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A Strategic Niche Analysis of Urban Road Pricing in the UK and Norway

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Traditional transport policies of road expansion entail a relatively simple system of actors and processes around which expertise, knowledge, and skills which has built up over many decades. Some of the more radical Travel Demand Management measures, including urban road pricing, involve a complicated set of institutions, processes, people and procedures. Road pricing schemes often get delayed or abandoned due to controversy, disagreements, unanticipated problems and a whole host of other delaying factors. If they are implemented, they tend to be diluted and consequently become less effective.
Strategic Niche Management (SNM) has previously been used to provide guidelines on the implementation of innovative transport technologies through setting up protected experimental settings (niches) in which actors learn about the design, user needs, social and political acceptability, and other aspects. Here SNM is modified to cover a policy approach through the analysis of road user charging case studies in the UK and Norway. A detailed analysis of the road user charging schemes in Bergen, Oslo, Durham and London is presented. Key factors identified include the role of stakeholder and user networks, the existence of a project champion, understanding the motivations and expectations of stakeholders and users, learning with regards to the regional context, and the change in perceptions associated with acceptance. Comparison between the four cases shows different approaches emerging from each country in implementing and 'marketing' of the policies.
The paper concentrates on approaches such as: the purpose for introducing the policies, the involvement of users in the planning process and, the use of revenues for either providing

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alternative transport modes or financing road infrastructure. Key factors identified using the SNM framework include the role of stakeholder and user networks, the existence of a project champion, understanding the motivations and expectations of stakeholders and users, learning with regards to the regional context, and the change in perceptions associated with acceptance. This type of analysis could prove useful for transport planners envisaging the implementation of road pricing projects.

Keywords: travel demand management, road pricing, toll rings, road user charging, strategic niche management, policy implementation

1. Introduction

Economic growth has put a tremendous strain on existing transport networks in recent years. Consequently, and also for broader environmental and financial reasons, transport issues have risen sharply on the political agenda of most countries, especially in areas where population density is the highest. Congestion is widely acknowledged as becoming the critical issue regarding surface transport especially in urban areas (DfT, 2004; EU, 2003). The UK and other western European countries are gradually learning that economic growth and traffic congestion cannot be reconciled by simply building new road infrastructure, as car traffic expands to fill up new road capacity. In the context of rising car ownership, pricing instruments as part of an integrated package of measures are increasingly seen as an effective strategy to reduce traffic and raise revenue (€UROPRICE 1, 1998).

The introduction in 2003 of an urban road user charging scheme in London has been followed by a renewed interest in the subject of road pricing both by practitioners and academics. In Europe, a number of trials of urban road user charging are underway (CUPID, 2004; €UROPRICE 2, 1998; PRoGRESS, 2003). But, despite gaining attention and enjoying the support of economists and transport professionals, there remain few implemented road pricing schemes. Ison (2004, p1) stated that:

There are however only a few schemes in existence world wide, which […] could be the result of it [road user charging] being unacceptable politically. In fact, political issues are as real and important for a programme's success as the economic and technical factors.

It appears that it is not the technical design or the economic justification that is problematic with road pricing projects, but the implementation processes and the difficulty in winning acceptance and support.

Four cases of successfully introduced road pricing projects are presented within the paper (see table 1 for the key characteristics of the four cities). The first cities to introduce road pricing measures in Norway and the United Kingdom were Bergen and Durham respectively. The other two cases refer to the capital cities Oslo and London.

Table 1. Selected characteristics of the four cities under investigation

	Bergen	Oslo	Durham	London
City population	239 000	530 000	85 000	7 500 000
Percentage living inside charged area	10	60	< 0.1	2
Starting date	Jan 1986 + (Feb 2004)	Feb 1990	Oct 2002	Feb 2003
Charging Area (km2)	18 (estimate)	64	0.35 (estimate)	21
Number of toll stations/control points	7	19	1	174
Entry charge for a small vehicle	15 NOK (€ 1.86 Euros)	20 NOK (€ 2.48 Euros)	£2 GBP (€ 3 Euros)	£7.5 GBP (€ 11 Euros)
Charging period	Mon - Fri All hours	All days, All hours	Mon - Sat 10am – 4pm	Mon - Fri 7am – 6.30pm
Average daily crossings during charging hours	73 000	248 900	239	205 000
Annual gross revenue[1] (millions)	220 NOK (€ 27.3)	1,192 NOK (€ 147.7)	£0.05 GBP (€ 0.07)	£90 GBP (€ 131.3)

This paper draws upon a framework that concentrates on the social learning processes that occur in the introduction of radical demand management policies like road user charging. The framework was based on an earlier method used to analyse the introduction of new transport technologies (Hoogma, 2002). Through SNM analysis, the study endeavours to structure the factors responsible for the effective implementation into a consistent framework for comparing the different schemes and to explore the relationships existing between critical issues. For more details on the methodology of both the study and the framework see Ieromonachou, 2005; Ieromonachou et al., 2004, 2006 and Potter et al., 2002.
This paper explores the planning and implementation processes that relate to urban road pricing. The aim of the paper therefore is to examine the reasons that allowed these radical policies in the four cities to become a reality. The paper also compares the different implementation techniques used in each city, to draw lessons of wider relevance.

2. Methodology

This paper has been compiled with information from reports, articles and other grey literature and more importantly from a series of semi-structured or focused (time limited) interviews with members of the Norwegian Public Road Administration and of local authorities in Bergen and Oslo, as well as the County Council in Durham. The London case study was constructed from existing material. The three data gathering techniques used in this study (appraisal, interviews and observation) served as a basis for data triangulation (Denzin and Lincoln, 1994). The interviews were done in a rigorous and consistent manner and were characterised by using a set of structured questionnaires to act as a framework for discussion.

[1] In 2004, 3.7 billion NOK (approximately 0.463 billion Euros) or almost 33% of the total annual state road construction budget in Norway came from toll fees collected from road users in almost 50 tolling schemes throughout the country.

