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Equity and Fairness in Transport Planning: The State of Play

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ABSTRACT

This paper explores the concept of equity, or fairness, in transport. As a pillar of sustainable development, social equity is an important objective of transport planning. The provision of transport infrastructure can have significant equity impacts on society through the distribution of costs and benefits. In recent years, there has been an increase in research interest in transportation related equity issues. The paper outlines the primary theoretical traditions that relate to equity and transport equity, and how equity concerns are currently addressed and evaluated in academia and in practice. Recent research has attempted to establish stronger principles from which to make sound moral judgements as to the fairness of transport impact distribution. The literature reveals that transport equity analysis is complex due to the numerous types of equity and impacts to consider. The paper concludes with a commentary on the state of play of transport equity and identifies areas for potential future research.

INTRODUCTION

As a pillar of sustainable development[1], social equity is an important objective of transport planning. The World Bank (*1*) argues that for transport policy to be effective it must support and improve the standard of living (economic and financial sustainability); it must improve the general quality of life (environmental and ecological sustainability); and its benefits must be shared equitably by all sections of the community (social sustainability). Banister (*2*) notes that a key role for transport planners is to set an agenda for transport based on the concepts of equity.

While environmentalism and economic development have tended to dominate the sustainable development agenda over the last decade or so (*3*), equity has emerged as an issue in the literature in recent years. There have been a growing number of transport-planning focussed papers addressing the subject area. The provision of transport infrastructure can have significant and diverse equity impacts on society through the distribution of costs and benefits (*4*). Costs (for example: road casualties; obesity; and air pollution) tend to be particularly high in societies with high levels of car-dependency and car-oriented land-use and design (*4*; *5*). Increasing car ownership, usage and dependency is a significant, and increasing global issue that presents one of the main challenges to sustainable development (*6*). Reducing the need to travel, particularly by car, and promoting more energy efficient modes of travel (for example, walking, cycling and public transport), are key objectives in sustainable development policy. To achieve sustainable transport, in particular, Banister (*6*) notes that equity, in addition to the environment and efficiency, are the three targets areas to be addressed.

This paper addresses the subject area of equity and its relevance to the field of transport and land-use planning. It is primarily concerned with the equity ramifications of transport planning in developed, and usually car-dependant Western countries. The overall aim of the paper is to gain a better understanding of the theoretical basis, and current state of play in academia and practice, of transport equity for passenger travel, walking and cycling. This paper will review the primary theoretical traditions that relate to equity and transport equity, and how equity is currently addressed and evaluated. In terms of the layout of the paper, section 2 gives a brief overview of the literature on theoretical concepts in equity and transportation-related equity. Section 3 briefly examines the costs and benefits of transport, and their distribution effects. Section 4 provides an overview of the primary appraisal techniques in practice, and a review of recent academic research that addresses equity issues. An objective of the latter is to identify potential gaps in appraisal and analysis methodologies with relation to equity, rather than comparing individual methods. Section 5 concludes and identifies potential future research directions.

THEORETICAL CONCEPTS IN EQUITY AND TRANSPORT EQUITY

Equity is a complex and multifaceted subject, and its definition is not straightforward. Essentially it is a form of distributive justice. For the purposes of this paper, transport related equity has been defined as the fair distribution of transport impacts (benefits and costs)

[1] Although there is intense debate in the literature about what sustainable development really means, addressing this is outside the scope of this paper. This paper assumes the generally accepted description of sustainable development as the convergence of the three pillars of social equity, environmental protection and economic development (Drexhage and Murphy, 2010).

throughout all sectors of society (*4*; *7*). What might be considered a fair distribution is, again, a complex notion – in relation to transport, this is discussed further below. According to Sen (*8*), central to fairness 'must be a demand to avoid bias in our evaluations, taking note of the interests and concerns of others as well, and in particular the need to avoid being influenced by our respective vested interests, or by our personal priorities or eccentricities or prejudices' (p. 54, *8*). Broadly, it can be seen as a demand for impartiality. Equity is a subject area that has been studied since at least the time of Aristotle, and is relevant to many disciplines and fields. The subject area appears to be more developed in some fields (for example, health and education), than others. Although scholars in the area of social justice have historically paid little attention to the field of transport planning, there has been a move within the planning and transport fields in recent years to explore this relationship in greater detail and to provide a more solid theoretical basis for transportation focussed equity (see, for example, *9*; *7*; *10*; and *11*).

