communication and knowledge integration processes. The problem perception is demanded according the three most important urban problem domains caused by transport.
2 Theory

This chapter provides the theoretical basis for this thesis. In the next section it will shown that there are some good reasons to solve ill-defined problems by a collaborative or transdisciplinary approach. A collaborative approach brings some difficulties, e.g. when many different stakeholders have their own problem perception while working together in the planning process. It is derived from a theoretical model that knowledge integration is the key variable for the individual problem perception. After that, the theory is transformed to the real world example of road pricing.

2.1. Transdisciplinarity as an approach for ill-defined problem solving

According to Scholz & Tietje (2002, p. 26), “ill-defined problems are characterized by an initial state that is not completely known, a target state that is only vaguely known and unknown types of barriers that have to be overcome to reach it.” The problem is usually multifaceted, ill-defined and structured into sets of mutually linked subsystems and impact factors (Scholz & Tietje, 2002). To date no single unifying theory or model exists for solving complex real-world- or ill-defined problems (ibid.).

![Figure 1: Attributes of ill-defined problems (Scholz & Tietje, 2002).](image)

There are some convincing reasons, why many types of ill-defined problems ask for a collaborative or transdisciplinary approach. Transdisciplinarity is a form of problem solving that emphasises cooperation among different parts of society and academia in order to meet the complex challenges of the problem (Thompson Klein et al., 2000). In transdisciplinary projects, the challenge is therefore on the integration of academic...
and non-academic knowledge cultures (Tress, Tress, & Bloemmen, 2003). The integration of varied knowledge and opinions allow a holistic and integrated view of the problem.

Ill-defined problems consist of multiple systems and dimensions. Often the knowledge of a single system or science is not enough to tackle these problems appropriately. In this case, a collaborative approach is needed where multiple stakeholders from different systems work together to solve the same problem. Ill-defined problems which concern a broad public, e.g. transport problems, often demand for an approach, where the public has to be involved in the problem solving process to find an appropriate and acceptable solution.

A collaborative and transdisciplinary approach brings about further challenges to the problem solving process: It is difficult to develop a clear and unambiguous problem solving strategy for complex problems (Scholz & Tietje, 2002). Often the multiple stakeholders all have different problem perceptions, which make it difficult to find a solution. Attempts to solve ill-defined and complex problems are considered to be more promising if there is a mutual consent on the existing problems among the concerned stakeholders (Thompson Klein et al., 2000).

### 2.2. Problem perception as key factor

Problem perception can be defined as the psychological process of scanning, noticing, and constructing meaning about environmental change (Kiesler & Sproull, 1982). The importance of problem perception arises from the fact that it is the first stage in the decision-making process (Berthon et al., 1998). How a problem is perceived (and consequently defined) delimits to a considerable degree the subsequent course of problem solving measures (Dunegan, 1993; Mintzberg, Raisinghani, & Theoret, 1976). There are often cases of inappropriate problem formulation and thus implementation of associated solutions (Berthon et al., 1998).

In a collaborative approach, where many different stakeholders work together in the planning process, everyone has its own problem perception. It seems obvious that, e.g. a representative of an environmental organisation perceives different problems as being important than a representative of a transport company or that a transport planer views the problems differently than a politician. In a collaborative process not only the problem as assessed by experts is of relevance, but rather the problem perceptions of all concerned stakeholders.

In approaching the notion of problem perception, this work takes a constructivist perspective. According to Eisner et al. (2003), all attempts to define a societal problem
according to its objective severity have failed. Constructivism sociology omits the distinction between ‘real’ and ‘unreal’ problems. The theory asks to regard the given problem proposition in society as a given social reality (Eisner, Graf, & Moser, 2003). Problems arise in people's minds and thus depend strongly on individual experiences (Glasersfeld, 1996). The constructivist’s tradition argues that problem perception is built up through a recursive dialectic between subject and object, thus problems cannot be reduced to either subject or object, but emerge in an ongoing manner from their interaction (Berthon et al., 1998). For a full description of the constructivist view of problems the reader is invited to review Landry, ‘A note on the conception of “Problem”’ (Laundry, 1995).

For a transdisciplinary and collaborative process, as well as for the present thesis, the problem perception and not the ‘objective’ problems, assessed only from a scientific or engineering perspective, engineers are of relevance.

### 2.3. Variables that influence the problem perception

Problem perception is possibly the least well researched phase of the decision-making process (Nutt, 1992). Only limited literature exists that discusses the problem perception of transport problems – the initial and crucial phase of problem solution. No literature was found, which quantitatively studies the problem perception among the key stakeholders.

In this section, a model on problem perception is introduced which delivers the theoretical basis for this work. Initial support for this model can be found in Cowan who was first to develop first a model of the problem recognition process (Cowan, 1986). Cowan argues that the problem recognition process is a function of individual cognitive frameworks, task-role schemas and informational situations. According to (Berthon et al., 1998), the perception of a problem is influenced by three variables:

\[ P_P = f_n (DM, DE, IS) \]

Where \( P_P \) = perception of the problem, \( DM \) = decision maker, \( DE \) = decision role environment, \( IS \) = information system.

The ‘information system’ is considered the most important variable for the individual problem perception. The perception of a problem depends on the subjective values, system values and ideology of a decision maker. Each ‘decision maker’ decides differently whether something is a problem or not. The ‘decision role environment’ defines for what problems a person is sensitised and what problems he has to tackled.
E.g. a transport planner focuses on transport problems, while the treasury has to manage the finances for dealing with the transport problems consequently they perceive different of the same general issue as being important.

The decision maker and the decision role environment are more or less invariable for a deciding individual and can’t be influenced for improvements of a collaborative and transdisciplinary process. Consequently, the information system is the only variable which can be influenced externally and thus influences the problem perception of different stakeholders.

This thesis uses the expression of knowledge integration (Scholz & Tietje, 2002) for the information system variable of the applied model. Information is defined as the result of the result of processing, manipulating and organising data in a way that adds to the knowledge of the person receiving it (Naudé, 2004). Knowledge is the sum of the received information and of all experiences made. Knowledge is only augmentable by communication (Luhmann, 1990).

Knowledge integration processes include all types of communication between the agents, ranging from telephone calls to complex methods like future workshops (Walter & Scholz, submitted)\(^1\). The different communication types have to be distinguished and have different effects in terms of knowledge integration. One-way communication is very limited and no learning or information exchange process is taking place. In modern democratic societies, with high educational background and consequently better informed and more intervening people, simple one way information provision is deemed to be insufficient for an adequate involvement of the public (Viegas, 2001). The bi-directional or even multilateral communication is not only more efficient, but there are also extended possibilities to communicate and discuss, thereby enabling a mutual learning process to take place (Scholz, 2000). Higher complexity leads to a more intensive knowledge integration.

To acquire a broader and deeper view of a complex problem, a single individual relies on the knowledge and data of other people. The different stakeholders who work in the different subsystems are mutually linked through communication relations to a network. By finding a body of common knowledge through knowledge integration, the stakeholders re-define their own perception of reality (Walter & Scholz, submitted). Comprehension of a system can be achieved primarily through communication and knowledge integration (ibid.).

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\(^1\) This rather fuzzy definition is adapted of the work of Walter & Scholz (submitted) that provides the method of this thesis.
2.4. The example: the implementation of road pricing

The introduced theory is now applied to the real world problem chosen in of this thesis - the implementation of road pricing. In the following sections, it will be shown that the implementation of road pricing contains all attributes of an ill-defined real-world problem and that there are several similarities between the proposed proceedings for the implementation of road pricing and the theory of ill-defined problem solving by a collaborative and transdisciplinary approach.

There are several subsystems which have to be taken into account for the successful implementation of an appropriate road pricing scheme, e.g. congestion and financial planning or also the improvement of environmental standards. Transport planning in general concerns many different systems of our society. Every individual person as mobility user or any kind of economic sector relies on a functioning transport system. Road pricing is an ambiguous concept (Mattson, 2003). Road pricing is a multidimensional measure to manage mainly three different transport problem domains: reduction of congestion; reduction of environmental problems caused by increasing traffic as well as to raise funds and the allocation of investment resources (Lindberg, 1995). Subsequently, the implementation of road pricing can be seen as a multi-dimensional problem.

The target state of an urban road pricing scheme is often only partly known. The theoretical long term target is a complete internalisation of all external costs. In reality the aim of a complete internalisation of all external costs, is never completely met (Nash & Niskanen, 2003). There are always unforeseeable additional constraints and barriers that have to be taken into account and cause a shift away from the originally focused target state (ibid). There will remain ever much uncertainty about the nature of these constraints and barriers (ibid).

A vast amount of literature exists that explains many different barriers and constraints for the implementation of urban road transport schemes (EU Framework Programs, 1995-2004), which have to be taken into account, but no single optimal implementation path or clear problem solving strategy has so far been identified. “In regard to road pricing, given the current rudimentary state of knowledge about the benefits, costs, politics and psychological factors involved (travel behaviour, acceptability), as well as the inherent complexity of economic dynamics, it would be rather naive to attempt to formulate an optimal control problem and to construct or derive an 'optimal' implementation path” (Niskanen et al., 2003).

Agents from all concerned systems have to work together and contribute with their varying knowledge to the common goal, the implementation of a new scheme. The
following some examples shall show, what kind of different stakeholders have to cooperate.

Technicians and engineers have to assess the right technology for the detection of the vehicles in the charging zone. They have to design the system according to the objectives in order to reach the wished effects concerning the revenue generation, notably the reduction of congestion or the improvement of the environmental standards. Technological problems have mainly been overcome, the issue now is cost and reliability of the technology and confidence therein rather than its availability per se (Nash & Niskanen, 2003).

Fundamental institutional problems are related to the relationship between different levels of government and politicians (Nash & Niskanen, 2003). In most countries, new laws have to be passed which allow charging public roads. In general diametric differences exist between the city government which represents the interests of city inhabitants and the primary sufferers of the transport problems and the county government which represents the interests of the main users and main polluters. Similar issues arise in terms of the relative roles of deregulation and privatisation versus government control (ibid.).

However, apart from technological and legal problems the lack of public acceptability is recognised as one of the main obstacles to the implementation of road pricing measures (Schade & Schlag, 2003). The acceptance of all concerned interest groups is of vital importance. Important interest groups are the business community as a key stakeholder group, trade unions, but also environmental, pedestrian or cyclist organisations. These key stakeholders, who are involved in the planning process, are defined as agents and categorized into different agent types depending on the organisation which they represent. A detailed definition of several agent types is introduced in the next chapter (see p. 13).

The knowledge acquired through many research projects and the lessons learnt from cities operating a road pricing scheme, underline that the implementation of road pricing needs a collaborative approach between all concerned stakeholders. These are decision makers, transport planers, experts of the corresponding fields and representatives of all interest groups (Europrice, 2002b; Jones, 2003; PATS, 2001; Walter & Scholz, submitted).

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2 So far, some 25 projects funded under the European Unions Commision’s Framework Programmes on research and development dealing with issues on marginal cost pricing (EU Framework Programs, 1995-2004). While the earlier projects have addressed more theoretical issues, the focus in the more recent projects has clearly shifted from theory to practical implementation of efficient pricing (Sikow-Magny, 2003).
How the problem perceptions vary among these agents and how the problem perceptions might be influenced to reach consent is the main topic of this study.

2.5. Theoretical background on road pricing

This section will describe why this thesis focuses only on the three most important problem domains of urban transport. The most important urban transport problem domains are: the congestion problem, the financial problem and the environmental problem (Lindberg, 1995).

Many other problem domains exist to which road pricing can have an effect as e.g. the equity, road accidents, and land use patterns. If a road pricing scheme increases or decreases the equity depends primarily on the scheme design and varies significant among the different existing schemes. It is very difficult to design a scheme that considers all different social groups. There are always winners and losers (Eliasson & Mattson, 2004). The most important aspects if a road pricing scheme increases the equity, are whether the fee is additionally to the existing fuel and vehicle taxes or not, whether the reductions for residents and disabled are allowed and what is done with the raised money respectively who gets the benefit of the raised money. The theory makes no statements about the impact on road accidents, but the example of London shows, that there is significant decrease of road accidents, in spite of the increase of the averaged traffic speed. These other problem caused by urban transport are not taken into account because there exist many other and in general also more efficient measures to tackle these problems {Whittles, 2003 #1}.