Interviewees were allowed to talk at length on their own expert subjects, in order to build up a real world view of the schemes (Yin, 1994). Unless otherwise stated, the information presented here is drawn from these interviews and referenced within the text. Further communications via a follow-up email were also carried out to clarify and update specific issues.

From the above information, the SNM framework was used as a tool for policy analysis and implementation to answer the following research questions that the original investigation, from which this paper stems, aimed to address:

- What were the reasons for implementing road pricing schemes (in this case toll rings)?
- How was the process of implementing the schemes planned?
- What were the main barriers faced during implementation?
- What were the main benefits arising from the implemented schemes?
- What was the role of partner-actor networks in the success of schemes?
- How protection/motivation measures were employed for promoting the schemes?

The theoretical SNM framework when applied cannot guarantee a successful implementation process. Nevertheless, its use is helpful in identifying critical issues relating to the introduction of road pricing schemes.

3. Road Pricing

It was as early as the 1920's, when economists (Knight, 1924; Pigou, 1920) recognised road pricing as a simple way for taxing the external costs of transportation – congestion, accident risks, noise and emissions of pollutants (Maddison et al., 1996). The concept of road pricing was 'revived' in the early 1960's both by American and British transport academics (Smeed: Ministry of Transport, 1964; Vickrey, 1963) who saw it as one of the few solutions left to deal with the ever-growing problems associated with road congestion.

With the exception of the Singapore scheme, it was not until two decades later that politicians started to recognise road pricing as a potential funding source and travel demand management measure. Road pricing has been increasingly advocated in several EU states e.g. the UK (Ison, 2004) and the Netherlands (Rietveld, 2001) and could link to a recent EU urban environment thematic strategy for sustainable development (Stead, 2004). Furthermore, urban road user charging has now started to become a reality. Examples include the Norwegian urban toll schemes of the mid-eighties and early nineties and the two UK road user charge schemes that came into operation more recently. This work focuses on analysis of road user charging schemes rather than searching for the optimal system. There are a variety of urban road pricing methods and sometimes a confusing variety of names are given to the schemes. It is therefore useful first to define the types road pricing presented in this paper.

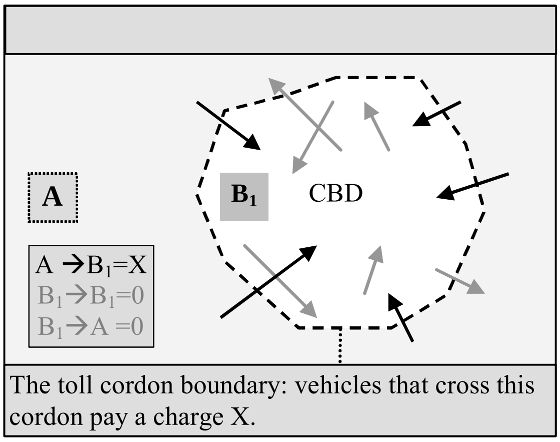

Figure 1. Cordon Charging
Examples include the Norwegian toll rings and the Durham Road Access Charge scheme.

<u>Cordon charging</u> (figure 1) involves charging drivers crossing a cordon to enter a specific area – usually the city's central business district (CBD). Drivers are charged when they pass through a specific point in the toll cordon. The fee can be levied using manual methods – either by manned toll booths or coin operated machines, as well as electronic tags – relatively simple read/write tags or smart card technology. Successful examples of cordon charging are found mainly in Norway where the policy (also called toll rings) has developed into a niche after most major cities adopted the measure (Ieromonachou et al., 2006).

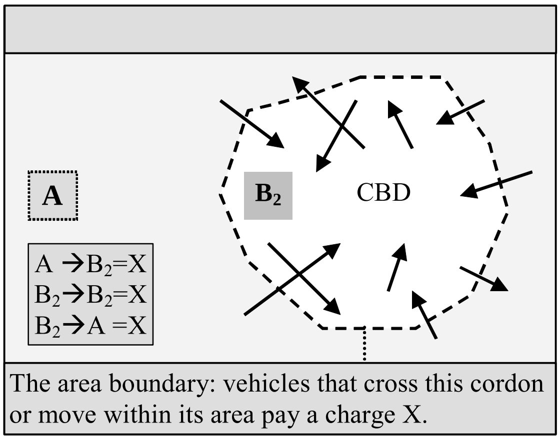

Figure 2. Area Charging
An example is the London Congestion Charge scheme.

<u>Area charging</u> (figure 2) applies to vehicles for accessing and travelling within a specified area. The first area charging scheme began in Singapore (1975). The scheme was based on a paper permit system that was upgraded to electronic road pricing (ERP) in 1998 (Enoch, 2004; Menon, 2000). The London Congestion Charging scheme (2003) operates as area charging. Another Norwegian scheme in Trondheim, which ceased operation at the end of 2005, started off as a cordon charging system. Seven years later, in 1998, it advanced to a 'proxy' area-based charging by dividing the initial area into several zones and introducing a charge for trips within zones (Ieromonachou et al., 2006). There can be variations in the way an area-based scheme operates. For example, in London drivers are charged only once per

24hr period, allowing them to make several trips in and out of the cordoned area, whereas in Norway every pass is charged, allowing one hour of travel with the zone.

4. The Norwegian experience

Funding road construction from toll revenue has been in practice for over 70 years (Wærsted, 2005) but their use has increased considerably in the last two decades. There are around 48 road toll projects in existence today (Amdal and Welde, 2005), with seven of them operating as urban toll rings[2]. Funds from these projects form the main source of road, and to a certain extent, public transport investment programmes (Odeck and Bråthen, 2002). Toll revenues are supplemented by additional governmental funds (Norwegian White Paper on Transport, 1996). On average, about 30% of the total annual state budget for road construction comes from toll revenue from both urban and motorway tolls (Langmyhr, 2003). The first Norwegian urban toll ring was established in Bergen in 1986 to raise funds to accelerate the implementation of a wide-ranging programme of transport investments. Since then, a number of other Norwegian cities have adopted urban toll charging including: Oslo, Trondheim, Stavanger and Kristiansand (Ramjerdi et al., 2004) as well as the smaller settlements of Tønsberg and Namsos (Wærsted, 2005).