Different ethical theories form the guiding principles for society over time. According to van Wee and Geurs (*11*), the primary theories of relevance in transportation today are utilitarianism, egalitarianism, and sufficientarianism . Utilitarian theory states that an act is only morally right if it maximises aggregate good, and the net benefits outweigh the costs (*12*). Much of the appraisal and evaluation of transport projects and plans are currently based on utilitarianism, such as Cost Benefit Analysis (*11*). This will be discussed in greater detail in later sections of this paper.

There are many egalitarian positions, but broadly speaking egalitarianism requires all like people to be treated equally (*13*). Temkin (*13*) expands on this to describe equality as comparability – how equally deserving people fare relative to others. Comparative egalitarianism is motivated by a sense of fairness. Temkin argues that in addition to many of the strong normative considerations that can influence when to intervene and help a person (such as compassion or giving extra weighting to the poor), egalitarian reasons of comparative fairness may help determine who amongst the needy has the strongest claim where resources are scarce.

Another egalitarian theory is the theory of justice of Rawls (*14*). Central to this is that all people should have equal rights to 'personal liberties' or 'primary goods' (for example: income; rights; and opportunities), and that social and economic benefits are just only if they result in compensating benefits for everyone; particularly the least advantaged members of society (*15*).

Egalitarianism focuses on the differences in people's well-being, whereas sufficientarianism assumes that everybody should be well-off to a level 'sufficient' for their needs. In this regards, people do not need to be equally well-off, as long as they can meet their own particular needs sufficiently. In this regards, priority should be given to the improvement of well-being if it is below a certain threshold (*16*; *11*).

Transportation Equity

Beyazit (*9*) describes two ways that transport plays a key role in ensuring an equitable and just society. Firstly, transport helps distribute the social and economic benefits that are created by, among other things, the means of transport. Secondly, transport supports peoples' capabilities[2] by linking them. According to the World Bank (*1*), inappropriately designed transport plans can *'aggravate the condition of the poor, harm the environment, ignore the changing needs of users, and exceed the capacity of public finances'* (p. 1, *1*).

[2] Capabilities refers to a *'person's capability to do things he or she has reason to value'* (Sen, 2009, p. 231). If a person's advantage is less than that of another, then he or she is less capable and therefore has less real opportunity to achieve what is valued.

164 According to Litman (*4*), and Banister (*2*), there are two key types of transportation related
165 equity; horizontal equity and vertical equity. Both could be said to be largely derived from
166 egalitarian theory. Litman (*4*) notes that the different types of equity are not clear-cut; they
167 often conflict as well as overlap. Horizontal equity is concerned with the equal distribution of
168 impacts, whereby no group or individual is favoured, unless explicitly justified. In this
169 regard, people should be largely treated alike in decisions regarding funding and the
170 distribution of benefits and costs. Vertical equity is concerned with the distribution of
171 impacts between groups or individuals that are not equal in abilities and needs. In this
172 regards, certain population groups are 'favoured' or given special consideration in decision
173 making (*4*). Litman (*4*) separates vertical equity into two categories: vertical equity with
174 regards to income and social class on one hand (which Litman states might also be called
175 social justice, environmental justice and social inclusion), and mobility need and ability on
176 the other. With regards to the former, '*transport policies are equitable if they favour*
177 *economically and socially disadvantaged groups, thereby compensating for overall*
178 *inequities*'[3] (p.3, *4*). The latter relates to the degree that the transport system meets the needs
179 of travellers with particular constraints; such as the disabled, the elderly or any group whose
180 mobility is physically impaired.
181 With vertical equity, there is some debate with regards to 'equity of opportunity' and
182 'equity of outcome' (*4*; *11*). The concept of disadvantaged people having adequate access to
183 education and employment opportunities (equity or equality of opportunity) is usually
184 accepted as an important function of transport; but there is less agreement with equity or
185 equality of outcome (*4*; *11*). The latter implies that disadvantaged people, for example,
186 actually succeed in these activities. Temkin (*13*) contends that in an egalitarian society,
187 unequal outcomes are morally wrong, thus equality of outcome is important. No-one should
188 be disadvantaged relative to another simply by being born into a lower social class. Temkin
189 (*13*) also argues that equality of opportunity is very important, particularly in times of scarce
190 resources where all needs are not able to be met. In this regards, all those who are equally
191 deserving should at least have equal opportunity to meet their needs Temkin (*13*) argues that
192 we must think carefully about the factors that are *'most central and valuable for human*
193 *flourishing, and how the various components of well-being are related and distributed'* (p.
194 167, *13*).
195 In their recent paper, Martens et al. (*10*) have made considerable progress towards
196 developing a justice based theoretical approach to the distribution of transport related
197 benefits. Building on Walzer's 'Spheres of Justice' (*17*) - which is broadly egalitarian in its
198 philosophy - the importance of transport to society is discussed with access as the prime
199 benefit distributed through transport investments. Mobility, rather than accessibility, has been
200 the focus of transport policy since the popularisation of the car[4] (*18*; *10*). This has largely
201 been to the detriment of those without access to a car and disadvantaged groups (for example:

[3] The literature reveals the groups that are most disadvantaged by car-oriented policies and car-dependency. In the UK, for example, the Sustainable Development Commission (2011) published a report which collates much of this literature. This report examines the issue of fairness in transport policy, and addresses the costs associated with high car dependency to the most vulnerable in society, including: children; the elderly; the poor; women; minority ethnic groups and disabled people.

[4] Accessibility can be defined as *'the extent to which the land use and transport systems enable (groups of) individuals to reach activities or destinations by means of a (combination of) transport modes'* (Geurs and van Wee, 2004, p.127). Mobility simply refers to the movement of people, or the amount of movement (Ross, 2000), but does not take account of the actual ability to reach destinations. There is also much debate in the literature regarding the definition of mobility.

children; the elderly; the disabled and the poor) (*10*; *5*). Martens et al. (*10*) focus on access as the appropriate social meaning of the provision of the transport good, as access to destinations is necessary to allow people to fully participate in society and to have the chance to fulfil life's opportunities. The scholars argue that 'pure equality' in the distribution of accessibility would be impossible in practice given the intrinsic nature of cities, where-by certain centres develop more than others because of their spatial advantages. They suggest a maximax distributive principle be used as a guiding principle for the just distribution of access. This is discussed further below in section 4.

TRANSPORT IMPACTS & DISTRIBUTIONAL EFFECTS

Transportation is the source of multiple social, economic and environmental costs and benefits. Costs and benefits have a reciprocal relationship: a cost can be characterised as a reduction in benefits, and a benefit as a reduction in costs (*19*). Although existing appraisal and evaluation literature tends to divide costs and benefits into discrete sets of impacts, many of these impacts overlap and each potentially has a social, economic and environmental dimension (*20*). Many of these costs and benefits are relevant to transport equity analysis, particularly through their distributional consequences. According to Jones and Lucas (*20*), distributional impacts may take three primary forms: spatial (for example, the varying geographical distribution of air and noise pollution); temporal (for example, varying noise pollution over the day and night); and socio-demographic (for example, differential impacts on a sector of the population such as the elderly, the poor, or pedestrians). A particularly acute situation of inequity would involve the cumulative effect of all three forms. For example, a disproportionate burden would be placed on a local community that derives no benefit from the development of a new motorway, and suffers from associated day and night time noise and air pollution, as well as severance[5] and negative visual impacts.

In their literature review on the social and distributional impacts of transport, Markovich and Lucas (*21*) argue that these impacts have received less academic and policy attention than economic and environmental impacts, and have been historically underestimated. Geurs et al., (*22*) define social impacts of transport as 'changes in transport sources that (might) positively or negatively influence the preferences, well-being, behaviour or perception of individuals, groups, social categories and society in general (in the future)' (p. 71). Geurs et al. (*22*), Jones and Lucas (*20*), and Markovich and Lucas (*21*) provide a comprehensive literature review on the social impacts of transport. It is not within the scope of this paper to discuss these impacts (both positive and negative) in detail, but in summary they include: transport casualties and injuries; noise and nuisance; air quality/pollution; accessibility; severance/ barrier effect; use of space; forced relocation; uncertainty of construction; accessibility; visual and aesthetic quality; social interaction; physical fitness; and leisure/valued journeys.

With regards to costs that have an environmental dimension, Feitelson (*23*) states that externalities primarily arise from the energy used to move traffic over space; the effects of the infrastructure needed to facilitate this movement; and the indirect effects of transport on land-use and development patterns. Many of these impacts overlap with social and economic impacts, and vary depending on the spatial scale; whether local, regional or global. The environmental impacts of transport are comprehensively addressed in the literature (see, for example, *24*; *23*; and *25*). Local impacts include: noise; vibrations; carbon monoxide; particulates; reduced groundwater recharge; loss of visual amenities; and changes in emission

[5] Severance refers to the 'existence of a real or perceived barrier to people's movement through an area that is created by the transport infrastructure (such as roads or railways) or traffic' (James *et al.*, 2005, p.24).

and exposure patterns. Regionally, effects include: nitrogen dioxide; ground-level ozone; flooding; and eco-system severance. The primary global effect is increased carbon dioxide levels. These externalities can have significant and long term consequences including climate change, non-renewable resource depletion, reduction of biodiversity and poor human health (*24*; *25*).