How a road pricing scheme is designed, depends on the chosen objectives. It can be a measure for reduce spatial or also temporal congestion, alleviate environmental problems and/or to raise revenue, to finance projects that benefit drivers and those affected by traffic. The existing and planned road pricing schemes vary by geographical extension, price structure, technology and the use of the revenues. In the case of urban road pricing, there is typically a balance between the competing objectives of congestion reduction, environmental improvements or to generate revenues for different purposes (Mattson, 2003). A revenue-oriented system should allow for season tickets and it would be tempting to choose charging points to avoid reductions of traffic flows. A congestion pricing system, aims directly reducing the traffic flows (Mattsson, 2003). The charge level in an environmental system should be related to the costs of pollution and noise that the traffic contributes to and could be added to the congestion-related charge.
How these objectives are chosen is not content of this thesis. This thesis sets the individual perceived problems in the content of the objectives of the road pricing schemes according three most important problem domains.
3 Research Design

3.1. Research questions and hypotheses

In the following, the core elements of the theory are reproduced briefly, in order to facilitate the understanding of the derivation of the guiding research question. The implementation of road pricing covers all attributes of an ill-defined problem. Ill-defined problems and consequently the implementation of road pricing ask for a collaborative and transdisciplinary approach. The problem perceptions of the concerned stakeholders differ connotatively. According to the model of problem perception of Berthon et al. (1998), knowledge integration has a significant influence on the problem perception of an individual person.

To acquire a broad and deeper view of a complex problem, a single individual relies on the knowledge and data of other people. If an agent integrates his or her knowledge about a complex problem to other collaborating agents, the mutual knowledge of all agents increases and knowledge differences among these agents decreases. Consequently, it is postulated that intense knowledge integration processes among the collaborating agents have an influence on the individual problem perception and thus increase the mutual consent on the perceived problems.

The consent on problem perception is measured by the difference of the averaged problem perception of all questioned agents to the individual problem perception of the specific agents. The averaged values of the problems and objectives are based on more than ten assessments of the agents and are considered as a good objective value. The questioned agents have all a good knowledge on the problems and the planned road pricing schemes with its objectives and are consequently considered as experts.

How road pricing scheme is designed, depends on its objectives. It is considered that some agents are more important\(^3\) than others and have a large influence on the determination of the objectives than others. It seems obvious, that these agents determine the objectives according their individual problem perception. Based on these considerations a second and alternative hypothesis is derived:

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\(^3\) The importance of an agent is defined by network analytical concepts of ‘prestige’ and ‘centrality’ and is described on p.22.
Guiding question
What influence does knowledge integration among the key stakeholders have on their individual problem perception and on the general objectives of the road pricing scheme?

Hypotheses
1. The more intense the knowledge integration processes of an agent are the closer his problem perception will be to the averaged problem perception of the other agents involved in the planning process.

2. The more important an agent is, the smaller the difference between his problem perception and the objectives of the road pricing scheme will be.

For the verification of the hypotheses a survey was carried out in three case cities. In each case city an online questioning with eight to twelve people provided the quantitative data basis for the verification the hypotheses.

3.2. Selection and quality of the sample
3.2.1 Selection of the cases
Based on the existing publications, all European cities which already have a running road pricing scheme or which were considering the implementation of a scheme were determined. Because there were almost no up-to-date and representative publications on the state of the road pricing implementation in these cities, telephone interviews with the relevant people gave information about the latest activities. Most of the cities had worked out first scheme designs and a few had already carried out pilot studies.

Case cities which were previously taken into consideration are Trondheim (NO), Leeds (UK), Durham (UK), Cambridge (UK), the Ranstad Area (The Hague, Rotterdam, Amsterdam) (NL), Gothenburg (SE) and Copenhagen (DN). They all have in common that they have or had projects dealing with road pricing, but in very differently advanced development stages and none passed the criteria set.

- Durham has a tiny city-centre scheme which encloses only one street which passes a world heritage site. The objective is to protect the site of pollution. The scheme started October 2002 (Durham County Council, 2004).
- Trondheim, Oslo and Bergen were the first European cities which had implemented a road pricing scheme. The only objective in all three cities was to generate revenues to finance transport infrastructure projects (Eliasson & Lundberg, 2003). The scheme of Trondheim will shut down next year. After a
14 year long period, the needed money required for the construction of public and private transport infrastructure is collected and the improvements are finished.

- Rome introduced an automated access control to a limited traffic zone in October 2001. A limited selection of drivers (about 10%) including non-residents and coaches have to pay a fee to enter the access control (Progress - Pricing ROad use for Greater Responsibility, 2002a).
- Bristol has broadly talked of a road pricing scheme and developed concrete plans. The Labour Party lost control and council is now governed by Liberal Democrats and that put subsequently the project is on hold (ibid.).
- Genoa is working on a pilot project with volunteers where the driver's attitudes will be studied (ibid.).
- Copenhagen and Gothenburg carried out technology demonstration and studied user behaviour through field trials with volunteers (ibid.).
- Helsinki has only carried out a study with a very limited technology demonstration (ibid.).
- Leeds decided to start with a working place parking levy (Santos, 2004)
- In Cambridge the planned road pricing scheme failed due to a political change (ibid.)
- The Ranstad region, failed little before the scheme started, due to a opposition campaign of the Dutch Automobile Club (Boot, Boot, & Verhoef, 1999).

However, at the time of writing, there was no active planning process in any of the cities that had previously been studied. Either the schemes had already been implemented for years (e.g. the Norwegian cities) or the schemes had failed by several reasons. Consequently, there were also no intensive communication activities about the issue of road pricing. Thus, the cases for the survey had to be chosen by different criteria:

- The city has implemented road pricing in the near past or will implement road pricing in the near future.
- The city must have a well elaborated and clear designed road pricing scheme.
- Transport planners, politicians and other important representatives, who were and/or are involved in the planning processes, have to be available to answer the questionnaire.

Only the following three case cities passed the criteria and turned out to be suitable for the survey:

- Edinburgh (UK), that has very concrete plans for a road pricing scheme. It will start in 2006 if the referendum in spring 2005 is positive;
- Stockholm (SE), that will start with a full scale pilot scheme in 2005; and
- London (UK), that has implemented the first large road pricing scheme in 2002
3.2.2 Selection of the agents

After suitable case cities were identified, all institutions and people who are more or less involved in the planning process were traced. These people are defined as agents and are categorized to different agent types (see section p.). The first contacts were obtained from research networks dealing with road pricing, e.g. Progress (Progress - Pricing ROad use for Greater Responsibility, 2002b) or through the authors of any publications on the issue. After first contacts had been established, each person was asked, to designate the five most important institutions and persons, involved in the planning process. The term ‘important’ was purposely not further defined to reach a heterogenic sample of persons for the survey. Not only the ‘most important’ people were chosen as case agents, attention was paid to achieve a mix of different, including those of less importance.

The target group for the study were people from different backgrounds, who are all more or less involved in the planning process. The chosen agents are all a kind of experts in their fields and it can be assumed that they have a sound understanding of the problems and issues of the road pricing scheme.
The media and the public were not included as agents. The media have no direct influence in the planning process. It is supposed, that the most important requests of the public, influence the planning processes through the different interest groups, e.g. environmental, cycling or pedestrian organisations.

### 3.2.3 Quality of the sample

In Edinburgh and Stockholm, all stakeholders from the questioned agents rated as important are represented in the sample, mostly even persons from the top management level. A list of the people questioned is in the Appendix on page 67. The rate of return was satisfactorily in Edinburgh and Stockholm. Table 1 indicates the number of people who were questioned, the rate of return and how many samples are valid.

**Table 1: Rate of return of the questionnaire.**

<table>
<thead>
<tr>
<th>City</th>
<th>Questioned</th>
<th>Returned</th>
<th>Valid samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edinburgh</td>
<td>19</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>Stockholm</td>
<td>20</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>London</td>
<td>15</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>54</strong></td>
<td><strong>33</strong></td>
<td><strong>29</strong></td>
</tr>
</tbody>
</table>

In the case of London, some very important agents did not participate and lead to an incomplete network sample. In spite of many attempts, the most important person, Ken Livingstone, the Mayor of London, and both business representatives, London First and London Chamber of Commerce (or any of their representatives) did not reply to the questionnaire demand. Consequently, the network of the London case could not be analysed. The Mayor of London forwarded the survey demand to the PR division of Transport for London. Two completed questionnaires represented the TfL already. The Leader of the City Council of Edinburgh refused the questionnaire, because politicians are not allowed to participate in any surveys. Stockholm achieved not only the best rate of return, but also no missing data.

In all samples, the problem perception and the objectives were asked with a redundant dimensioning. Based on the redundant dimensioning an inconsistency value for each answer was determined. 16 of 29 valid samples indicated an inconsistent problem perception and 8 of 29 indicated an inconsistent assessment of the objective. Due to the small sample the inconsistent values were taken into account anyway but were considered in the discussion.
3.3. The questionnaire

The questionnaire consists of three parts. In the first part, the questions ask the participants about their individual problem perception and the objectives of the road pricing schemes in their city. The second part collects information on the communication- and knowledge integration processes among the concerned people. Finally, socio-demographic data and information on the roles and responsibilities were asked. All people received a personal email with the invitation to fill out the questionnaire (see Appendix 8.1, p. 65). The survey was carried out in October and November 2004. The questionnaire was programmed with a software program called survey monkey software (Survey Monkey Software, 2004).

3.3.1 Problems and objectives

The goal was not to get a detailed assessment of the problems, but to raise a rough relative appraisal of these problem domains that can be tackled by road pricing. The people questioned had to compare a pair of these three problem domains three times. They had to rate by their personal view each pair on a nine point scale ranging from, e.g. environmental pollution is more serious (+4), over environmental and congestion problems are equal serious (0) to congestion is more serious (-4), (see the questionnaire in Appendix 0 on page 76. Subsequently, they had to indicate the general objectives of the road pricing schemes in their city according to the same procedure.

3.3.2 Knowledge integration

The intensity of knowledge integration between two agents is measured by means of the communication frequency and the types of communication between them.

To determine the communication relations among a group of agents, the people were allocated to different agent types. The agent types determine the organisation or institution which the people represent. The following ten agent types were defined, based on the complete stakeholder list from the Europrice (Europrice, 2002c) research project:

- Politicians, decision makers;
- Transport planer from public administration;
- External consultants;
- Members from universities;
- Business representatives (Retail, Leisure, Tourist);
- Transport industry representatives (freight transport industry, taxi);
- Trade unions;
• Environmental organisations;
• Cycling & pedestrian organisations; and
• Motoring organisations.

Each person had to indicate, which agent group he/she represents.

To compare processes of different complexity the communication relations between two agents were classified into four different types of communication (Walter & Scholz, submitted; Wasserman & Galaskiewicz, 1994).

• One-way information: One agent provides information without expecting a reaction of the recipient, e.g. internet, leaflets, press release.

• One-way analysis: One agent gathers information from another. Study of a system with no feedback to the concerned agents, e.g. consultation, survey.

• Bi-directional communication: Two agents communicate bidirectional and a transfer of knowledge from one agent to the other happens with the expectation of feedback, e.g. document sharing, telephone, and email exchange.

• Multi-lateral: More than two agents communicate multilaterally. Goal of mutual understanding, e.g. meetings, workshops.

The frequency of communication was determined by how many times two agents had communicated together in the last 12 months of active planning.

Each agent had to indicate, how frequently he had communicated with which agent and by what type of communication. Additionally, the agents had to indicate from a list of different planning methods, which have been applied (see Appendix 0, p. 76).

### 3.3.3 Socio demographic data

This part contains questions on the person’s role and responsibility concerning the planning process of the road pricing and his or her educational background of the person. Additionally, the five most important agents for the planning process of the road pricing scheme were demanded.
3.4. **Procedure of the Analysis**

In this section the procedure of the analysis of the data and the different cases is described. The procedure contents four elements, firstly a case description, secondly a network analysis, thirdly the construction of the variables and finally how the variables are statistically analysed.

3.4.1 **Case description**

A case description makes an introduction on the situation and the transport problems. Additionally, the road pricing schemes with the objected improvements were analysed and described briefly.

3.4.2 **Network analysis**

A basic network analysis is performed in addition to the quantitative analysis of the communication relations for the verification of the hypotheses. The communication relations of all agents together form a communication network. This network analysis fulfils two purposes, one the one side to give an overview on the communication relations of all the agents in one figure and on the other side to provide background information about the different agents.