4.1 The Bergen Toll Ring System

Bergen’s charging system was unique not only because it was the first Norwegian urban toll scheme but it also involves the smallest in area, lowest number of toll booths and traditionally had the lowest gross revenue of the three biggest Norwegian urban toll schemes. It was the director of the local branch of the National Public Roads Administration (NPRA) that pioneered the initial idea for the urban toll ring in Bergen. Permission from the central government for the operation of the toll ring scheme was given in June 1985 and seven months later, the system was completed. Toll stations were placed on all the main access roads leading to the centre of the city; initially there were six, with another one added later. All vehicles entering the tolled area between 6am to 10pm Monday to Friday, apart from buses, paid the fee. The fee was 5 NOK (€ 0.62)[3] for cars and 10 NOK (€ 1.24) for trucks until 1999 when they were doubled. In 2004 the fee was increased to 15 NOK (€ 1.86) for cars, and 30 NOK (€ 3.72) for trucks, per crossing. Prepaid tickets and monthly, bi-annual and annual permits were also available, at a slightly discounted rate.

The toll fees were designed to raise 35 million NOK (€ 4.34 million) for 1986 traffic levels based on approximately 70,000 vehicles accessing the tolled area per day. Almost 70% of the income went towards road construction costs, 20% for operating costs and the remaining 10% was put aside in a fund, the use of which was regularly under heated political discussion (Herdlevær and Arnesen, 2003). Operating costs in Bergen were higher than in other Norwegian cities due to the manned tollbooths. Enforcement was through digital video control, with offenders fined 300 NOK (€ 37.2). This manual system remained in place until 1st of February 2004, when a new electronic toll collection (ETC) system was introduced; ETC is carried out by using an on-board unit (OBU) which identifies each vehicle during

[2] With the closure of the Trondheim scheme at the end of December 2005, six were left operating.
[3] Exchange rate at time of writing 1 NOK ≈ € 0.124 Euros

movement into the charging area at a defined boundary. The OBU system – called AutoPass– was already in place in Trondheim and Oslo since 1991 (Ieromonachou, 2005).
The toll scheme was intended to cease in 2001 but Bergen developed a new programme for transport and city development. To raise the money for the plan, the toll ring was retained. The new transport programme reflected a shift in transport planning. Of the 4 billion NOK (€ 0.5 billion) budget; only 45% would be used for road infrastructure investment and the remaining 55% for city centre 'environmental' improvements. Funding public transport operations was one of the original intentions but there were legal restrictions on what tolls could fund. However, new legislation that promoted the use of congestion pricing measures allowed the revenue to be used for wider purposes, such as building public transport projects (i.e. light rail) and subsidising tickets. The toll scheme was not intended to affect traffic levels, and although there was a small initial drop in traffic (≈6-7% overall), the infrastructure built with toll revenue facilitated traffic growth. Motorisation rates also grew rapidly during this time period. Traffic management was carried out not through the tolls, but by controlling the amount and cost of parking spaces in the city centre. Parking charges were 10-20 times as much as the toll fee. This helped lessen traffic within city boundaries over time, whilst overall traffic in the region was increasing 3-5% per year.

4.2 The Oslo Toll Ring System

In February 1990, Oslo followed Bergen's example and implemented a toll ring scheme. Again, the initial objective was mainly to provide funds to enlarge road capacity. Discussions for the introduction of the toll ring in Oslo started about 10 years before its implementation. During this time many issues were debated concerning the planning phase, in particular the balance between revenue generation and traffic reduction. Traffic reduction was forfeited, and this was ultimately reflected in the low toll price. Four years before implementation, Oslo City Council and Akershus County Council finally agreed and sought approval from parliament for some type of toll to provide finance for road construction projects, whilst having as little traffic consequences as possible. The toll fee started at 11 NOK (€ 1.36) and currently is at 15 NOK (€ 1.86) per cordon pass, with an AutoPass season ticket being available. At the beginning it was operated manually but this lasted only a few months; since 1991 tolls have been collected electronically. Today over a quarter of a million vehicles drive through the toll cordon every day. Of these, more than 60% pay the tolls electronically through AutoPass tags. During rush hours, 85% of the traffic is recorded using the AutoPass system.
Currently there are 19 operating toll booths located in a ring around the city. Toll stations vary in size according to the corridor that they serve. The toll stations were geo-strategically placed between 3 and 8 km from the city centre solely to maximise revenue. In the first year of operation of the Oslo toll ring scheme, the initial investment of 250million NOK (€ 31 million) was covered by revenue of 750million NOK (€ 93 million). Revenue reached 1,192 million NOK (€ 147.7 million) in 2004, with operational costs being only 10% of the total revenue. Both transport packages for Oslo (OsloPakke 1 & 2, 1990; 2002) dictated that toll funds must be used for investment in road construction or public transport infrastructure and not towards operating costs (e.g. bus subsidies, etc.). The difference with the second transport package (called OsloPakke 2 and set for the period 2001-2011) was that it dedicated almost all toll revenues to public transport investment.

5. United Kingdom

Legislation did not exist in the UK for road pricing measures until quite recently. The UK Transport White paper (DETR, 1998a) and the following daughter document (DETR, 1998b) supported the policy of road pricing. The 2000 Transport Act (HMG, 2000) contains permissive powers for local authorities to introduce '*road user charging*' or '*workplace parking charge'* schemes provided they form part of an integrated transport plan. The legislation allowing for the implementation of congestion charging in Central London was made available earlier under the Greater London Authority (GLA) Act (HMG, 1999) which was the same legislation that provided for the establishment of the Office of the Mayor of London, the GLA and Transport for London (TfL).