Bristow and Nellthorp (*26*) provide a summary of the direct financial costs and benefits of transport (as well as environmental and socio-economic impacts), as typically used in evaluation frameworks in the European Union. Capital costs include construction, disruption and land costs. Recurring costs and benefits include: maintenance costs; operating costs; revenues; passenger cost savings; time savings; safety (collisions); and service level. Bristow and Nellthorp (*26*) state that there is a significant degree of agreement on the inclusion and monetisation of these impacts in transportation appraisal in the European Union, particularly through Cost-Benefit Analysis (CBA). The indirect impacts of these benefits (at the microeconomic level) are also taken into account in the form of lower assembly costs in production and gains from logistic reorganisation (*27*). There are also macroeconomic benefits such as economy-wide cost reductions and output expansions derived from transport infrastructure (*27*). Creation of employment is a key benefit gained from this. Recent research by Lakshmanan (*27*) also discusses the broader economic benefits of transport investment including the opening up of new markets, achieving gains from trade, the promotion of inter-regional integration, and enhancing the performance of factor markets.

TRANSPORT EQUITY ANALYSIS

The sections above illustrate how transport planning decisions can have significant and varied equity impacts. These decisions involve making a moral judgement regarding the fairness of the distribution of costs and benefits (*11*). This gives rise to the need for transport decisions to be appraised and evaluated in order to analyse and assess their [potential] equity impact on different population groups. For the purposes of this paper, this process is referred to as 'transport equity analysis' (*4*).

In his guidance document on evaluating transportation equity, Litman (*4*) notes that transport equity analysis can be difficult due to the numerous types of equity, ways to categorise people and impacts to consider. Martens (*16*) argues that a suitable equity analysis cannot be undertaken without defining which distributive concerns should be addressed. He suggests that the following questions need to be answered to determine the above: which benefits and costs should be the focus on the analysis?; what societal groups should be distinguished?; and what principle would determine that a particular distribution is considered fair?

Martens (*7*) discusses three potential foci for transport equity analysis[6]: net benefits; mobility-enhancing benefits; and single benefits and costs. The net benefits approach is the approach taken in standard cost-benefit analysis and is described further below. Mobility-enhancing benefits (also known as 'travel ability' or 'accessibility') refer to the overarching goal of most transport projects to improve people's ability to travel from one place to another. Martens (*7*) argues that 'potential mobility' is the most important benefit distributed through transport projects, and should be the focus of equity analysis. Single benefits and costs would involve the evaluation of all costs and benefits separately by criteria relevant for each particular impact. Fruin and Sriraj (2005) argue that such a comprehensive equity analysis would be extremely difficult given resource and time constraints, particularly at a macro

[6] Marten's (2011) paper is focused on transport equity analysis within the context of social cost-benefit analysis.

level. Martens (*28*) also contends that institutional arrangements in most Western countries greatly reduces the need to consider all benefits and costs, particularly environmental externalities, as legal thresholds and environmental norms already exist to protect the population.

This section discusses some of the key methodologies in practice and academia for appraising and evaluating transport infrastructure, projects and plans, with a focus on how equity concerns are addressed. In the literature reviewed, equity related concerns tend to be focussed on two broad categories: ex-ante transport appraisal of large infrastructure projects; or an evaluation of the status quo. The following subject areas have been reviewed, and are discussed in greater detail below: ex-ante transport appraisals of large infrastructure projects; transport service quality and accessibility; sustainable transportation; project funding allocation/distribution; the distribution of transportation externalities, particularly for disadvantaged groups in car-dependant societies; and transportation cost burdens. This review is not comprehensive, but it is designed to give a good cross-sectional view of the breadth of literature that addresses the subject area to one degree or another.

Ex-ante Transport Appraisal for Large Infrastructure Projects

Cost-benefit analysis (CBA) is the primary method for evaluating ex-ante transport policy options, including infrastructure plans (*9*; *11*). CBA assesses the economic efficiency of a project using a lump sum approach whereby the costs and benefits are aggregated (*29*). CBA is a popular methodology as the outputs are easy to understand, particularly for politicians and other decision makers (*9*). Multi-criteria analysis (MCA), in addition to quantitative measurements and qualitative assessments (or a combination of the above) are the other key types of national appraisal practices in the European Union (*26*; *30*; *22*).