For a communication relation, not only the frequency or type of communication is of relevance, but also with whom an agent communicates. Therefore also quantitative background information about an agent is necessary. The network analysis describes the key agents and their relation to other agents. The roles and responsibilities of the most important agents are described here briefly. It is described who is responsible for the decisions and who for the implementations of the scheme. The information basis was predominantly qualitative information gathered in the survey or derived from various publications and reports.

The network figures give and overview about the communication frequencies and communication types of the agents. The communication relations of the ten different agent types are drawn with the Ucinet software (Borgatti, Everett, & Freeman, 1999). Data for the illustration of the communication networks was derived from the survey.

---

4 As described in the preface, the primary goal of this thesis was to perform a comparative social network analysis. After the questionnaire was started, it turned out that the there were too little suitable networks for a comparison. Consequently, the research question changed and it was tried to adapt the analysis for the present research question. Insofar, is the network analysis a leftover of the previous research design and it was tried to adapt into the present study.

5 To understand a single agents relations, not only the study of his relations to other agents is necessary, but also the other agents with whom he is connected to (Jansen, 2003).
3.4.3 Construction of the variables

The next sections explain how the data collected are transformed to quantitative values as a basis for the statistical analysis.

Problem perception and the objectives of the road pricing scheme

The comparative values of the problem and the objectives were transformed to direct relative values with the software program expert choice. The sum of the three problem- or objective domains are normed to make the value of one. The difference of an individual problem perception and the averaged problem perception is defined as the sum of the absolute values of the mathematical differences (the Euclidian distance) in the three dimensions.

\[
\text{PiPa} = |\sum_{i=1}^{n} \frac{C_{p,i}}{n}| + |\sum_{i=1}^{n} \frac{E_{p,i}}{n}| + |\sum_{i=1}^{n} \frac{F_{p,i}}{n}|
\]

\text{PiPa}: Difference of individual problem perception and averaged problem perception
\text{C}_{p,i}: Individual Congestion Problem Perception of agent i
\text{E}_{p,i}: Individual Environmental Problem Perception of agent i
\text{F}_{p,i}: Individual Financial Problem Perception of agent i

The difference between individual problem perception and averaged objectives is vice versa calculated by the same formula. The described variables are illustrated in Figure 3 on page 20.
Figure 3: Example illustration of the three problem domains and the variables. Each problem domain ranges from the relative value 0 = not important, the longest side of the triangle to 1 = very important in the corner of triangle. The values are indicated by 0.1 line intervals and are labelled by the same orientation as the lines of the corresponding problem domain.

- ●: problem perceptions of the questioned people, ○: personal assessment of the objectives of the road pricing scheme, ★: averaged of the problems, ☆: average of the objectives. A sample of problem perception and objective is connected with a black line. The dotted lines indicate the difference between individual problem perceptions and the averaged problem perception. The broken line, which connects the black points with the white star are the differences of individual problem perceptions and the averaged objectives.

Intensity of knowledge integration of an agent

The knowledge integration intensity of each agent is defined in this work by the multiplication of the types of communication and the communication frequency. The different communication types have different effects in terms of knowledge integration (see Theory 2.3, p.5). The different types of communication are allocated by different values of knowledge integration intensity. The one way communication (to provide or raise information), has the lowest knowledge integration intensity, the multi-lateral communication gets the highest knowledge integration intensity allocated.
The knowledge integration intensity was calculated according to the following formula:

\[
KI_i = \sum^n_{i} CF_i \times CT_i
\]

KI<sub>i</sub>: Knowledge integration intensity of agent i
CF<sub>ij</sub>: Communication frequency intensity value of agent i with agent j
CT<sub>ij</sub>: Communication type intensity of agent i with agent j

**Table 2: Overview of the types of communication**

C<sub>ij</sub>: Communication relation between agent i and j; CT<sub>ij</sub>: Communication type intensity of agent i with agent j; one way information gets the lowest and multi-lateral communication the highest knowledge integration intensity value allocated

<table>
<thead>
<tr>
<th>Types of communication</th>
<th>Matrix notation</th>
<th>Visualisation</th>
<th>CT&lt;sub&gt;ij&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>No communication</td>
<td>C&lt;sub&gt;ij&lt;/sub&gt; = (0,0)</td>
<td>□ n&lt;sub&gt;i&lt;/sub&gt; □ n&lt;sub&gt;j&lt;/sub&gt;</td>
<td>0</td>
</tr>
<tr>
<td>Provide information</td>
<td>C&lt;sub&gt;ij&lt;/sub&gt; = (1,0)</td>
<td>□ n&lt;sub&gt;i&lt;/sub&gt; → □ n&lt;sub&gt;j&lt;/sub&gt;</td>
<td>1</td>
</tr>
<tr>
<td>Raise information</td>
<td>C&lt;sub&gt;ij&lt;/sub&gt; = (0,1)</td>
<td>□ n&lt;sub&gt;i&lt;/sub&gt; ← □ n&lt;sub&gt;j&lt;/sub&gt;</td>
<td>1</td>
</tr>
<tr>
<td>Bidirectional</td>
<td>C&lt;sub&gt;ij&lt;/sub&gt; = (1,1)</td>
<td>□ n&lt;sub&gt;i&lt;/sub&gt; ↔ □ n&lt;sub&gt;j&lt;/sub&gt;</td>
<td>2</td>
</tr>
<tr>
<td>communication</td>
<td>C&lt;sub&gt;i-k&lt;/sub&gt; = (1,1,1)</td>
<td>□ n&lt;sub&gt;i&lt;/sub&gt; ↔ □ n&lt;sub&gt;j&lt;/sub&gt; □ n&lt;sub&gt;i&lt;/sub&gt; ↔ □ n&lt;sub&gt;k&lt;/sub&gt; □ n&lt;sub&gt;j&lt;/sub&gt; ↔ □ n&lt;sub&gt;k&lt;/sub&gt;</td>
<td>3</td>
</tr>
</tbody>
</table>

**Table 3: Communication frequency intensity values**

<table>
<thead>
<tr>
<th>Communication frequency</th>
<th>CF&lt;sub&gt;ij&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>0</td>
</tr>
<tr>
<td>1-2 times</td>
<td>1</td>
</tr>
<tr>
<td>3-6 times</td>
<td>2</td>
</tr>
<tr>
<td>&gt; 6 times</td>
<td>3</td>
</tr>
</tbody>
</table>

The knowledge integration intensity of an agent increases:

- the more frequently he communicates
- the more he communicates bi- and multilaterally
- the more communication relations he has to other agents.
Importance of an agent

In the following, a short overview on network analytical theories regarding the importance of agents is given. Centrality and prestige are network analytical concepts, which describe the importance or ‘prominence’ of an agent.

The concept of centrality describes, that an agent who has more relations to other agents is more prominent. This concept assumes that ‘central’ agents have a better access to resources, control over the network and information. Actors that receive information from many sources may also be more powerful – to the extent that “knowledge is power” (Hanneman, 2001). It seems obvious, that there are agents who have a stronger influence to the network and the project than others. Thus, their communication is more important and has a higher impact.

While centrality is a rather objective value based on the existing communication relations, the prestige is a subjective value (Jansen, 2003). There are often cases, in which centrality does not correlate with prestige.6

A communication relation is here defined if two agents communicate frequently, in this case more than three times in the last 12 months. Centrality is a value to indicate the number of relations to other agents.7 The centrality was calculated according the following formula:

\[ C_i = \sum CR_{ij} \]

- \( C_i \): Centrality of Agent i
- \( CR_{ij} \): Communication relation between i and j

To determine the prestige of an agent, each agent was asked: what the five most important agents are. The agents had to indicate the most important institution and also a representing person. The frequency an agent was mentioned as important, divided by the number of nominations indicates the rank of prestige.

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6 There can be a significant difference between the centrality and prestige of an agent (Jansen, 2003) E.g. a scientific author cites many well cited other authors, but these do not cite himself. In this case, the prestige is low, but the centrality is high. Prestige depends on values (ibid).

7 The best way to illustrate the centrality is to compare sociograms, see e.g. Figure 8, p. 34 By comparing networks with the figures of a star, a circle, or a chain, it is obvious, that the agent in the centre of a star has the highest centrality with the most relations. The simplest value is based on the degree of an agent (Freeman, 1992).
3.4.4 Statistical analysis

The results are analysed by three different statistical analyses with the software program SPSS.

Firstly, for the verification of the hypotheses it was tested if there are any correlations by Pearson and Spearman-Rho between the following variable pairs:

- ‘Intensity of knowledge integration’ versus the absolute value of the ‘difference between the individual problem perception and the averaged problem perception’.

- ‘Importance of an agent’ versus absolute value of the difference between the ‘individual problem perception’ and ‘the averaged problem perception’.

Secondly, it was tested if the road pricing schemes meets the perceived problems. The means of the different objectives was taken for the real objective values of the scheme. It is considered that the objectives of a road pricing scheme do not rely on subjective perception. Consequently, a one sample t-test analysed, e.g. if the congestion objective tackles the individual perceived congestion problem of all the questioned agents. This test was repeated for all three problem domains and all three cases.

Thirdly, for a comparison of the difference between the problems and the objectives in the various cities an ANOVA with repeated measurement was calculated.
4 Results

4.1. Case description

A brief case description provides background information about the current situation, the problems and the road pricing schemes in the three case cities.

4.1.1 Edinburgh

Situation
Edinburgh is the capital city of Scotland, with a population of 448 000. The periphery brings approximately another 500 000 people, who work in the city (The Edinburgh City Council, 2001). Edinburgh is an employment, shopping and services centre for the whole of South East Scotland, and linkages between the city and the surrounding area are provided by road and rail. Trips by Edinburgh’s residents are made 56.6% by car and 18.3 by public transport, the proportions of public transport is much higher compared to other cities in the UK (The City of Edinburgh Council, 2000b). Edinburgh has a relatively cheap public transport and a strong sustainable transport strategy.

Problem
The Local Transport Strategy of Edinburgh (The City of Edinburgh Council, 2000b) provides a detailed description of the transport situation and its problem of the city. The following information is, if not otherwise cited from this report. Edinburgh’s economy is booming what has a significant impact to the traffic situation: “Car ownership has grown rapidly; the number of cars per 1,000 people in Edinburgh increased by 77% from 211 in 1981 to 373 in 1997” (The City of Edinburgh Council, 2000b, p. 17). By 2016, traffic is forecast to increase by more than a quarter. Without congestion charging, delays to the city are forecast to double by 2016 (The City of Edinburgh Council, 2000b).

Introduction of improvements is dependent on the identification and allocation of appropriate levels of funding. If congestion charging were to be adopted, it is estimated that the Council could raise an additional £450 million (£640 mil. €) over 10 years, all of which would be spent on transport and traffic infrastructure improvements, in addition to the current levels of funding. Through this additional
funding, it would be possible to introduce a substantial number of the measures described in the local transport strategy. (The City of Edinburgh Council, 2000b).

The environmental problems are described as not serious in Edinburgh (Bielefeldt, 2004). Air pollution is seen as the major environmental problem caused by road transport. The assessments of the air quality management plan (The City of Edinburgh Council, 2000a) show that a few of the objected EU standards for a pollutant are likely not to be achieved by 2005. The Council has declared an air quality management area and the trends indicate that most target benchmark will be reached in near future (The City of Edinburgh Council, 2000a).

The Road User Charging Scheme

The road user charging scheme is described in the report of the council ‘investing in travel improvements’ (The City of Edinburgh Council, 2004). The following information derives from this report. Two charging cordons are planned, city centre cordon operating on weekdays from 7am to 6.30 pm and the outer cordon inside city bypass operating from 7.00-10.00 am. The charge is £2 (2.8 €), one charge each day, no matter how many times you cross either cordon. Charge would only apply to vehicles entering the city. No charge would be made for crossing either cordon on trips heading out of the city. Drivers would be able to choose from a wide range of methods to pay the charge: ticket machines, internet, mobile and payment at shops. Payments could be made on a daily, weekly, monthly or annual basis.

Figure 4: The Edinburgh road user charging scheme, with the two cordons and the registering points (TIE, 2004).
Objectives

“The objectives of the road user charge are to control growing congestion and to raise money for our transport system. Congestion charging would raise an estimated £760 million over 20 years. Congestion has been growing every year and by 2016 the time spent in congestion will more than double. With the revenue, we would improve public transport, including buses and trams, and maintain our roads and infrastructure provide cycling and walking facilities and introduce other improvements. From the reductions in congestion and vehicle volume an indicative figure of a 20% reduction in NOx emissions based on transport modelling is forecast in the city centre” (The City of Edinburgh Council, 2004).