5.1 The Durham Road Access Charge

As with many transport projects, the historical background to the Durham scheme was very important to understanding the contextual factors. The council had being trying to restrict traffic to the Peninsula since 1949, but it was only in 1975 (DCC, 2001) that measures to manage traffic movement in the Peninsula were introduced. In 1988 a group was set up to review the situation and develop proposals for access restrictions (DCC, 2001). The group, consisting of Members and Officers of Durham County Council, agreed on a package of strict measures that included controlling access or making pedestrian access a priority. The proposal was unsuccessful because it was viewed as unnecessarily radical by the major stakeholders on the Peninsula. In 1994 the council conducted a thorough public consultation followed by an experiment with less radical measures that included, parking restrictions, vehicle weight and length restrictions and commercial loading timetables (DCC, 2001). While successful, the new scheme required a greater enforcement effort than the local police and traffic wardens could handle. With the ineffectiveness of the conventional parking and traffic management scheme, 1997 saw the creation of Durham's Transport Steering Group (DCC, 2000). This consisted of members of the City and County Council members and various representatives of the major stakeholders on the Peninsula, businesses and other establishments as well as the police and the Chamber of Trade. This group was responsible for implementing a new set of measures suggested by a 1997 transport study (DCTS, 1997). Since that time, the agreed aim for the Peninsula was to significantly reduce the pedestrian and vehicular conflict by removing a substantial proportion of the existing traffic (DCC, 2001). However, they agreed that more had to be done to increase the City's regional, spatial, economic and transport significance (DCC, 2005). Support for the road user charging scheme was strong both among the elected representatives and the officials of the Labour-controlled County Council.

The Durham Road Access Charge Scheme began operating in October 2002, the first scheme to take advantage of powers granted in the Transport Act 2000 (Ieromonachou et al., 2003). The charging zone included the Cathedral and Castle, the University of Durham, the Chorister school, the market place area, other trading and servicing establishments and a small number of private dwellings. Motorists pay a £2 (€3)[4] charge to exit the area on Monday to Saturday between 10am and 4pm (the busiest time for both car and pedestrian traffic) via the Peninsula's only access thoroughfare, Saddler Street. The exit is controlled

[4] Exchange rate at time of writing £1 GBP ≈ € 1.46 Euros

during the charging period by an automatic rising bollard that is dropped upon payment (the machine accepts coins and cards, while annual permit holders can lower the bollard by using a transponder). The exit charge allows the free flow of vehicles into the area, preventing traffic queues forming in the entrance that would disrupt flows on the main thoroughfare (Ieromonachou et al., 2004).

A key part of introducing the access charge was an understanding and acceptance of the problem that existed. The area had particularly acute traffic problems. Of the 4,000 vehicles that entered the area each day prior to the scheme being adopted, 50%, dubbed 'serial parkers' (DCTS, 1997), used the road for short term parking, thus contributing to congestion by interrupting flows. Congestion was high because of the sheer number of vehicles and pedestrians concentrated in a small street with 13,000 people visiting each weekday and 17,000 on Saturdays (DCC, 2003). The situation in the area was untenable, threatening the viability of local businesses and damaging the appeal of the Durham Peninsula as a World Heritage site.

Another key part in the introduction was the provision of an alternative means of access to the Peninsula, and discussions with public transport users resulted in the launch of a new minibus service. It began operating some two months before the congestion charge was introduced. Partly-funded by the access charge, the 'Cathedral Bus' was introduced to link the Cathedral and Market Square with the Rail, Coach Stations and a Park and Ride Car Park, every 20 minutes. As noted by Ubbels et al. (2001), there is a growing trend to funding bus improvements through the use of such earmarked charges. The overall cost of Durham's Access Charge project to implementation including the operating systems, buses and pedestrian improvements was £250,000 (€364.7K), and was funded entirely through the Council's Local Transport Plan (LTP).

5.2 The London Congestion Charge

London's traffic problems are well known. Over the years, a number of measures had been implemented but none have alleviated the problem. The Congestion Charge scheme was introduced on February 17, 2003, following an intense planning and advertising campaign led by the Mayor, Ken Livingstone. A fee (initially £5 GBP (€ 7.3), raised to £7.50 (€ 11) in 2005) is charged to motorists entering a central zone of a 5km radius between the hours of 7 a.m. and 6.30 p.m. (TfL, 2003a). The £5 charge was expected to deter 10-15% of vehicles entering the zone and reduce journey times by 25%. In reality it reduced cars by around 20% and congestion by 30% compared with the last few weeks before charging (TfL, 2004) and by 38% compared with the equivalent period in 2002 (Pricing Urban Transport, 2003). This also reduced the revenue from an expected £130 million GBP (€ 190 million) to around £90 million (€ 131.3 million) (Ison, 2004).

London was not the first city to introduce road charging but is certainly the largest in terms of size and traffic flows to do so. The charged area represents a small proportion (1.3%) of the total Greater London area and around 200,000 vehicles drive into the charging zone every day. From these, the charge applies to about 110,000. The remaining are exempt vehicles including taxis, emergency vehicles, disabled badge holders as well as other groups[5]. There is also a 90% reduction to residents of the zone (TfL, 2004).

[5] Alternative fuel and electrically propelled vehicles, vehicles of 9 seats or more and roadside recovery vehicles.

A network of 700 video cameras in 230 positions throughout the charging zone, 174 of which are on the inner ring road, enforce the scheme (TfL, 2003a). There are also a number of mobile units with cameras patrol within the zone. There are two types of analogue cameras used: *colour* – for providing an image of the vehicle in the context of its surroundings and *monochromatic* – for reading number plates. Video streams are transmitted to a data centre where computer systems equipped with character recognition software deduce the vehicle registrations. The information is then compared against the database of vehicles with exemptions and those that paid their charge. Payment can be made to any of the 9,500 Pay Points at various petrol stations and shops throughout the UK; 200 places are within the charging zone and 1,200 within the M25 orbital Motorway. Within the charging zone there are also 100 pay-machines in car parks and 112 BT internet kiosks. Payments can also be made by phone, SMS text, or the internet (TfL, 2003a).