Several authors (see, for example: *9*; *26*; *11*) contend that distribution effects and equity, and social exclusion, are poorly addressed in transport appraisals in general, and CBA in particular. van Wee and Geurs (*11*) and Beyazit (*9*) also argue that CBA is not suitable for evaluating social exclusion or social justice policies. Beyazit (*9*) notes that CBA does not consider the social impacts of a project at a disaggregate level. This in turn, *'disregards the individual diversities, the actual needs and wants of the members of a society, and the distributional effects of transport and thus tends to favour the ones who are already mobile in the market'* (*9*). Ultimately, CBA works by asking the basic question of whether a transport project generates more benefits than costs, where equity analysis should ask who gains the benefits and who bears the costs (i.e. the distribution of the impacts) (*29*).

Thomopoulos et al. (*31*) provide a review of the main strengths and weaknesses of CBA and MCA in seeking to incorporate equity concerns in transportation evaluation. They argue that equity considerations are difficult to evaluate by conventional CBA. A key limitation of CBA is that it focuses on aggregate welfare and does not account for the welfare loss of certain groups or regions. With CBA, all impacts are quantified and expressed in monetary terms,but many impacts are not easily monetised (for example, visual intrusion and health), and the use of monetary values to assess human welfare is criticised by many authors (see, for example, *9; 31*). The quantification of all impacts does allow for consistency and easier decision making, as well as a compensation regime, although financial compensation may not be very helpful to those that are negatively impacted on. Compensation is also likely to be only theoretical, rather than realised. As Martens (*7*) argues, transport is first and foremost a tool to assist people in-kind, not a tool to generate income.

Geurs et al. (*22*) argue that CBA employs a utilitarian approach where 'justice is done when the total amount of utility is maximised, regardless of the distribution' (p. 85, *22*). Martens (*29*) also contends that CBA is biased in favour of wealthy households. Higher

income groups tend to make more trips and travel longer distances. The consequence of this is that the travel time savings and vehicle operation cost reduction components of CBA inherently favour these higher income households. In his paper on cost-benefit analysis and equity, Martens (*7*) concludes that for an adequate assessment of the equity impacts of transport projects, any analysis should be undertaken alongside but separate from cost-benefit analysis. An example of such an approach has been developed by the same author (*29*) on behalf of the Israeli Ministry of Transport. These guidelines for practice suggest how equity considerations could be considered as a complement to the established cost-benefit analysis framework. The guidelines recommend focussing on 'travel ability' or accessibility as the fundamental indicator of equity, rather then considering all costs and benefits. The report recommends carrying out the equity analysis at two levels: the household level, and the community level. Equity is judged on the 'equalization' criterion[7] for the household level, and on the criterion of 'positive discrimination' for the community level. The latter is based on the notion that 'weaker' socio-economic communities are only able to close the gap with 'stronger' socio-economic communities if they are at an advantage in terms of accessibility. A key strength of this approach is that it is designed to fit within the established and popular CBA approach, and is simple and easy to understand.

With Multi-Criteria Analysis, several criteria can be taken into account at the same time. It attempts to make a balanced assessment based on the diverse objectives and preferences of the various actors in the decision making process (*31*; *32*). As MCA does not monetise impacts, it allows for more impacts to be potentially considered, such as social impacts. MCA involves establishing objectives and determining relative importance weights from which a decision making team makes transparent judgements based upon (*33*). Thomopoulos et al. (*31*) argue that allowing for value judgements is essential in equity evaluation. As this could be criticised for subjectivity, the authors propose an MCA framework methodology to overcome this by introducing pairwise comparisons and then contrasting the results with predefined policy or project objectives. A limitation of MCA is that it cannot show that a particular transport project, for example, would add more to welfare than it detracts (*33*).

Transport Service Quality and Accessibility

As an important indicator of transport equity (*29*), accessibility has received much attention in the literature in recent years, and a number of different accessibility analysis methodologies have been developed. This sub-section discusses some of the key methodologies used in practice, and recent research undertaken in academia. In the United Kingdom (UK), accessibility assessments are now a mandated part of the planning system. This was a key outcome of the report, *'Making the Connections: Final Report on Transport and Social Exclusion'* (*34*). This report examines the link between social exclusion, transport and the location of services; and concludes that good accessibility is essential for reducing social exclusion. Accessibility is defined as the ability to reach desired goods, services, activities and destinations at a reasonable cost, in reasonable time and with reasonable ease. It focuses on access to opportunities that have 'the most impact on life-chances, such as work, learning and healthcare' (p.1, *34*), particularly for disadvantaged groups. The report clearly sets out how the UK Government will address transport and accessibility issues that affect social exclusion.