4.1.2 Stockholm

Situation

In the Stockholm-Mälar Region about 1.8 million people live on a area of about 6400 km². Within the city boundaries about 745 000 inhabitants are registered (Stockholms Stad, 2004). Most of the people working in the centre live in the suburbs, subsequently commuter traffic is substantial (Ahlstrand, 2001), with daily a quarter million people travelling into the centre (Landtmäteriet, 2004). The car density is 401 cars per 1000 inhabitants (418 in the county). Stockholm has a large metro system, which is the cornerstone of its good public transport system (Stockholms Stad, 2004).

For a better understanding of the network constellation of this case, a brief historical input introduces the key agents are introduced. In 2002 the social democratic candidate for mayor, Annika Billström explicitly ruled out road pricing in her election campaign. At the same time, the national parties of the Greens, the Post Communists and the social democrats agreed on a coalition to reach a majority in the government to introduce road pricing in Stockholm. The social democrats were obliged to agree to the alliance to reach a majority in the parliament, the price they had to pay is the support of the road pricing. The local politicians and the mayor of Stockholm had to follow to that alliance. In the local parliament of Stockholm, the alliance between the social democrats and the green came to an agreement that the public can vote on the road pricing, but not until after a one year trial had been conducted. Whether the system will be permanent or not will be subject to a referendum in the city of

8Already in the 1990s, the first concrete plans of road pricing in Stockholm were discussed in the national parliament. Before Stockholm could introduce road pricing, a new law had to be passed by the national parliament. The Denis Packet, a set of huge road and construction investments of about 6 billion Euros, financed by road pricing became the first big failure on political level. Behind the political scenes were strong oppositional forces. A new try of an adapted packet felt as well under a different governing legislation in 1998.

**Problem**

In the rush hour the mean speed of car traffic in the central city of Stockholm is 19 km/h, considerably more than in the central cities of e.g. London or Paris (Ahlstrand, 2001). The pleasant environment of Stockholm with large water areas may have influenced people to be concerned about increasing car traffic (ibid.). This was already reflected in local politics in the 1970s.

The main problem is the congestion situation. The politically right side demand huge funds for investments in road infrastructure and the left demands for a strong improvement of public transport so that the environmental situation does not worsen. The only current politically feasible funding is seen as the congestion charging scheme, which will have a strong demand decreasing effect at the same time.

The additional answers of the survey all primarily indicate the congestion problem in addition with the limited funds for solving the congestion problems and the environmental impact caused through further road construction.

**The congestion charging scheme**

The city of Stockholm is now planning for what is described a full-scale test of congestion pricing, in Swedish ‘Trängselavgift’, to be in place in the year 2005 (Eliasson & Mattsson, 2004). The basic role for the experiment is to show the citizens in Stockholm that congesting pricing is technically feasible and that congestion actually will go down. So, political and public acceptance is also important reasons behind the experiment. It should be noted that although it is a full-scaled experiment with advanced (and expensive) electronic fee collection, it is still an experiment for only about a year (Mattsson, 2004). Then it will be closed down and a referendum will be held. Depending on the outcome of the referendum it will be determined (unclear exactly how) whether the pricing system will be opened again (Mattsson, 2004).

The specifications of the congestion charging scheme are described in Swedish on the homepage of Stockholm Stad (Stockholms Stad, 2004). The information for the following summary derives from this homepage.

There will be two charging zones: One outer and one inner zone boundary. Vehicles passing in both directions will be charged during day-time and weekdays. During peak hours the charge is planned to be about 2 Euro for crossing the outer zone boundary, 1 Euro for crossing the inner zone, and during off-peak hours 1 Euro for each boundary.
A maximum charge of about 8 Euro a day is proposed. The city plans to install devices around the city to read electronic tags on the cars. The money generated is intended to be used to improve public transport in the region. The planned congestion charging area covers almost 30 km², within this area 275,000 people live. The charges are intended to reduce congestion, increase accessibility and improve the environment. The public transport including park and ride facilities are able to increase attractiveness and supply. The charging system is estimated to yield revenue close to 1,300 million SEK (150 million Euro) per year (Eliasson & Mattsson, 2004).

**Figure 5: The Stockholm charging zone with the toll passages (Stockholms Stad, 2004).**

**Objectives**

The project leader mentions the following main objectives (Dickinson, 2004):

- “To reduce traffic volume by 10-15 percent on the most heavily used routes during morning and afternoon hours.
- To improve accessibility for buses and cars in the inner city.
- To cut emissions of carbon dioxide, nitrogen oxides and airborne particles in the inner city. People in the inner city should experience an improved environment at the street level.” (Stockholms Stad, 2004)
4 Results

Without charges  With charges

Figure 6: Modelled improvements of travel speed through congestion charging in Stockholm (Eliasson & Mattsson, 2004). The density of coloured (slow) traffic is clearly lower in the right picture, which illustrates the city with the charge.

4.1.3 London

Situation

The area of Greater London covers about 1580 km2 and has about 7.36 million inhabitants with a population density of 4600 per km2 (Government Office for London, 2004). Inner London has a population of 2.7 million, a population density of 8600 per km2 and an area of 320 km2 (ibid.). 365 of 1000 citizens own a car. Modal split for travel trips are made to 43% by road transport, 34% by public transport and 23% by feet or bicycle (Transport for London, 2003b).

Problem

The city’s transport system has been starved of the investment necessary to sustain existing services, let alone meet the challenge of rising travel demand. Traffic congestion is such that roads in central London and some London town centres are now approaching gridlock – polluting the city’s air and causing misery to motorists, bus passengers and pedestrians alike. Traffic speed on central London’s roads was at 9.6 mph (14.5 km/H) in the period of 2000 and 2003 (Transport for London, 2003b). “Underground passengers face gross overcrowding on trains, broken escalators and serious problems of unreliability” (Mayor of London & Greater London Authority, 2001).
The congestion charging scheme

The congestion charging zone of London covers an area of 21 km² in the inner city. In this area only about 136 000 people live. Each vehicle (beside some defined exceptions) have to pay 5 £ (7 €) per day between 7am - 6.30pm Monday to Friday for entering the zone. The cars entering the zone are detected by Automatic Number Plate Recognition (ANPR) and the driver has to pay the registered number by different means (internet, SMS, phone, parking stations…). The raised money has to be reinvested in transport infrastructure by law.

![Figure 7: The area of the congestion charging scheme in central London.](image)

Objectives of the scheme

According the modelling predictions before the scheme started, the congestion charging would reduce traffic by 10 - 15% and traffic speeds would increase by 10 - 15% (Transport for London, 2004a). The scheme was primarily planned to improve the congestion situation in the inner London. No targets or improvements have been made for the environmental situation.

The success of the scheme

The London congestion scheme started in February 2002, roughly 250 000 vehicles entering it every day. Latest estimates from Transport for London (TfL) are that net revenue will be some £68 million (€100 mill.) this year and £80 million to £100 million in subsequent years (Mayor of London & Greater London Authority, 2001). Over the first 10 years of the scheme it will raise more than £1.3 bn (€1.84 bn) which
are to be re-invested in transport improvements across the capital (Transport for London, 2004a).

TfL’s current estimate is that quicker and more reliable journeys for buses, commercial vehicles and taxis within the zone and reduced fuel costs are saving Londoners and London business about £180 million (€254 mill.) per year (Transport for London, 2003a). The scheme causes a decrease of 30% of congestion and 18% less vehicles entering the zone (Transport for London, 2004b). A comprehensive analysis has identified a significant improvement of environmental parameters. Between 2002 and 2003, total NOX emissions in the charging zone have reduced by 12.0%, PM10 emissions have reduced by 11.9 (Beevers & Carslaw, 2005). A reduction in CO2 by 19.5% has also been stated (ibid.) The evidence presented shows that the congestion charging schemes could assist in attaining both the UK government’s targets on air pollution as well as those relating to climate change and other international obligations (ibid.).

4.2. Network analysis

A short introduction describes the key agents, the consultation processes and the allocation of power and resources. The figures give an overview of all the communication relations as a whole. The results are gained from the survey, if not otherwise cited.

4.2.1 Edinburgh

In May 1999 the New Transport Initiative (NTI) studied ways of providing the city with the transport infrastructure it needs to support the ‘local economy and promote a healthy and sustainable environment, given diminishing capital allocations from central government’ (The City of Edinburgh Council, 2000b).

A major consultation programme on the local transport strategy took place in autumn 1999 and in 2003 one for the concrete plans of the road user charging was proposed. For the consultation all kinds of knowledge integration methods were used, from a simple opinion survey, through scenario planning and future workshops with the whole breadth of social groups e.g. with local people in the different quarters or even with business representatives. In order to progress the New Transport Initiative, which includes Road Charging proposals, Edinburgh had an approved expenditure of 320,000 Euros in 2002/03 to cover mainly public consultation (55%), Public Relations and publicity (16%), focus groups (12.5%) and market research (12.5%) (Europrice, 2002a). This ensured that it reflects as far as possible the aspirations of Edinburgh’s citizens, and helped feed new ideas into the strategy. The extended consultation
The most important people for road pricing in Edinburgh measured by the prestige.

<table>
<thead>
<tr>
<th>Representing head of organisation</th>
<th>Function, Institution</th>
<th>Prestige</th>
</tr>
</thead>
<tbody>
<tr>
<td>Donald Anderson</td>
<td>Leader of City Council of Edinburgh (CEC)</td>
<td>8/8</td>
</tr>
<tr>
<td>Andrew Burns</td>
<td>Ward &amp; Executive Member for Transport, CEC</td>
<td>3/8</td>
</tr>
<tr>
<td>Barry Cross</td>
<td>City Development Department</td>
<td>4/8</td>
</tr>
<tr>
<td>Andrew Holmes</td>
<td>Executive, Director of City Development and Congestion Charging, CEC</td>
<td>2/8</td>
</tr>
<tr>
<td>Alex Macaulay</td>
<td>Chief Executive Officer, TIE</td>
<td>7/8</td>
</tr>
<tr>
<td>Paul Saunders</td>
<td>Project Manager, TIE</td>
<td>3/8</td>
</tr>
<tr>
<td>Kirsty Lewin</td>
<td>Scottish Executive responsible for the Consultations</td>
<td>3/8</td>
</tr>
</tbody>
</table>

The communication network shows the dominant role of the transport planner, politicians and external consultants, which has not only the highest centrality but also most frequent communication relations among themselves. Because of the unclear allocation of the agent roles to the associating institutions the results are not very clear. The broad consultation carried out by the ‘Executive of Scotland’ as a political institution is considered to be the reason of the centric position of the politicians.
Figure 8: The communication relations network of the Edinburgh case. (The thickness of the arrows illustrates the frequency of the communication, the thicker the line, the more frequent is the communication. Thicknesses of the lines are relative to the other network agents. The pointer of the arrows indicate the direction of the communication and consequently the type of communication, e.g. if it is one-way or bidirectional communication. The illustration is biased according to the ten selected agent types (see Research Design 3.2.2 p.14 ). The distances of the arrows have no meaning.)

Figure 8 shows explicitly, that the politicians are the centre of the network with the highest number of relations, and the high. The agents with the most intensive knowledge integration are: the politicians, transport planer, external consultation and the environmental organisations.

4.2.2 Stockholm

The pilot phase became only possible due to the alliance among the Greens- and Social Democratic Party. The executive Major has to implement a scheme which she does not personally support, due to the alliance between the Greens and the Social Democrats. The executive and deciding agents are quite strongly interwoven. There are some people who are active as politicians and transport planners in the council (Stockholms Stad, 2004). The evaluation of the test will be done by a plan made of the university and external consultants.

A secretariat for congestion charging has been set up and started working since June 2003, executing the orders of the Mayor and the Parliament of Stockholm. The secretariat is attached to the city council of Stockholm (the Stadhuset), and is directly responsible to the mayor and the executive of Stockholm. The most important agents and institutions are listed in Table 5.
Table 5: The most important people for the implementation of the congestion charging scheme in Stockholm; measured by the prestige.