Traffic diversion outside the congestion zone has, contrary to expectations, been minimal. To accommodate modal transfer, 300 additional buses, offering 11,000 places were added to the already extensive bus network of London (6,500 buses) increasing bus patronage by more than 7%. London buses carry over 6 million passengers a day over 700 routes (TfL, 2003b). Making radical improvements in bus services was one among the Mayor’s ten priorities for transport in London (TfL, 2004). The scheme also generated net revenues to generally improve transport in London. Plans are now well advanced for a westward extension of the charging zone.

6. Strategic Niche Management

6.1 Background

Strategic Niche Management (SNM) is an organisational innovation diffusion theory that explores the processes and actors needed in shaping, and the application of, new technologies (Weber et al., 1999; Hoogma et al., 2002). By definition Strategic Niche Management is: “*The creation, development and controlled break-down of test-beds (experiments, demonstration projects) for promising new technologies and concepts with the aim of learning about the desirability (for example in terms of sustainability) and enhancing the rate of diffusion of the new technology*” (Weber et al., 1999). SNM had its roots in Constructive Technology Assessment (CTA) (Schot and Rip, 1996). Dissatisfied with existing approaches to technology innovation diffusion such as *'technology push'* and *'market pull'* strategies, Schot and Rip (1996) explored another type of model. This attempted to shift the focus away from forecasting the impacts of new technologies towards broadening the design processes to include new social actors and factors with the aim to anticipate and accommodate social impacts within technology development. CTA precipitated a redistribution of responsibilities for technology development among new actors, aiming to replace the polarised positions taken by (corporate) technology promoters and government agencies of regulatory control.

Schot and Rip suggested using Strategic Niche Management as a CTA strategy that encourages the idea of creating a protected space for the alternative technology within which 'second-order' learning could occur. This learning is defined as the process of “clarifying values and ways of relating values to each other" within the partnership network surrounding the new technology (Schot and Rip, 1996). The concept of a ‘protected space’ in SNM is more than technological ‘pump priming’ to support a desired technology. It is difficult to introduce new technologies that do not fit with the existing system (an obvious example is the difficulties of introducing electric vehicles into an internal-combustion engine transport regime). Alternative technologies to the ‘fossil-fuelled’ cars of today stand little chance if their speed, size, comfort and cost cannot be matched. Because it is impossible to design a first-time-perfect technology, SNM accepts the need for protection to experiment and learn. The experimental introduction of these new technologies is with the intention to learn and to diffuse this learning.

The reason that led to the use of this method for policy analysis was the need to analyse the processes, networks and stakeholders involved in implementing innovative and often radical demand management transport policies. SNM analysis uses a series of key terms and concepts. These include *technological niche* and *technological regime*, *transitions* and *regime transformation*. *Technological niches* are ‘protected spaces’ within the technological regime – that promote alternative technologies to those dominant in the regime (Weber et al., 1999).

Technological regime can be defined as “*the dominant social, technical and economic forces that support the technology and its physical and non-physical infrastructure*” (Lane, 2002). Internal combustion-engine vehicles form an example of a technological regime, which encompasses not only the technology but the whole economic and social system linked to it. An example of a technological niche within this regime might be demonstration projects for electric vehicles or CNG-powered buses. *Transitions* are societal transformations in which society or a complex subsystem structurally changes in a continuous, gradual way (Rotmans et al., 2001). Transitions are the result of a dynamic interplay among multiple factors, which mutually shape each other but at the same time have their own trajectory of development (Kemp and Rotmans, 2001; Geels, 2002). *Regime transformation* could well be defined as the ‘end product’ of a successful transition. In the case of SNM theory, transitions are achieved by the creation of niches.

SNM has been developed in the context of innovative technology projects (including new transport technologies). However, behind these specific technologies has been some form of policy initiative. Hoogma et al. (2002, p. 202) noted the need for more research “*on the relationship between SNM and state policies, and the relationship between SNM and planning. In general, SNM may be used to inform planning (both transport planning and town planning) while planning may be used to foster niche development processes*.”

Many of the project management aspects in the structured SNM framework relate to processes that also apply to developing urban policy instruments. Factors such as enabling learning, support measures, motivations of key actors, the evolution of expectations, barriers, acceptance and relationship to the existing regime, can all be applied to policies as well as technologies (Ieromonachou et al., 2004). The question is whether innovative policy instruments could be viewed in the same way as technologies, such that there is a ‘policy niche’ in the same way as SNM has a ‘technology niche’.

6.2 Using SNM for policy implementation analysis

It appears there is a potential to analyse various transport policies such as urban road pricing, using a policy adaptation of SNM. This would be particularly appropriate for more radical policies that have proved to be difficult to implement or to transfer between situations, as they challenge the dominant transport regime. The use of an SNM-type analysis could help identify critical information, processes and actors in the planning, introduction and implementation of the policy projects, the barriers that planners face during implementation (social, political, institutional, financial), and the different information needs for each step in the process. Consideration could also be given to whether policies require more protection than already provided by the regulatory framework and to how long the protection measures are required.

In order to use the concept of SNM to analyse policy implementation some adaptation to the structure of technology implementation is needed, but the main conceptual structure of supporting niches within the existing regime in order to create a shift towards a more sustainable system remains the same. An SNM-type analysis would consider protection measures like financial incentives and other actors' goals but in addition social and environmental benefits would need to be incorporated in the early stages of the project. Participating network partners and actors would need to be analysed by their enthusiasm and benefit they derive from the scheme. In the case of designing long-term policy strategies using SNM, development of sustainability-oriented niches will not only depend on actors but will also require a strong public role in leading the transition process. Numerous studies of product innovation and failure according to Hoogma (Hoogma et al., 2001) have shown that involvement of users is an important factor for successful market introduction, while a lack of user involvement is a major cause of failure. Creating a niche with one or more interrelated demand management policies will facilitate the process of societal embedding as well as overcoming several other barriers including institutional arrangements or regulatory frameworks that favour the established regime (Kemp et al., 1998). At the same time, barriers have to be overcome in order to find partners willing to support the new concepts and provide alternatives that will encourage their acceptance. Other authors investigating road pricing implementation processes (e.g. Ison and Rye, 2005), while not using a network-based theoretical framework such as SNM, have identified some of these key factors.