[7] Equalization is a principle of equality that is sometimes referred to as the 'compensatory principle'. In this regards, project alternatives that distribute transport impacts so that they narrow the existing gaps in society are preferred over those that widen the gap (Martens, 2011).

The aim of the new accessibility planning framework is to enable government agencies to systematically assess whether people can get to important activities, and to effectively solve accessibility problems. Since 2006, Local Authorities have been required to include an accessibility plan as part of their Local Transport Plans. The report recommends that an accessibility audit, a resources audit, an action plan, and an implementation and monitoring plan is undertaken as part of the accessibility planning framework. Further guidance on the methodology is provided by the Department for Transport (*35*). This guidance also links accessibility to equity on numerous occasions.

A key component to the accessibility audit is the use of a bespoke commissioned Geographic Information Systems (GIS) based software called 'Accession'[8]. The aim of the software is to help local authorities produce maps of their local areas that will illustrate travel times (as an indicator of service quality) to services and employment using different transport modes, including public transport, walking and cycling. Analysis with key socio-economic and demographic data is then used to evaluate impacts on particular groups. The guidance recommends that auditing should take place at a strategic (level initially to provide an overview of potential accessibility issues, which then can be used to identify priority areas for examination in greater detail. The guidance sets core indicators that are focussed on journey times to jobs and services by public transport, walking and cycling. In addition, the guidance recommends that local authorities develop locally specific indicators to support local accessibility objectives. The monitoring of core indicators over time enables the assessment of changes in equity of opportunity, but not necessarily equity of outcome (*36*).

Public Transport Accessibility Level (PTAL) is another approach that can be used to spatially assess the equity of public transport supply. Wu and Hine (*37*) analysed the existing and a hypothetical bus network in Northern Ireland used PTAL. They tested how the hypothetical changes would affect public transport accessibility for different age and religious groups. The authors state that the level of access to public transport services is 'a function of the degree to which social exclusion processes are experienced' (p. 309, *37*). Accessibility is measured using an index that reflects the walking time to the transport stop, reliability of service, number of services within a catchment and average waiting time. The primary limitations of the methodology are that supply to destinations, and aspects of travel time such as speed of service; congestion; crowding; and ease of interchange, are not considered (*37*).

Delbosc and Currie (*36*) developed a simple system-wide measure of the equity performance of public transport using the Lorenz curve from the field of economics. They compared the distribution of public transport supply across population and employment in Melbourne, Australia. The paper addressed horizontal and vertical equity separately. Horizontal equity was assessed via the Lorenz curve (and spatially mapped), and vertical equity through a comparison of public transport supply for different societal groups in greater need of public transport service (categorised by age, income and car ownership). This method allows for a single value for horizontal equity assessment across an entire transit system, and a visual representation of gaps in public transport supply relative to population and employment. In this regards, the simplicity of the methodology should allow for its employment in other jurisdictions. Limitations of the methodology include a lack of clarity of the real meaning of the single value, and that destinations are not considered in the analysis of service frequency.

[8] The software was produced by MVA Consultancy & Citilabs, UK.

Martens et al. (*10*) developed a theoretical framework for the evaluation of the fairness of transport impact distribution based on accessibility as the fundamental indicator. The authors developed the following three guiding principles (maximax criterion):

1. The gap between the areas with the lowest and highest level of access should remain within a predefined range (this will allow for an 'acceptable' level of access across social groups regardless of mode availability);
2. The gap between car-owning and car-less households (as car availability strongly shapes a person's level of access in car-focussed societies) in the same area should remain within a predefined range;
3. Aim to achieve the highest possible average access level across areas and modal groups.

The authors contend that where there are large existing gaps in access levels, in practice this may require that low-mobile groups are provided with disproportionate benefits in transport projects in order for any investment to be considered equitable. The authors review their guiding principles against the typical approaches to justice undertaken by transport agencies in the United States of America (USA). These agencies work within the framework of the Civil Rights Act of 1964 and the subsequent rulings incorporating environmental justice considerations in transport planning. Martens et al. (*10*) find that none of the approaches reviewed come close to the ideal of the three guiding principles, and many failed to define a sound goal against which to assess the transport equity analysis result.

Sustainable Transportation

An increasing number of studies are aiming to address the three dimensions of sustainable development, and how they relate to transport (see, for example, *38*; *39*). Nicolas et al. (*38*) provide an overview of mobility as it relates to sustainable development. The study applies social, environmental and economic indicators as they relate to mobility, to a case study of Lyons, France. The authors' aim was to develop a methodology that can be applied to a range of European cities so that comparisons of the indicators could be made. To facilitate this, the city is divided into three zones of development density for separate analysis: the dense historical centre; the neighbouring municipalities; and the greater suburbs. Social equity forms the basis of the social indicators, with an emphasis on mobility and transportation affordability for socio-economic groupings, disaggregated by mode and city density/proximity to city centre.