<table>
<thead>
<tr>
<th>Most important agents</th>
<th>Function, Institution</th>
<th>Prestige</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnus Carle</td>
<td>Head of Congestion Charging Secretariat, City Council of Stockholm</td>
<td>8/8</td>
</tr>
<tr>
<td>Birger Höök</td>
<td>National Road Administration</td>
<td>7/8</td>
</tr>
<tr>
<td>Eric Tedesjö; Monica Hildningsson</td>
<td>Local public transport, responsible for the extension of the local transport</td>
<td>4/8</td>
</tr>
<tr>
<td>Annika Billström</td>
<td>Mayor of Stockholm</td>
<td>3/8</td>
</tr>
<tr>
<td>Isa Romson</td>
<td>Green Party, joined the alliance with the Social Democrats by the condition of the implementation of congestion charging</td>
<td>3/8</td>
</tr>
<tr>
<td>Ericsson</td>
<td>Ministry of finance</td>
<td>3/8</td>
</tr>
<tr>
<td>Christer Ljungberg</td>
<td>Tivector Consulting, responsible for evaluation</td>
<td>2/8</td>
</tr>
</tbody>
</table>

With the approach to start with a test trial, only a very few official consultations were carried out compared to the other cities like Edinburgh or London. In the pre-urban communities a referendum was held, which indicated a strong opposition. But the referendum was without any legal compliance. In the City of Stockholm about 55% are against the scheme and 38% support it (Stockholms Stad, 2004). Magnus Carle emphasizes, it would be exaggerated to speak of a strong opposition. Several formal knowledge integration methods, like future workshops or mediation were applied but the public was only poorly taken into account.

Figure 9 shows explicitly that the transport planner, politicians and consultancies have the highest knowledge integration. That means the most number of relations, with the highest frequency and predominantly bi- and multilateral communication relations. All other agents have lower knowledge integration intensity.
Figure 9: The communication relations network of the Stockholm case. (The thickness of the arrows illustrates the frequency of the communication, the thicker the line, the more frequent is the communication. Thicknesses of the lines are relative to the other network agents. The pointer of the arrows indicate the direction of the communication and consequently the type of communication, e.g. if it is one-way or bidirectional communication. The illustration is biased according to the ten selected agent types (see Research Design 3.2.2 p.14 ). The distances of the arrows have no meaning.)

4.2.3 London

In the sample of London, the most important agent, the Mayor of London is missing. If the data of very important agents are missing, no valid network analysis can be made (Jansen, 2003). According to qualitative results based on publications and the comments raised in the survey, although certain qualitative statements can be made.

The most important agents are the Mayor of London, who is the principle decision maker and the TfL, the planning and executing body, and the boroughs of London, which had the strongest influence in the consultation process. The network is clearly centred on the TfL. The other involved agents are mostly only being involved in the consultation process. There was little to no communication between the other members of this network.

The mayor of London, Ken Livingston was elected with the election promise to tackle London’s transport problems by introducing congestion charging. Hereby, he was supported of a broad majority from the public and business side. The success of the scheme enabled him the re-election. Important decisions about the transport strategy and the scheme are made only by the mayor.
TfL is the integrated body responsible for the capital's transport system. Its role is to implement the Mayor's Transport Strategy for London and manage the transport services across the capital for which the Mayor has responsibility. TfL is accountable for both the planning and delivery of transport facilities, which enables it to take a truly integrated approach to how people, goods and services move around London. TfL is directed by a management board whose members are chosen for their understanding of transport matters and appointed by the Mayor of London, who chairs the TfL Board (Transport for London, 2004c).

TfL has carried out the biggest consultation process in London ever done. Some opinions presume that it was only an exercise (The Royal Borough of Kensington and Chelsea, 2004), because the consultation is obliged by law, with no influence to the decisions. The consultation process is carried out primarily by bi-directional communication between the TfL and the specific agents. In the answers of the survey, it was mentioned several times that the media played the most important information role. Through its large public relation division the TfL made a strong support campaign.

London has a very strong dyadic structure between the Mayor of London and the TfL group. While the mayor is responsible for all crucial decisions, the TfL is the advising and operational organization. They carried out all consultations, developed the whole plans and transformed them to reality. The TfL is the main transport provider of London. TfL is only little reliant on external consultancy, due to its size and huge intern knowledge compared to other similar organisations. The TfL is responsible for the evaluation of the congestion charging scheme, while in the other cities the evaluation plans are predominately made by universities.
4.3. Quantitative Results

In this section the quantitative results are reproduced. Firstly, graphs of the three case cities illustrate the individual problem perception compared to the objectives of the road pricing scheme. Secondly, the different variables are statistically analysed.

4.3.1 The problem perception and the objectives of the three case cities

*Edinburgh*

Figure 10 shows explicitly that the congestion is the major problem and that the environment is no problem (8 of 11 values are above of the value of 0.6 on the congestion scale, 10 of 11 values are below the 0.2 on the environment scale. The difference between the problem perception and the objectives are in 8 of 11 values below 0.15. The averaged values fall less than 0.1 apart. The small standard error (see Figure 10 p. 38) shows, that most agents perceive the same problem as important.

![Figure 10: Problem perception and objectives of the road user charging scheme of Edinburgh.](image)

- •: problem perceptions of the questioned people, ○: personal assessment of the objectives of the road pricing scheme, ★: averaged of the problems, ★★: average of the objectives. The lines combine the measurements of one sample. Each problem domain ranges from the relative values 0: not important (longest side of the triangle) to 1: very important (corner of
Figure 11 shows that the problem perceptions are broad distributed and no consent exists. Two different groups can be defined. 6 values indicate that the environmental problem is not serious with a value below the 0.15 line, and 6 indicate that the finances are no problem (values below the 0.1 line). The objective of the scheme tackles primarily the congestion problem (11 of 12 values above the 0.45 line) and secondarily the environment (10 of 12 the values are between the 0.2 and 0.5). The averaged values fall less than 0.1 apart.
London

The problem perceptions are broad distributed; the number of values is only seven. Five of seven values indicate that the congestion is the main problem. All indicate that the only relevant objectives of the congestion charging scheme is the congestion (congestion value $\geq 0.6$).

![Figure 12: Problem perception and objectives of the congestion charging scheme in London.](image)

- : problem perceptions of the questioned people, ○ : personal assessment of the objectives of the road pricing scheme, ⭐ : averaged of the problems, ⚫ average of the objectives. The lines combine the measurements of one sample. Each problem domain ranges from the relative values 0: not important (longest side of the triangle) to 1: very important (corner of triangle). The values are indicated by 0.1 line intervals and are labelled by the same orientation as the lines of the corresponding problem domain.
4.3.2 Statistical analysis

This section provides the results of the statistical analyses. Firstly, a comparison between the problems and the objectives concerning the three domains and in all case cities is made. Secondly, an ANOVA with repeated measurements analyses any cross references and compares the different cities concerning the problems and objectives. Thirdly, the defined variables concerning the problems and objectives (see Construction of the variables, section 3.4.3 on page 19) and the impact of knowledge integration are analysed by Pearson and Spearman-Rho correlations.

Comparative view on the problems and the objectives

![Comparison of problems and objectives](image)

Figure 13: Averaged problem perceptions compared to the objectives of the road pricing schemes in Edinburgh, Stockholm and London with the standard deviation.

The objectives of all studied road pricing schemes tackle firstly the congestion, which is rated as the worst problem by the agents. In Edinburgh and Stockholm the differences between problems and objectives are low within the standard error (Figure 13). The standard error and the rate of inconsistent answers of the objectives are in all cases smaller than of the problems.

Table 6: Individual problem perception vs. mean of objectives, significance values of one sample t-tests.

<table>
<thead>
<tr>
<th></th>
<th>Edinburgh</th>
<th>Stockholm</th>
<th>London</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestion</td>
<td>0.375</td>
<td>0.011</td>
<td>0.066</td>
</tr>
<tr>
<td>Finances</td>
<td>0.280</td>
<td>0.730</td>
<td>0.147</td>
</tr>
<tr>
<td>Environment</td>
<td>0.803</td>
<td>0.579</td>
<td>0.392</td>
</tr>
</tbody>
</table>
Edinburgh: No significant difference between the individual problem perception and the mean of the objectives of a scheme of all three problem domains were detected. The road pricing scheme tackles the problems of all three problem domains appropriate to the perceived problems.

Stockholm: There is a significant difference between the perceived congestion problems and the objectives of the road pricing scheme. No significant difference between the individual problem perception and the mean of the objectives of a scheme of the financial and environmental domain were detected.

London: There is a significant difference between the perceived congestion problems and the objectives of the road pricing scheme. No significant difference between the individual problem perception and the mean of the objectives of a scheme of the financial and environmental domain were detected.

According to this analysis, no significant differences between the individual problem perceptions and the averaged objectives could be detected, except to the congestion problem in the case of Stockholm and London.

**Table 7: Individual problem perception vs. individual objectives with the grouping factor cities, significance values ANOVA-with repeated values.**

<table>
<thead>
<tr>
<th></th>
<th>1. problem vs. objective</th>
<th>2. Difference between problem vs. objective vs. City</th>
<th>3. Difference between cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestion</td>
<td>0.003</td>
<td>0.155</td>
<td>0.300</td>
</tr>
<tr>
<td>Finances</td>
<td>0.005</td>
<td>0.593</td>
<td>0.206</td>
</tr>
<tr>
<td>Environment</td>
<td>0.573</td>
<td>0.551</td>
<td>0.032</td>
</tr>
</tbody>
</table>

1. Problem versus objectives

- **Congestion:** Between the individual congestion problem perception and the individual objective assessment among all samples is a significant difference (significance = 0.003). According to the mean values (see Figure 13) the road pricing schemes tackle too strong on the congestion problem.

- **Finances:** Between the individual financial problem perception and the individual objective assessment among all samples is a significant difference (significance = 0.005). According to the mean values (see Figure 13), the road pricing schemes tackle too little on the financial problem.

- **Environment:** Between the individual environmental problem perception and the individual objective assessment is no significant difference (significance = 0.573). The objectives are appropriate to the problems.
2. In all cities and all three domains is no significant difference between the problems and objectives (all significance values > 0.05).

3. A significant difference between the cities is only detectable according to the environmental problem domain (significance: 0.032). This difference is obvious recognizable in Figure 13. The mean value of the environmental problem and objective is significant higher in Stockholm (Problem 0.33) compared to the other cities.

**Impact of knowledge integration**

In this section, correlations between the variables are tested. There is a significant correlation between the knowledge integration intensity and the importance of an agent measured by centrality (Pearson correlation: 0.475, significance: 0.009, n=29) and prestige (Pearson Correlation: 0.888, significance: 0.001, n=29). The importance analysed by the subjective value of prestige shows the same result as the objective centrality value. There is a strong correlation between these two variables. (Pearson Correlation: 0.553, significance 0.002). It can be concluded the higher the importance of an agent measured in prestige the more intensive is his knowledge integration. The most important agent types are in all cases the politicians, transport planer and consultancies, followed by environmental organisations.

A significant correlation can be found between the communication frequency and the type of communication. Agents, who communicate with many other agents with a high frequency, communicate predominantly bi-directionally or multi-laterally. Thus there is also correlation between the importance and the communication type. Important agents communicate predominantly bi-directionally or multi-laterally.

There is no correlation between the knowledge integration intensity and the difference between the individual problem perception and the averaged problem perception (Pearson: 0.901; Spearman-Rho: 0.768). No correlation could be found between the importance and the difference between individual problem perception and the averaged problem perception (Pearson: 0.44, Spearman-Rho: 0.65).

No correlation was found between any of the defined variables and the inconsistency values of the answers.
4.4. Review of the hypotheses

Both hypotheses have to be disapproved. According to the raised data and the statistical analysis in the previous section, the intensity of knowledge integration among the agents has no influence to the difference between the individual problem perception and the averaged problem perception of the specific agents. The importance of an agent also has no influence to the difference of problem perception and the objectives of the schemes.
5 Conclusions

5.1. Conclusion of the network analysis

It can be concluded that each of the studied networks is unique in its structure, and communication relations, and concerning the importance of the different agents. To reach a convincing conclusion, it is identified as important to study the networks on an individual level of the persons or institutions and not on categorises of agent types as done in this thesis. No reliable results can be concluded of the network analysis on the agent types. Therefore, a brief quantitative description of the most important persons and institutions in all three cases gives an overview about these networks in the section after the section after next.

The importance of an agents reflects to a wide extend the intensity of his knowledge integration. In Edinburgh and Stockholm the politicians, transport planers, and external consultants belong to the core network and have the highest knowledge integration intensity. These key agents have communicated with the highest frequency and predominantly multilaterally. All other agents have very low knowledge integration intensities, predominantly in the form of a one-way information exchange by consultation or even only information.