7. Framework Analysis

7.1 Framework Factors

The following is a short version of the SNM framework for policy analysis (Ieromonachou, 2005). This documents and explores the critical six factors identified in the four cases reported in this paper relating to the success of their road pricing schemes. The framework is network centred but the order of the factors does not demonstrate their importance. The role and influence of these factors in the outcome of the schemes varied between cases.

<u>Partner-Actor Networks:</u> SNM analysis identifies the stakeholder network for developing and implementing a policy initiative. A distinction is made between two groups: (a) those actively involved in the planning, implementation and operation of a scheme, the *partners* and (b) users and other groups that were indirectly involved in the decision making process, the *actors*. A network of partners and actors was apparent in all the investigated cases, but the level of involvement of each group differed in each project. For example, Durham had a very inclusive network for its small scheme, whereas the larger London and Norwegian schemes had networks that concentrated on the partners. SNM examines how these networks are formed and how they hold together.

Project champion: Project champions are charismatic individuals that spearhead projects. A project champion can stimulate the learning and acceptance process. Support of politicians is vital to the introduction of any road-pricing scheme whether a charismatic project champion exists or not. The project champion emerges as a critical part of the process of getting the charging system into place. All projects have some type of champion figure whether this is an individual (London, Bergen) or a coalition (Oslo) or community group (Durham). In some places (like London) the champions held special places (such as a government office) and their personal motivation could have been linked to motives beyond the implementation of a transport policy.

Expectations – Motivations: SNM analysis explores the motivations and the extent to which the different expectations of partners and actors come together. Many of the parties involved bring their own notions, values and beliefs with them which may be summarised in general as their motivation. When examined, motivations help explain why each group became involved in a road pricing scheme in the first place. Sometimes this is obvious and in some cases it develops or evolves during the various scheme phases. Motivations are intrinsically linked to the expected outcome of the scheme. These expectations of partners and actors are useful to analyse for many reasons. It is insightful to find how the expectations of different partners and actors gradually become aligned and, for this to happen, a shift in expectations would have occurred. One example was the case of Durham where groups that would otherwise be seen as actors in the scheme were brought to the network as partners (Ieromonachou et al. 2004). They were given power and responsibilities and thus were able to voice their concerns and have more control over their expectations while at the same time help the project overcome some of the barriers created by them.

Protection: Protection measures for policy niches were grouped into two key categories; the first, a) *enhancement protection* and the second, b) *compensation protection*. SNM assumes that protection measures can be phased out after some time. For policies, enhancement protection is the purpose of the policy, for example providing extra public transport in order to cause a modal shift; this must not be temporary - it is the very purpose for which policy is developed. Compensation protection is to shield certain users from the effects of the new policy, for example provide permits for disabled drivers when accessing a controlled access zone. In some cases this can be gradually or partly phased out.

Network Learning: From SNM theory, niche development depends on the local level of innovation processes and stakeholders behaviour. If the innovations (in this paper concerning road pricing policies) are successful, then the niche they create will become known and may be adopted more widely – proven in the case of the Norwegian urban toll rings and, promising in the UK as more cities outline plans for road user charging schemes. Niche development can be evaluated by the level of learning and the level of institutional embedding. Hoogma et al. (2002, p.28) appreciate the learning that occurs through a range of processes of articulating "*relevant technology, market and other properties*" but enhance this notion by suggesting that a second-order learning is required for niche development to result in a regime shift. This form of learning will involve a co-evolutionary learning (Wynne, 1995) that will draw in the partners and actors involved in the scheme but also third parties like governments that can help in the institutional and societal embedding. Learning processes need to extend beyond the immediate local network of stakeholders. This is where the wider issue arises of what contributes to acceptance of a policy measure.

User Learning - Acceptance: The social and political acceptance of road pricing plays a central role in the feasibility of implementing a road-pricing programme, as was highlighted by the 2005 referendum rejection of road pricing for Edinburgh. Levels of acceptance are usually very poor. Ison (2000) found that approximately 80% viewed urban road pricing as being publicly unacceptable. A number of studies have taken place in order to establish the social aspects and acceptability of transport pricing policies both in the UK and Norway (Jones, 1998; Odeck and Bråthen, 1997; Preston *et al,* 2000; Rajé, 2003). These studies show that viability of road pricing depends upon perceived benefits and the justification given for the development of such a programme in the selected area. Other studies (Jones 1991, Schade and Schlag 2003a) indicated the acceptability of road pricing policies to be low and many factors contributing to this low acceptance had since been identified (Jones 1998, Schade and Schlag 2003b). Langmyhr (1999) confirmed that the general public (at least in Norway) seemed to favour and accept more easily, charges that financed expanded road capacity as well as environmental and safety improvements rather than charges for managing demand.

It is clearly important to take into consideration at the design phase of the scheme the views that arise within the general public, and embed them, whenever possible, within the future operating plan. Acceptability needs to be considered seriously by implementers and government officials. Goodwin (1989) suggested that in an urban road pricing scheme the various actors' views should be included early in the design stage. He also noted the importance of different interest groups rather than the overall state of public opinion. Empirical literature shows that the public still has little knowledge of the possibilities of pricing policies as solutions to traffic congestion over other policies.

7.2 Key Factors from the Cases

Key factors in the four cases, presented using the SNM framework, are summarised in table 2. The commentary that follows picks up on a number of these factors with reference to particular cities, and explores the links between them.

The pioneering niche of Bergen emerged due to particular circumstances, that developed partner motivations, the most important of which was a resource constraint – the need to raise revenue to accelerate the building of much needed road infrastructure. This was linked to an increase in traffic congestion in the city streets. The niche was not for a demand management mechanism but has now begun to evolve in this direction. This suggests the need for flexibility and the ability to evolve when considering niches. Evolution in the case of the Norwegian tolls also included a change in technology with the move towards an electronic toll collection system, and this, in itself paved the way for further road pricing schemes. Urban tolling was inspired by Bergen but developed in different directions (Langmyhr, 1999).