While the focus of research by Zheng et al. (*39*) is on characterising and measuring the economic aspects of sustainable transportation, a composite index for overall transportation sustainability is also presented with associated indicators. The index is intended to be simple and flexible so that it can be easily applied by policymakers at various geographic scales. In this regard, twelve elements of transport sustainability are presented with nineteen overall indicators. The authors argue that an extensive list of variables is not necessary as one or two key variables can satisfactorily represent the indictors. The authors note that social equity and efficiency form the underlying principles of sustainability, and they provide the link between the economic domain, and the social and environmental domains of sustainable development. The concept of equity forms a key element to many of the indicators, including: social equity; accessibility; affordability; and finance equity. Through a case study, the overall performance of the transportation system in the USA is assessed in terms of sustainability. A key finding is that high automobile use may undermine the economic domain of transportation sustainability. Based on the literature, the likely main

reason for this being market distortion due to the lack of consideration of external costs and subsidies.

Transportation Project Funding Distribution

Fruin and Sriraj (*28*) developed a methodology to evaluate the equitable distribution of a public transport capital improvement program, using Chicago as a case study. This study was undertaken in the context of new environmental justice (EJ) legislation introduced at a federal level in the 1990s in the USA. It required all government agencies to analyse investments early in the planning stages in order to estimate impacts on various population groups. This legislation was developed out of a well-documented history of racial and social discrimination in transportation projects in the USA. Fruin and Sriraj (*28*) note that most equity studies in the area of transportation are undertaken on a project-by-project basis, as opposed to macro or regional level studies. The few large scale studies that have been completed have utilised an accessibility index or locational analysis. The former measures changes in travel times across population groups that result from the completion of a transport project. The latter evaluates the perceived benefits spatially across population groups. The authors base their study on locational analysis. The methodology involves identifying 'environmental justice neighbourhoods' (with a concentration of a particular disadvantaged group) and examining funding ratios between EJ neighbourhoods and non-EJ neighbourhoods. GIS is used to illustrate the spatial outcomes of the analysis and to assist in determining transport service areas and the unit of analysis. The distribution of other transport benefits and burdens could also be explored using this methodology.

Transportation Externalities, Cost Burdens and Disadvantage

There are numerous studies that have inferred equity related concerns based on the distribution of environmental externalities. For example, Mitchell (*40*) investigated the relationship between urban air quality and social deprivation in Leeds, England, and found that inequities exist. For example, Crouse et al. (*41*) found associations between concentrations of air pollutants (nitrogen dioxide) and neighbourhood level deprivation including unemployed adults, low income households and visible minorities in Montreal, Canada. The authors note, though, that clear exceptions existed and that the correlations should not be used to infer causality; but can be used to identify statistically significant associations.

Fietelson (*23*) states that at the local and regional level, the focus of environmental equity studies (particularly during the 1990s) was on attempting to find a spatial correlation between noxious facilities or emission sources and adjacent population attributes. He argues that many studies are 'fraught with methodological problems' (p. 116, *23*), particularly cross-sectional studies as opposed to longitudinal studies. Fietelson (*23*) contends that the equity outcome of exposure from transport may be an indirect consequence of the transport system on land use. He describes how traffic externalities, for example, are largely governed at a regional scale by meteorological variables, although local effects are more consistent over time and space (*42*; *23*). Deakin (*15*) argues that 'regardless of the causality, the result is the same: a disproportionate burden on people of colour and the poor' - referring to the USA (p. 61, *15*). In addition, disadvantaged groups, such as those on a low income, are the least able to take action towards mitigating exposure to pollutants (*41*). Fietelson (*23*) recommends that future research should 'focus on comparisons of the attributes of users of the transport systems to those affected by such systems, and on the equity ramifications of transport policies geared to mitigate the environmental effects of transport' (p.116, *23*).