In Stockholm, a strong political alliance between the social democratic- and the green party enables the implementation of a 13 month test trial. Stockholm did not perform a consultation with the general public, but with single organisations and representatives (e.g. automobile club or Swedish Society for Nature Conservation). A referendum after the test trial will be held and gives the public their vote. The implementation of the scheme is predominantly executed by the public authorities - the congestion charging implementation secretariat of the city council (Stockholms Stad, 2004).

The local parliament has a strong influence to all of the analysed public planning activities. Edinburgh involved its citizens with an extended consultation process including a direct opinion surveyed of all inhabitants of Edinburgh, and accompanied by a broad information campaign (leaf-let information, many forums, internet etc.) The Transport initiative of Edinburgh (TIE), a government owned non profit company was formed for the implementation of the road user charging scheme (TIE, 2004).

In London the Mayor and the London Authority predominantly decide on their own. Transport for London (TfL) has a status as consultancy and executive body (Mayor of London & Greater London Authority, 2001). The mayor was re-elected in 2004 and
thus received a confirmation for his ambiguous transport strategy. The consultation is performed from the TfL. The consultation process of London, performed by the TfL, is disputed because some agents accuse that the consultation has had no influence to the scheme.

5.2. Knowledge integration has no influence to the problem perception

The problem perception and the objectives of the analysed cases are not influenced by the measured knowledge integration of the last twelve months. Neither the frequency of communication nor the type of communication of the last twelve months has a significant impact to the problem perception of the agents.

5.3. The consent about the perceived problems and the objectives

In Edinburgh there is a clear consent about the priorities of all existing problems. In the case of Stockholm it is unclear whether the environmental or financial problems are more serious. In all three cities, the congestion is significantly the mayor problem. In Edinburgh and London, the environmental problems are assessed as the least serious transport problems. A much clearer consent exists concerning the objectives of the schemes. All studied road pricing schemes tackle primary the congestion with no other objectives.

5.4. The objectives of the schemes meet the perceived problems

In all three cases only a small difference exists between the averaged problem perceptions and the objectives of the schemes. Between the individual problem perceptions and the averaged objectives are no significant differences concerning all domains and cases, except in the case of the congestion problems in London and Stockholm. In these two cities, the objective of the road pricing scheme focus to strong on the congestion problem compared to the other two problem domains. It can be concluded that the objectives of the road pricing schemes meet almost in all cases the perceived problem of the questioned agents.
6 Discussion

In this chapter the results, the applied method, and the underlying theory are discussed. Section 6.1 on page 47 delivers some explanations for the results concerning the consent on the problem perception and the differences between the problem perception and the objectives. Section 6.2 on page 50 describes encountered difficulties of the applied method (research approach) and makes suggestions for improvements. Section 6.3 on page 53 discusses the theory and concludes on its appropriateness by a comparison with other theoretic models. Section 6.4 on page 56 makes some notes on open questions and further research.

6.1. Discussion of the results

The results indicate that the measured knowledge integration of the last twelve months has no influence to the individual problem perception and consequently no influence to the consent of the different problem perceptions. Due to the weaknesses of the chosen method and the small sample, no clear closing statement can be made that the knowledge integration processes has no influence of the knowledge integration process to the problem perception of the individual agents.

In the following sector two issues are discussed: what variables may influence the consent on the problems and also the significant difference between the consent of problem perception and the consent on the objectives of the road pricing scheme. Finally the clear objectives of the three studied road pricing schemes are compared with the objectives of other operating road pricing schemes.

6.1.1 Explanation for the consent on the problem perception

Many different variables influence the individual problem perception. In the discussion of the theory in section 6.3, three different theoretical models all underline the importance of communication and information exchange for the individual problem perception. Therefore it is seen as appropriate, to rely on the assumption that the information exchange among the agents has an influence to the individual problem perception.

Before discussing about any explanations what variables might influence the consent on problem perception, it has to be defined what is a good consent about the problems. In this context, is consent on problems understood that the majority of the people perceive the same problems as important. Therefore we rely on the priority ranks of the three problem domains. Edinburgh has the best problem consent of the three
studied cases. Apart of one outlier, all questioned people assessed that the environmental pollution of road transport is no serious problem. 8 of 11 (72%) people indicated the same priority order of the three problem domains and have consequently a very similar problem perception. From the results of Edinburgh, it can be concluded that it is possible to reach consent among a vast majority or among more than two third of all agents.

It remains an open question which type of communication, what knowledge, how much knowledge for what agent type influences the problem perception. If there is any type of information that results in a better consent on the problems aside of the studied knowledge integration, it must be information which is similar for all concerned agents.

This applies for the public consultation processes. Consultation is comprehended in this context includes the raising of opinions but also the different information campaigns including public forums, hearings, internet forums, where people can post their concerns and requests and other knowledge information methods.

These assumptions are supported by the facts from Edinburgh and Stockholm. The good consent among the questioned people in Edinburgh might be a consequence of the extended consultation processes. For the consultation all kinds of knowledge integration methods were used (see the results p. 32), internet, public discussion forums, newsletter and even all inquiries were made public on the Scottish Executive homepage (Scottish Executive, 2004). The information situation in Stockholm is very different. Even on the official congestion charging homepage of the city council of Stockholm only little information can be found (Stockholms Stad, 2004). The low inclusion of the public and the lack of any public consultation in Stockholm is strongly criticised by its citizens (Kaufmann, 2004). Why this knowledge integration is considered to have an influence on the mutual problem consent and nevertheless a correlation was found is explained in the discussion of the method, section 6.2.

Another explanation for the high consent on problem perception in the case of Edinburgh is the low importance of the environmental problems. The results of the survey and the additional comments of Edinburgh indicate that the environmental problems caused by transport are not perceived as a serious. With every reduced dimension the theoretical chance to reach consent on the problems increases. Thus, the reduced number of problem domains due to the ‘non-existence’ of the environmental problem, might be another explanation for the good consent on the problems and the objectives in this case.
6.1.2 Comparison of the problems with the objectives

The results show clearly in all three cases that there is a better consent on the objectives of the road pricing schemes than on the problem perception. Additionally, are the standard errors of the objectives in all three cases significantly lower compared those of the problem perception (see Results 4.3.2, p.38).

The objectives of a scheme rely only on the provided and available information and without any subjective variables. In the studied cities only a few publications are available about the planned road pricing schemes and these mostly rely on a single local transport strategy. Consequently have most of the agents have the identical information sources about the objectives and specifications of the planned road pricing scheme.

The literature introduced in the theory chapter (see p. 5) points out that the problem perception of a person relies not only on information but also on subjective experiences. These other variables, which don’t exist concerning the objectives, vary significantly among the different agents. Each person experiences a problem differently, e.g. an automobile driver in the congestion or a person who lives at a corner with much noise and pollution. (Berger & Luckmann, 2000).

With this background, it seems questionable to raise the objectives of a road pricing scheme by a socio-scientific questionnaire. These data on the objectives could be also raised by careful study of the scheme design documents.

6.1.3 Objectives of road pricing schemes

All studied road pricing schemes have the primary objective to tackle first of all the congestion problem. In these cities congestion is perceived as the major problem. Consequently, it can be concluded that the objectives of the road pricing schemes tackle the most important problem in accordance to the perceptions of these agents.

When comparing the objectives with other existing schemes, no clear tendencies can be identified. Singapore has a congestion scheme. Rome has objectives to reduce congestion and also the environmental impacts to the antique buildings. The three rather small Norwegian cities, Bergen, Oslo and Trondheim, all have all system to generate revenues for transport infrastructure. Aside of these schemes, exist numerous toll passages of bridges and tunnels exists. These are all revenue orientated.

Literature gives contrary statements about what has to be considered to select the an appropriate objective of a road pricing scheme in a specific city. However, the effectiveness of a road pricing scheme is seen as an important impact variables to
increase the public acceptability (Güller, 2000; Schade & Schlag, 2003). In this context, effectiveness is understood as the way that the objectives tackle the problems of a certain target group. Aside of the fact that most persons perceive different problems as important, the perceived problems as perceived by the public and politicians are without any doubt two very important groups which have to be taken into account.

6.2. Discussion of the method

The chosen path, raising communication data of experts through an online survey was satisfactorily. The completeness and the rate of return indicate that the procedure was appropriate for the chosen target group. Conceptual difficulties negatively affect the reliability of the results. In the following section, the most important difficulties are explained and some improvements proposed.

6.2.1 Raise communication data on an individual level

The major problem of the chosen method is that the communication between the agents is questioned according to generally categorised agent groups. The questioned people were categorised to different agent types according to the institution or organisation which they represent (see Section 3.3, p. 16, p. ff.). By this categorisation two imprecise steps are made. Firstly, the respondents have to allocate the well known people to generalised agent groups, (i.e. a person has to decide to what agent type the other person either belongs to). It is ambiguous how exactly the demanded persons distinguished between the function and representing institution of another person. Secondly, the questioned people had to summarise their communication relations to different people who belong to the same agent type. E.g. a representative of an environmental organisation had to summarise his communications with a transport planner of the chamber of commerce, the transport planers of the city council.

For further studies, it is proposed to make the census on an individual person level. That means, that the person will be asked about their communication, e.g. with Mr. X from the City Council and Professor Y from the Chair of Transport from the University. Therefore a pre-study has to be carried out with a detailed analysis of the important organisations and persons. Consequently the demanded people can be asked about their communications with specific persons instead of generalised agent types.

A general problem in such a census is that people often have double roles, e.g. a local politician from the council is at the same time transport planer in the council. There are also several persons which can’t be clearly allocated to an agent groups. In these
cases, either the raise of the data is inaccurate or the analysis fosters inaccurate assumptions. Only personal interviews with these persons can reduce such imprecision more exact.

6.2.2 The assessment method of the problem perception

The procedure chosen in this work, to rate the transport problems according to the three problem domains by a pair wise comparison is a very simple and provides good results. Missing additional concerning comments and the low level of inconsistency of the assessment of the objectives (7 of 30 replies) point out that the questioned people have understood the method and that they were able to indicate a comparison of three problem domains.

A more precise distinction between individual and social problem perception is necessary. Some additional comments in the questionnaire, indicated that it was not clear enough if they had to rate their individual problem perception (e.g. as citizen or motorist) or the perceived problems as perceived within their agent group (e.g. as a transport planner). Rienstra et al. (1999) showed that there is a clear difference between ‘perception of mobility as individual problem’ and ‘perception of mobility as a social problem’. A statistical analysis of opinions of various relevant subgroups of citizens in the Netherlands showed that safety problems are considered most important from an individual point of view, while environmental problems are most severe from a social point of view. The distinction of the two problem levels has to be considered carefully in any further study.

6.2.3 Method to quantify knowledge integration

The completeness and quality of the survey answers have shown indicates that people can give detailed and differentiated information according to their communication relations of the last twelve months. It remains an open question whether the knowledge integration of the last 12 months is relevant for the change of an individual problem perception of the chosen target group.

In general, it can be regarded as correct, that the knowledge integration intensity increases the more frequent a person communicates and that bi-directional and multi-lateral communication has higher knowledge integration intensity. The intensity of knowledge integration is defined in this thesis, by the product of the communication frequency and the type of communication.

The results and some examples which are described in the following section, show that the method needs to be further differentiated. People who are informed frequently
(by a one way communication) get achieved a knowledge integration intensity as associated to people who have multi-lateral meetings by a low frequency. The frequency of any information replaces by far no multi-lateral meeting. To reach appropriate knowledge integration in a transdisciplinary process, some formative methods for planning and knowledge integration have to be applied. No information campaign even if it provides very frequent one-way information, replaces a multi-lateral meeting as e.g. a future workshop. On the other hand it has to be remarked, that only multi-lateral meetings are not very efficient for all kinds of information. A good distribution among the different types of communication is necessary. This distribution has to be compiled to be able to make any statements if the knowledge integration process was ‘good’ or not.

No data was raised about the content or type of the exchanged knowledge or information. There are references that the cooperating agents in such planning processes focus too strongly on the measures, without appropriately integrating knowledge about the underlying problems (Walter, 2003). Frequent communication by the right method about the wrong problem is senseless.

If the content of information would also be taken into account, a much more detailed picture could be drawn. This would ask for much greater resources. For a study of the information content, detailed structured interviews would be an appropriate supplementation.