The biggest issue that the city of Bergen faced was obtaining initial approval for the Toll Ring system, as Norwegians already bore heavy taxes including those for road transport. Cars were expensive to purchase; there were high road taxes and insurance costs as well as high fuel prices. (This is a context not dissimilar to the UK.) People argued that road building was a government responsibility, thus, the government should provide the funds for it. The public was overwhelmingly against the toll scheme at the start of the project (Odeck and Bråthen, 1997). Again this similarity in opinion was also voiced by residents in London when faced with the prospect of the congestion charge (TfL, 2004). Opinions in Bergen started changing when the first results were apparent - new relief roads, motorways and tunnels. The toll price, having been kept at low levels until the toll project was renewed, also helped. At the time that the toll ring was introduced in Bergen, the most important factor was to win over the local politicians and not the public. This is still reflected by the fact that public opposition towards the scheme is still quite high after twenty years and so many completed road projects. This is different to the London case where public opinion shifted in favour towards the charge system (Potter, 2004) and the system now looks set to expand (TfL, 2005).

Table 2. Summary of key factors applied to the various cases

	Bergen	Oslo	Durham	London
Partner-Actor Network	- Authoritative, Institutional - Partner emphasis – Actors not consulted		- Actors empowered and made Partners	- Actors consulted not empowered - TfL was the main Partner
Project champion	*Arild Egen,* the Bergen champion – good networker, acted as a catalyst for quick implementation	After success in Bergen was not so important	- Transport Steering Group - Institutional/group champion	*Ken Livingstone* Strong support by the champion
Expectations-Motivations	- Consistent policy (due to power concentration) - Parties reached agreement due to the scheme's importance in funding infrastructure - Aim was to raise revenue, not reduce traffic - Actors expected better new roads		- Reduce traffic congestion and pedestrian/ vehicle conflict - Less radical than pedestrianisation - Better environment	- Reduce congestion - Save money/time - Raise money for Public Transport enhancement
Protection measures: (a)Enhancement, (b)Compensation	- Political support both nationally and locally - (type a)	- Delivered the 'castle tunnel' before toll ring to gain support - (type a)	- Exemptions for church and university users (type b) - New bus service (type a)	- Enhanced P.T. and especially buses (type a) - Exemptions for many groups (type b)
Network learning	- Spatial planning factors are very strong - If a promise was made for a toll ring duration it should be kept, boosts political credibility		- Bigger drop in traffic than expected - Restricted area works well - Retail sales have been sustained	- Income too low -cost of scheme too high - Buses provided cost-effective capacity - No loss to economy
User learning - Acceptance	- Scheme delivered objectives - roads, trams and urban regeneration - Opposition only marginally reduced - Toll rings still not accepted, and seen as yet another tax		- Solution was provided to a widely accepted problem - Networking helped build trust	- Road congestion reduced - Buses can work but other modes necessary

The Durham congestion-charging scheme appears remarkably successful since it achieved its major objective of reducing traffic levels in the Peninsula area while satisfying the concerns of all major stakeholders. Although it is a modest project, how this has been achieved, contains lessons that could apply elsewhere. Perhaps most importantly were the presence of strong political leadership from both the elected representatives and the officials of the County Council who campaigned many years for the scheme. Secondly, the traffic problem in the area was well recognised by most people in the city, who were easily convinced that serious action was needed. This was supported by the special nature of the site (being a World Heritage site with the Cathedral and Castle) which provided an added incentive for action to restrict traffic. Thirdly, the access charge was proposed as an alternative to a total ban on vehicular access, and can thus be seen as a relatively benign measure in comparison. Milder measures had been attempted and did not work. The access charge ended up being just the latest in a whole series of measures aimed at gradually restricting traffic access to the Peninsula. The small size and scope of the scheme (with the charge only applying to a single road) made the scheme technically simple to introduce with relatively few people directly affected. Fourthly, the charging policy was preceded by improvements to public transport access to the area that have been clearly linked to the implementation of the scheme. Finally, the active involvement, and empowerment of a number of project partners, once again over a number of years, combined with a widespread consultation process and a publicity campaign ultimately helped the County Council achieve consensus and support for charging.

In the case of London there were several elements necessary for success already in place, such as a very committed political champion, an almost unanimous acceptance of an existing transport problem, and a list of well-known and realistic objectives. In addition, there was also a relatively broad coalition of support for the scheme itself from some of the key players. However, there remained strong opposition to Congestion Charging in London from some groups, and the local media adopted a very negative stance (LTT, 2004; 2005) – as it seems to do for the majority of transport issues (Ryley, 2004).

Providing alternative public transport in London with buses proved a more successful solution than expected. The boost in bus use helped the scheme's acceptance levels and kept costs down. Buses were a cheaper solution than, for example, new rail projects, as Oslo introduced. A similar issue arose with the charging system. The camera system was criticised as costly and not 100% accurate, as well as being visually obtrusive. But it constituted a tested technological option that could easily and quickly be put in place before the proposed start date. In the end it proved remarkably versatile and it remains relatively trouble free.

8. Conclusion

The use of the SNM framework to analyse the cases reported in this paper has helped to identify a number of key issues involved in the implementation of urban road pricing. Overall there are general similarities between the UK and Norwegian schemes despite the very different root aims (congestion reduction versus raising revenue). These include the importance of a champion figure or champion body, the role of ongoing learning for users and other actors, and the importance of the root motivation(s) being met, or at least to be perceived as being met.

The partner networks in Norway and the UK reflect the different starting points and objectives of the RUC schemes. The initial purpose of the Norwegian schemes was to finance additional roads and road users were familiar with tolling schemes. This helps to explain why the Norwegian networks concentrated on political and technical authorities. The UK schemes started with little or no user familiarity with road user charges and also sought to cut traffic flows. This combination required a wider partner/actor network and project planning system. Durham identified and empowered a wide range of community stakeholders and London had all vital partners grouped under the aegis of one 'lead player', TfL (Transport for London).