There is also a considerable body of literature that links disadvantage with a disproportionate amount of traffic collisions, health and cost burdens. In the United Kingdom (UK), the Sustainable Development Commission (*5*) recently published a report which collates much of this literature. This report examines the issue of fairness in transport policy, and addresses the costs associated with high car dependency to the most vulnerable in society (such as the young, the old and the poor). For example, there are strong links between child pedestrian deaths and poverty, and childhood obesity and poverty. The report also illustrates how the increase in car-dependency, and car-oriented design and land-use has lead to a significant decrease in the ability of the elderly and children to travel independently. Those on low incomes are also shown to spend a disproportionate amount of their household budget on motoring costs. A key outcome of the report is a recommendation of a new sustainable transport hierarchy to increase the equity of transport in the UK. Demand reduction for powered transport is given priority, followed by (in order): modal shift to more sustainable and space efficient modes; efficiency improvements of existing modes; and capacity increases for powered modes.

Discussion, Conclusion and Future Research Agenda

As a pillar of sustainable development, equity is a complex and multi-faceted subject. Like Haughton (*42*) argues with regards to sustainable development; it may never be a fully achievable or quantifiable end-goal, but the importance of the process of moving towards a more just society should be recognised (*8*). Because of the normative nature of equity, the subject area will inevitably draw varying and conflicting views. The overall aim of this paper is to gain a better understanding of the theoretical basis for transportation related equity and how the subject area is currently being addressed in academia and practice. Scholars of ethical theory have rarely addressed equity issues specifically relating to transport planning, but in recent years, scholars within the field of transport planning have been increasingly tackling the subject area. Equity and wider justice issues are well established in other applied fields, such as healthcare and education. As the subject area evolves within transport planning, there could be scope to further learn from these other fields.

Equity is deeply rooted in ethical theory, which helps form the guiding principles for society. Much of the existing research does not appear to make strong links with theories of distributive justice, but there has been a move in recent years to form a stronger and clearer theoretical basis to frame research within, and to establish distributive principles from which a sound moral judgement as to the fairness of a particular distribution (within a particular context) can be drawn. Further research will need to test and refine transport equity analysis within the evolving theoretical frameworks. With vertical equity, strategic and local contextually specific aims and objectives can help define what groups should be given special consideration. Defining sound goals against which to assess the transport equity analysis result will be critical (*10*). In this regards, the importance of equity within the context of sustainable development should be reinforced. As the Sustainable Development Commission (*5*) recommends in the UK, a new sustainable transport hierarchy should be considered to increase the equity of transport in car dependant societies. Martens (*10*) also argues, where there are considerable gaps in access, for example, between the car-owning and car-less, disproportionate benefits in transport projects may need to be directed to the less mobile groups to be considered equitable. However, care will need to be taken to ensure that addressing equity for one group does not unfairly disadvantage another group. Litman (*4*) recommends that it is generally best to consider a variety of perspectives, impacts and analysis methods. Temkin (*13*) argues, for example, that egalitarian reasons of comparative

fairness may help determine who amongst the needy has the strongest claim where resources are scarce.

The transport related literature reveals a lack of coherence when addressing equity concerns. This may be compounded by the varying types of equity and impact categories, and perhaps by the cross disciplinary nature of the subject area. Although the literature reveals an expansive list of the costs and benefits of transport; social impacts, and in particular the fairness of the spatial, temporal and socio-demographic distribution of these impacts are not addressed in a comprehensive manner. Research to-date has tended to focus on the negative impacts of transport, and on analysis using a small number of equity indicators; such as mobility, accessibility, public transport service quality, and the impact of transport externalities on disadvantaged groups. Accessibility as a key indicator of transport equity tends not to be addressed holistically in the literature, for example, travel time savings tend to dominate over access to destinations, ease and affordability of travel. Little research has attempted a more comprehensive and multi-variable approach to equity analysis, although some scholars have argued that it would be overcomplicated and resource intensive (see, for example, *28*; *7*). A concern with the limited variable approach is that smaller costs could be overlooked that have the potential for significant longer term incremental and cumulative impacts.

Geurs et al. (*22*) contend that the methodological soundness of social impact assessments needs to be improved; including the definitions of indicators, context specific assessment techniques, and the relative importance and value of different indicators for different types of projects and plans. Mode specific equity and the equity of non-motorised transport (walking and cycling) verses motorised or private transport, appears to be an area that has received little research focus to-date, especially in the transport planning field. Guers and van Wee (*11*) argue that the 'literature so far has almost completely overlooked accessibility by slow modes, particularly the accessibility of land use and infrastructure planning for slow modes' (p.363, *11*). These scholars also see the need for research on the effects of local land-use and transport characteristics (for example, street design) on travel times and accessibility.

Currently, equity analysis is only haphazardly applied in practice, or in many cases, not at all. With improvements in the definition of distributive principles and assessment methodologies, there is an opportunity to expand it into the evaluation of both large and small transport projects and plans, as well as an assessment of the status quo in order to improve existing transport networks.

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