In the context of the compilation of knowledge integration, two disadvantageous questions had a bad effect for the reliability of the results. The type of communication was raised by the question: “How do you share your knowledge predominantly?” (And the people had to choose one of the four communication types as; to 1) provide, 2) raise information, 3) communicate bi-directionally or 4) communicate multilaterally). The results seems to be correct (more important people, have tendentially more often ‘communicated predominantly multi-laterally’ among themselves). But in general it is questionable, if people have more often multi-lateral meetings or conference than e.g. bi-lateral communication.

In the questionnaire it was asked which of the listed planning methods (e.g. as scenario planning, risk assessment) were applied (see Appendix p. 69 ff.). Unfortunately, the replies among the same cases were very contrary and consequently it was not possible to conclude reliable results. Based on the experiences from this survey, it is not possible to reach reliable data on such complex issues with the selected target group by an online survey.
6.2.4 Limitations for the survey

The time of the questioned people is the primary limiting factor for such a survey. The rate of return was very satisfactorily. The time limitation of the agents sets strong constraints to the method and the number of raised data. It was desirable to address more detailed questions to get a deeper view in the communication relations of the agents. Not only was the quality of the data very limiting, but also the number of replies reduced the quantity of the results. One the one side, only a few cases turned out to be suitable for the chosen research question and on the other side the target group of important people, who deal with the implementation of road pricing, is very small. The trade-off between the length of the questionnaire and the number of replies has to be considered carefully in any further study. With such small samples as in this survey, it is questionable per se to get any reliable results for such complex research question.

6.2.5 Target group

The target group for the survey was chosen according the real existing transdisciplinary composition of these agents (see Selection of the agents, p. 14). Thus the sample represented a broad and heterogenic spectrum of different agent types from politics, public authorities to divers’ interest groups. The more heterogenic a sample is, the more important get other variables, which are not constant. Consequently, the results could be expected more significant if the sample consist of people from the same agent type with different knowledge integration intensity.

In the discussion of the theory (see p. 50), it is concluded that people with an extended and sophisticated knowledge have a much clearer and a fixer opinion and problem perception. According this assumption, it is recommended to take public people with no certain interests and a low basic knowledge to show the impact of knowledge integration to the problem perception. If the results with the simplest and clearest research setting are positive, an attempt could attempted with complex and real world environment.

6.3. Discussion of the theory

The chosen track by analysing the existing transport problems by a societal and constructivists approach has proved to be appropriate. There is a broad consent in the literature that the social barriers (e.g. political and public acceptance) are of superior importance for a successful implementation of a road pricing scheme. (Boot et al., 1999; Europrice, 2002b; Güller, 2000; Jones, 2003; May, 1986; Milne, Niskanen, & Verhoef, 2001; Nash & Niskanen, 2003). To overcome these social barriers, it is
important to understand the different problem perceptions of the different agents. Insofar, it can be concluded that the problem perception is the relevant

From the model of (Berthon et al., 1998) it was derived that knowledge integration is a dominant variable for the individual problem perception. Three additional models were considered, which deal with the question how the problem perception is influenced (Berger & Luckmann, 2000; Berthon et al., 1998; Eisner et al., 2003; Glasersfeld, 1996). All these studied models mention that the communication and information exchange is a dominant variable for the individual problem perception. The definition of ‘communication processes’ and the ‘problem perception’ vary significant among the three models. Consequently, they can’t be applied directly for the research questions of this thesis, but they give strong evidence that communication and information exchange is a relevant variable for the individual problem perception.

For future studies with similar research, questions are two general improvements recommendable. On the one side, to study the knowledge integration processes more in detail (see p. 51). Therefore, it is necessary to consider a broader and more detailed definition of the term knowledge integration. On the other side it is recommendable, for making any statements on the relevance of knowledge integration, to taken the additional variables which influence the problem perception into consideration. The applied model specifies already two other important and broad variables for the problem perception which were not accounted in this study: the decision maker and the role environment. These two variables have certainly an impact and might overweight the effect of knowledge integration. These other effects can’t be discussed completing and the reader invited to read the primary literature: ‘The Impact of Individual and Organizational Factors on Problem Perception’ (Berthon et al., 1998).

Following are two additional improvements proposed, which were not specially noted in the applied model. We rely on the results of this study to discuss these improvements. The majority of the questioned agents, e.g. as representatives of the interest groups as motoring-, environmental, cycling or pedestrian organisations, played a secondarily role in the planning process. These agents had much lower knowledge integration than many other agents and a few where very close at the averaged problem perception. It can be considered that little information to a low informed person has strong impact on the change of problem perception. People with a low problem understanding might be much more influenceable than a high specialised expert. In contrary it seems plausible that an expert changes its opinion on a problem not as easy as a person who knows rather less about the same problem.

From this consideration it can be concluded that the pre-knowledge of an agent has not only a strong influence to the problem perception but also to the likeliness that this expert shifts its opinion or perception on a problem. It can be concluded that the same
amount of knowledge integration has very different effects on such a heterogenic sample group as in this study.

It is assumed that the history of the problem has a significant influence, not only on the problem perception, but also to the fact how a person changes its perception. A brief outline of the three different cases shall show how the history and development of the different problems might have an influence on the problem perception. The problems in the three cities have many similarities but also many differences. The first verifiable solution approaches by congestion charging in London goes back into the sixties (Smeed, 1964), where first road pricing proposals were discussed. As the different solution approaches show, was congestion always was the main problem (Greater London Council, 1974; London Planning Advisory Committee, 1998; Ministry of Transport, 1967; MVA Consultancy & Great Britain. Government Office for London., 1995). Since the 1960s it was more or less clear what the major problem is which has to be solved.

In Stockholm the discussions on road pricing goes back into the late 80s, got a hard fallback by the failure of the Denis packet (Ahlstrand, 2001). The failure of the economic approach, showed clear that it is not enough to tackle only the congestion problems by a huge investment effort. The failure of this approach diverged the different opinions on the problems and thus on the solutions.

The very fast increase in mobility demand in Edinburgh (77% between 1982 and 1997, (The City of Edinburgh Council, 2000b)), exaggerates fast measures to deal with the huge forecasted increase. With the improvements of cleaner vehicles, it is very likely that e.g. the air pollution targets will be met (The City of Edinburgh Council, 2004) and consequently it is easier to reach an clear compromise of two main problems.

This review of the problem history, show that in the case of London, a clear focus on the congestion problem exists since four decades, while in Edinburgh one of the major problem domains is solved through the technology before it became to a serious problem. In Stockholm, the importance of the different problem domains remains unclear. The background of the problem history points out that not only the communication processes of the last twelve months are of relevance.

It can be assumed that older problems are discussed less idealistic and rather objective and factually (Eisner et al., 2003). This is approved by the example of Bristol, where the first solution approach was on the environmental problems and later a significant change focused on the congestion problems(Progress - Pricing ROad use for Greater Responsibility, 2004). Concluding it can be said that the time scale and history is of relevance for the problem perception and the change of the perception of the different
agents. Consequently, it appears desirable to take also of the history and time scale of the development of the problems into consideration. A before and after study, would reduce all the mentioned side effects.

6.4. Further research questions

It belongs to the shape of a thesis of six months, that there are many open questions. Concluding, a few of the open questions will be discussed in the next sections.

Objective or subjective problem analysis

The majority of transport planer and engineers handles transport problems as real existing and objective problems which can be measured by indicators, e.g. congestion is indicated by the averaged travel speed, air pollution by particular matters (PM10) or noise. Among social scientists is a broad consent that societal problems, as e.g. environmental or transport problems have to be approached from a constructivism view (Berger & Luckmann, 2000; Berthon et al., 1998; Eisner et al., 2003). Eisner even says all attempts defined a societal problem according its objective severity has become a failure.

There exists no clear opinion about the line how far the perceived or rather the measured problems are of relevance for the solution process. The additional comments of the questionnaire showed that the opinion diverge strongly. It is supposed that there is no clear line. The dispute how far the transport problems have to be handled by a constructivism or realism approach is without any doubt of interest for a more efficient solution process and would be interesting and relevant research question for the future.

Study the benefit of a mutual consent of problem for a transdisciplinary process

Several sources from transdisciplinary research acknowledge that a mutual consent of problem perception among the agents, who are involved in the planning process, is a noteworthy aspect for an efficient solution process (Schade & Schlag, 2003; Thompson Klein et al., 2000; Tress et al., 2003; Walter & Scholz, submitted). On the one side, several theoretical reasons indicate the advantages to start with the integration of problem knowledge and thus reach an appropriate consent to the problem before focusing on the measures for solution. On the other side, the results indicate that there is a much better consent on solution measure like road pricing than on the problems. Thus it could be concluded that if it’s easier to reach consent on the solution than on the problems, it spares resources to leave out the problem definition process.
The open question remains, if a sound consent about the problems has to be reached before starting the implementation of a scheme.

So far, no quantitative study demonstrates clearly the net benefit of a good guided process to reach mutual problem consent among the agents who cooperate on the same complex problem before starting to discuss on the measures. It is considered to be interesting to study the influence of a clear consent on the problems among the agents involved in a network to a transdisciplinary process before starting with any measures for the solution.

*Impact variables for individual problem perception*

How problems rise, change and fall on a societal or an individual level depends on several impact variables (see Theory, p. 5). Eisner showed quite in detail the principle archetypes on the macro level of the society of the rise and fall of those (Stockholms Stad, 2004) problems and by what impact variables they are influenced. Aside from the simple theoretical concept of Berthon et al. (Berthon et al., 1998), which provides the basis for this work, no profound theory was found that illustrates more detailed the impact variables to the problem perception of complex societal problems on an individual level. It would be of great interests, to development a theoretical model which describes more in detail what variables the problem perception influences. The comprehension of these mechanisms is an important basis to understand by what measures consent for a problem can be fostered in a transdisciplinary process.
References


Ministry of Transport. (1967). *Better town with less traffic*.


Naudé, F. (2004). *Oracle FAQ*


8 Appendix

8.1. Invitation email for the survey

Dear Mr. ..., 

I contact you on the behalf of a research project under the lead of Prof. Roland W. Scholz (www.nssi.ethz.ch), ETH Zurich. We are currently conducting a survey about current developments in the area of road pricing. We would appreciate very much if you could spare five minutes for the questionnaire, which is located at the following weblink:


Our research depends on your participation. All your data will of course be handled confidentially and used for research purposes only. It will not be possible to connect your name to your answers.

If you have any questions or comments, please feel free to contact us.

Thank you for your support.

Regards Aeneas Wanner

Introduction

A successful implementation of a road pricing scheme depends on a variety of factors.

One important factor is the quality of communication and cooperation in the planning process. In this context, the planning process encloses not only the engineering planning but also the broad span of communication processes which happen between the initial phase of the problem cognition and the implementation of the scheme.

This study focuses on the communication processes between the different agents, which are involved in the planning process of road pricing. These agents come from a variety of institutions (e.g. transport planners, politicians, experts from universities and representatives of interest groups.)