One important lesson is that all these successful schemes have used an incremental approach with flexibility to experiment and adapt. The following table (table 3) shows each of the four cities presented in the paper and the different ways in which they used incremental processes.

Table 3. Incremental implementation in each of the four cases

Bergen	Opted initially for a simple manual toll collection system and retained it until the end of 2003. The shift to an electronic system reduced costs further.
Oslo	Had an incremental change in its project aims from funding road building (first Oslo transport package) to predominantly funding public transport (second Oslo transport package).
Durham	Long history of attempted solutions (that generally failed) until it reached the successful access charge system.
London	Various traffic management options were tried out but these were insufficient; the congestion charge emerged as the only solution. The congestion charging set-up itself is incremental, in that it uses a basic technology that can be upgraded once the scheme was established.

Incremental approaches permit learning and enhance understanding and acceptance. The UK and Norwegian schemes started from different user experiences. In Norway, urban road tolling, even though still opposed, was an extension of previous common practices (road and bridge tolls). Since they had experience of widespread road tolls, there was a potential for motorists to accept an urban road pricing scheme without significantly increased resentment. Public opinion concerning the tolls in Norway has improved during the years but not significantly (Odeck and Bråthen, 2002). This suggests that more emphasis should have been placed on educating and informing road users of the benefits that the schemes would bring in the long term. Initially, outputs focused on road building (something that in theory should have pleased drivers), and not on alternative modes of travel. The gradual acceptance of the need to support public transport modes verified the evolution (or shift) of perceived benefits. In the UK there was little experience of road charges, which meant that the London and Durham schemes involved something quite new. In many cases, acceptance of road pricing required widespread acceptance that it would address an accepted problem. In London and Durham it was congestion (or the perception of congestion); in Norway, this was initially the need to finance roadbuilding, and later financing public transport and other environmental improvements. It is essential that the charging scheme is seen as a solution to an accepted problem, for the scheme to be successful from the user's perspective (Ison and Rye, 2005).

Radical policies with eventually large scale changes can be planned and introduced incrementally. This is consistent with SNM theory that identifies the need for experimentation, adaptation and evolution. As the process unfolds, many of the barriers would be (or in effect seen) as less dramatic. Figure 3 shows in relative terms the position of each of the four cities with regards to the nature of the policy and the implementation process. Although some readers may not agree completely with the placement of each scheme within Fig. 3, the authors put forward this framework as a means to observe the differences between various schemes. Normally, radical policies are expected to require a relatively un-complicated start and a pre-defined 'test' phase that would allow for problems like political and public acceptability to gradually normalise but this was not always the case. Each country and in effect each individual city needs to assess its circumstances and have a thorough understanding of the measure required and its effect within a regional context.

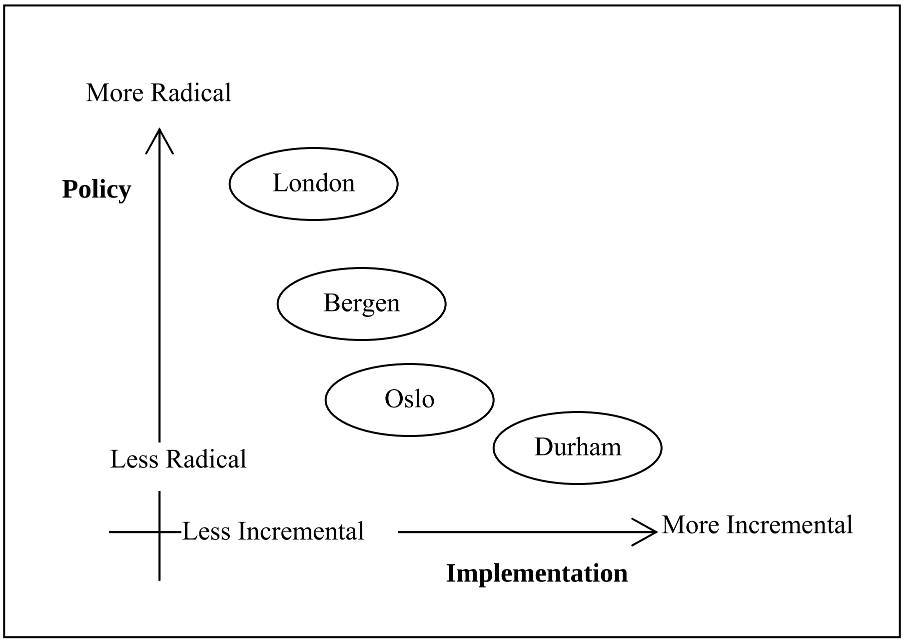

Figure 3. Incremental versus radical in the four cases

Protection measures to support the road pricing policies were needed most where demand management was involved. These were therefore an inherent part of the London and Durham schemes. A major part of protection in London was enhancing public transport services and the London experience shows how much can be accomplished in a relatively short amount of time and with relatively low capital, i.e. extra 300 buses (TfL, 2003b). Protection measures only emerged in Norway as the policy focus shifted from road building to funding alternative modes. Some protection measures for particular key groups (like retail) could also be crucial in winning widespread support, rather than reluctant acceptance, yet early indications show very little retail displacement beyond London (Quddus et al., 2005). Odeck and Bråthen (2002) noted that other key acceptability points should include higher levels of information and marketing to the public, a strong link between the revenue use and transport upgrade (while making sure that the public perceives things happening as soon as charges are collected), and ensuring that the information is transformed into stronger public confidence.

The theory of SNM although helpful, is still an emerging methodology and this paper stems from recent work in its development. The authors have focused on analysing a specific innovation and whether it will succeed within a niche. Shaping factors are critical in the process but they cannot be separated from the local context. The cases presented here were analysed retrospectively using SNM. It is not, at present, a policy implementation tool. Also, the work involving SNM should be considered as more qualitative rather than quantitative. However, the framework can be used by practitioners to ensure key factors are addressed in policy implementation and to help identify which of these particularly apply to their schemes.

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