The NSSI Natural Social Science Interface from the Swiss Federal Institute of Technology Zurich (ETH) conducts this study on planned road pricing projects in various cities internationally. This study is embedded in the frame of an international
research project on transition processes in urban mobility. Partners in this research project are: Massachusetts Institute of Technology (USA), Tokyo University, (JP), University Graz (AU), Chalmers University, (SE).
### 8.2. Survey participants

Table 8: Survey participants in the different cases cities, specified by organisation (Edinburgh: 1-11; Stockholm: 12-23; London: 24-30)

<table>
<thead>
<tr>
<th>#</th>
<th>Names</th>
<th>Institution</th>
<th>Role / Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>David Burns</td>
<td>Transport Initiatives Edinburgh Ltd</td>
<td>Project Manager</td>
</tr>
<tr>
<td>2</td>
<td>John Saunders</td>
<td>Transport Initiatives Edinburgh Ltd</td>
<td>Project Manager</td>
</tr>
<tr>
<td>3</td>
<td>Barry Cross</td>
<td>City Development Department</td>
<td>Information transfer</td>
</tr>
<tr>
<td>4</td>
<td>Bill Furness</td>
<td>Chief executive of the Edinburgh Chamber of Commerce</td>
<td>Consultee- no formal role</td>
</tr>
<tr>
<td>5</td>
<td>George Hazel</td>
<td>Institution of Highways &amp; Transportation, UK. Managing Director, McLean Hazel Ltd, Prof. for Transport, University of Aberdeen</td>
<td>Consultancy</td>
</tr>
<tr>
<td>6</td>
<td>David Connoly</td>
<td>MVA Consultancy</td>
<td>Consultancy</td>
</tr>
<tr>
<td>7</td>
<td>Neil Johnstone</td>
<td>Halcrow Consultancy</td>
<td>Consultancy</td>
</tr>
<tr>
<td>8</td>
<td>Neil Renilson</td>
<td>Lothian Busses</td>
<td>Transport Provider</td>
</tr>
<tr>
<td>9</td>
<td>Andrew Burns</td>
<td>City of Edinburgh, Labour Councilor</td>
<td>Executive Member for Transport</td>
</tr>
<tr>
<td>10</td>
<td>Christiane Bielefeld</td>
<td>Professor TRi Napier University</td>
<td>Design of monitoring plan</td>
</tr>
<tr>
<td>11</td>
<td>Jolin Warren</td>
<td>Friend of the Earth Edinburgh</td>
<td>Campaigning for Road Pricing</td>
</tr>
<tr>
<td>12</td>
<td>Per Bolund</td>
<td>Member of town council of Stockholm. Green Party</td>
<td>Political advisor</td>
</tr>
<tr>
<td>13</td>
<td>Asa Romson</td>
<td>Member of town council of Stockholm. Green Party</td>
<td>Information transfer</td>
</tr>
<tr>
<td>14</td>
<td>Maria Ostberg-Swanelind</td>
<td>Office of Mayor</td>
<td>Political coordinator of congestion charging and advisor of Mayor</td>
</tr>
<tr>
<td>15</td>
<td>Magnus Carle</td>
<td>Stadshed</td>
<td>Head of implementation secretariat</td>
</tr>
<tr>
<td>16</td>
<td>Margaret Olofsson</td>
<td>Member of town council of Stockholm. Left Party</td>
<td>Deputy mayor</td>
</tr>
<tr>
<td>17</td>
<td>Hans Rode</td>
<td>Swedish Road Administration (SRA).</td>
<td>Head of road administration</td>
</tr>
<tr>
<td>18</td>
<td>Magnus Nilsson</td>
<td>Swedish Society for Nature Conservation</td>
<td>Campaigning for road pricing</td>
</tr>
<tr>
<td>19</td>
<td>Lars-Göran Mattson</td>
<td>Royal Institute of Technology, Professor of Transport Systems Analysis</td>
<td>Member of reference group and partly involved in evaluation studies</td>
</tr>
<tr>
<td>20</td>
<td>Marika Janstav</td>
<td>Transek</td>
<td>Managing director, design and evaluation</td>
</tr>
<tr>
<td>21</td>
<td>Christer Ljungberg</td>
<td>Trivector</td>
<td>Consultancy, responsible for evaluation scheme</td>
</tr>
<tr>
<td>22</td>
<td>Helena Sundberg</td>
<td>Stockholm, Local Traffic</td>
<td>Project leader for the public transport organisation</td>
</tr>
<tr>
<td>23</td>
<td>Birker Höök</td>
<td>Swedish Road Administration (SRA).</td>
<td>Project Manager</td>
</tr>
<tr>
<td>24</td>
<td>Nigel Bell</td>
<td>Professor Imperial College</td>
<td>Greater London Authority's Sustainable Development</td>
</tr>
<tr>
<td></td>
<td>Name</td>
<td>Organization</td>
<td>Position</td>
</tr>
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<td>-----------------------------------------------</td>
</tr>
<tr>
<td>25</td>
<td>Tim Steer</td>
<td>Transport for London</td>
<td>Policy Officer</td>
</tr>
<tr>
<td>26</td>
<td>Richard Bourne</td>
<td>Transport 2000</td>
<td>Campaigning for Congestion Charging</td>
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<td>27</td>
<td>Nick Fairholme</td>
<td>Transport for London</td>
<td>Policy Manager</td>
</tr>
<tr>
<td>28</td>
<td>Richard Case</td>
<td>Royal Borough of Kensington and Chelsea</td>
<td>Transport Manager</td>
</tr>
<tr>
<td>29</td>
<td>Anonymous</td>
<td>University, Advisor</td>
<td>Member of Transport for London Board</td>
</tr>
<tr>
<td>30</td>
<td>Anonymous</td>
<td>Politician</td>
<td>Non-executive Board member</td>
</tr>
</tbody>
</table>
### 8.3. Questionnaire

#### International survey on road pricing

**Problems caused by urban road transport**

Page 1 of 7

Urban road traffic causes problems from three typical domains:
- Environment (including air pollution, noise, greenhouse gas emissions, energy consumption)
- Lack of finances (the necessary and/or planned transport infrastructure can’t be built)
- Congestion

Road pricing is one possible solution to these problems. Each city has its own problems, which other cities.

Please compare the following pairs of problem domains. Rate for each pair, which domain you personally judge more serious in your city.

<table>
<thead>
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<th>The environmental problem is more serious</th>
<th>The congestion is more serious</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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<tr>
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<td></td>
</tr>
<tr>
<td>3</td>
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</table>

<table>
<thead>
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<th>The lack of finances is more serious</th>
<th>The environmental problems is more serious</th>
</tr>
</thead>
<tbody>
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<td></td>
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<td>3</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>The congestion is more serious</th>
<th>The lack of finances is more serious</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
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<td>2</td>
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<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

other comments...

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Next >>
International survey on road pricing
Objectives of road pricing scheme

Page 2 of 7

As the overall objectives of a road pricing scheme are influenced by many different opinions, generally a political compromise. In the following we are interested in the general objectives of the planned road pricing scheme.

What are the objectives of the road pricing scheme in your city?

Please rate comparatively for each pair, what the road pricing scheme aims to improve, e.g. quality or only the congestion situation or an intermediate choice.

a) The objective of the road pricing scheme in my city is to improve rather the...

<table>
<thead>
<tr>
<th>environmental quality</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>environmental quality &amp; congestion equally</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>congestion</td>
<td></td>
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</tr>
</tbody>
</table>

b) The objective of the road pricing scheme in my city is to improve rather the...

<table>
<thead>
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<th>generation of revenues</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>equal</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>environmental quality</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

c) The objective of the road pricing scheme in my city is to improve rather the...

<table>
<thead>
<tr>
<th>congestion</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>equal</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>generation of revenues</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please mention the most dominant factors that determined the objectives of the road pricing in your city?
International survey on road pricing

Page 3 of 7

How often, as far as you know, were the listed agents involved in the planning process of the road pricing scheme in the last 12 months of active planning?

Side Note: **Involved** means any kind of bidirectional communication between one of the mentioned agent with any other, e.g. telephone, email ex-change, meetings... In this context, the **planning process** encloses not only the engineering planning but a broad span of processes which happen between the initial phase of the problem recognition until/to the op-erating road pricing scheme.

<table>
<thead>
<tr>
<th>Agent</th>
<th>not involved</th>
<th>1-2 times involved</th>
<th>2-6 times involved</th>
<th>in most processes involved</th>
<th>I don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Politicians, Decision makers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport planner from public admin</td>
<td></td>
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</tr>
<tr>
<td>External consultants</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Members from universities</td>
<td></td>
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</tr>
<tr>
<td>Business representatives (Retail, Leisure, Tourist)</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Transport industry representatives</td>
<td></td>
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</tr>
<tr>
<td>Trade unions</td>
<td></td>
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<tr>
<td>Environmental organisations</td>
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<tr>
<td>Cycling &amp; pedestrian organisations</td>
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<tr>
<td>Motoring organisations</td>
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</tbody>
</table>

Other agents... (please name and specify how often the agent was involved)
## International survey on road pricing

**Communication frequency**

Page 4 of 7

**How often have you communicated with the mentioned agent in the last 12 months of active planning?**

Side note: to *communicate* means exchange of any information, knowledge and documents, e.g. telephone, email, document sharing, meetings...

<table>
<thead>
<tr>
<th>Agent</th>
<th>never</th>
<th>1-2 times</th>
<th>3-6 times</th>
<th>&gt;6 times</th>
<th>I don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Politicians, Decision makers</td>
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<tr>
<td>Transport planner from public administration</td>
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<tr>
<td>External consultants</td>
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<tr>
<td>Members from universities</td>
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<tr>
<td>Business representatives (Retail, Leisure, Tourist)</td>
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<tr>
<td>Transport industry representatives</td>
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<td>Trade unions</td>
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<tr>
<td>Motoring organisations</td>
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</tbody>
</table>

**other agents...** (please name and specify how often you have communicated with the agent)

![TextArea](image)

<< Prev  Next >>
## International survey on road pricing

### Communication type

**How do you exchange your knowledge predominantly with the mentioned agents?**

<table>
<thead>
<tr>
<th></th>
<th>You provide information for the agent (e.g. internet, leaflets, press release)</th>
<th>You raise information from the agent (e.g. consultation, survey)</th>
<th>You communicate bidirectionally with the agent (e.g. document sharing, telephone, email)</th>
<th>You communicate with more than two agents multilaterally (e.g. meetings, workshops)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Politicians, Decision makers</td>
<td>![ ]</td>
<td>![ ]</td>
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<tr>
<td>Transport planner from public administration</td>
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<tr>
<td>External consultants</td>
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<tr>
<td>Members from universities</td>
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<tr>
<td>Business representatives (Retail, Leisure, Tourist)</td>
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<tr>
<td>Transport industry representatives</td>
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<tr>
<td>Environmental organisations</td>
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<td>Cycling &amp; pedestrian organisations</td>
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<td>Motoring organisations</td>
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</tbody>
</table>

*other, please specify...*
**International survey on road pricing**

**Page 6 of 7**

Which of the following planning methods have been applied in the planning process in your city?

<table>
<thead>
<tr>
<th>Method</th>
<th>Applied</th>
<th>Not Applied</th>
<th>I don't know</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scenario planning</strong></td>
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<tr>
<td>Scenarios are hypothetical future states of a system and they help to gain insight into a system and its dynamics. In scenario planning, more than one scheme with different features and objectives is designed and systematically evaluated.</td>
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<tr>
<td><strong>Risk assessment</strong></td>
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<tr>
<td>If there are different alternatives or scenarios available (e.g., technologically), the question is often which alternative poses the least risk and meets the goals the best.</td>
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<tr>
<td><strong>Stakeholder consultation</strong></td>
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<tr>
<td>All the scheme specifications are outlined — any individual or organisation can give their views on what they think of the proposals.</td>
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<tr>
<td><strong>Mediation</strong></td>
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<tr>
<td>A meeting between the disputants and a neutral whose role is to help the parties explore issues, needs and settlement options.</td>
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<tr>
<td><strong>Future workshop</strong></td>
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<tr>
<td>The method could also be described as a structured brainstorming technique. A Future Workshop is a participative creativity method that tackles with the problems, visions and measures to reach these visions.</td>
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</tbody>
</table>

**Other, please specify**

[ ] [ ] [ ]
International survey on road pricing

Socio demographic data

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Which organisation / institution do you come from?
All your data will of course be handled confidentially and used for research purposes only. It will not be possible to connect your name to your answers. We need this details for possible request.

<table>
<thead>
<tr>
<th>Name of institution</th>
<th>Your Name</th>
<th>City</th>
<th>Telephone and/or email</th>
</tr>
</thead>
</table>

Please, choose the agent type which you represent

What is your role or responsibility in the implementation process of road pricing?

What is your educational background? (Multiple choices possible)

- Civil Engineering, Architect
- Mechanical Engineering
- Economics
- Natural sciences
- Social sciences
- Politics
- Communication, Journalism
- Other

What are the five most important institutions or representatives of the planning process? Please, fill in the names of the responsible person and the organisation they come from.

1. 
2. 
3. 
4. 
5. 

<< Prev   Done >>
8 Appendix

8.4 Row data

<table>
<thead>
<tr>
<th>Agent type</th>
<th>Problem</th>
<th>Communication Frequency</th>
<th>Communication Type</th>
<th>Pres</th>
<th>Knowledge Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edinburgh</td>
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<td>Stockholm</td>
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<td>London</td>
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</tbody>
</table>

Agent type: 1=Politician; 2=Transport Planer; 3=Consultancy; 4=Member from University; 5=Busines Consultancy; 6=Transport Representativ; 7=Trade Union; 8=Environmental Org; 9=Cycling& Pedestrian Org; 10=Motoring Org

Communication Frequency: 1=never communicated; 2=2-3 times in last 12 months; 3=3-6 times; 4=more than 6 times

Communication type: 1=provide information; 2=raise information; 3=bi-directional; 4=multi-lateral communication