



Developing sustainable transport for the next generation: The need for a multi-sector approach

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ABSTRACT

While some countries have made progress in encouraging more sustainable transport and travel patterns, there are limits as to how far this can be taken simply by looking at the decarbonisation of transport systems, since most travel is a derived demand and hence is strongly influenced by decisions taken by public and private sector agencies in different sectors. The paper first identifies some of the major non-transport sector influences on different aspects of travel behaviour. It then looks in more detail at changing patterns of grocery shopping over the last half century, and how these changes have been associated with new non-transport technologies and accompanying developments in business and social practices. Next, a simple visual spreadsheet tool is presented, that has been used by agencies to explore the main cross sector impacts (both positive and negative) of their major location and operating decisions. Finally, the paper proposes three ways in which cross sector synergies can be encouraged: (i) by giving each sector or major organisation responsibility for all CO₂ emissions associated with its activities, including those generated by the travel of its staff, customers, suppliers, etc.; (ii) by making major policy making within government a cross sector activity; and (iii) by developing a common, cross sector appraisal methodology for assessing the full range of impacts of policy proposals.

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1. Introduction

In most countries, policy-making takes place in a series of thematic ‘silos’, with one ministry responsible for a particular sector of the economy. For example, education policy is formulated and implemented by a Ministry or Department of Education, and the same arrangements apply to health, industrial policy, etc. Transport policy, similarly, is usually the responsibility of a Ministry or Department of Transport. While this policy mechanism is administratively simple to operate, it is not very effective when issues are not sector-specific, such as social exclusion or obesity, which have multiple causes and require policy measures which cut across several sectors.

In practice, transport finds itself in a similar situation. While at one level it is a clearly identifiable sector of the economy, this is just the ‘tip of the iceberg’. Since transport is primarily a derived demand, the underlying drivers of demand result from actions in other parts of the economy (e.g. health, education, retailing), and are heavily influenced by a country’s wider social and cultural context. The ways in which that demand is manifest, and the scope for using different sustainable modes of transport to meet that demand, is highly dependent on land use planning policies; and the extent to which

movement can, for example, be made using low carbon vehicles partly dependents on decisions taken in the energy and industrial sectors.

Often, policies in a non-transport sector may have a negative impact on the achievement of sustainable transport policies within the transport sector. In the UK, for example, the national government had pursued a ‘choice’ agenda that encourages people to attend their ‘best’ schools and hospitals; often these will not be the closest ones to their homes, thereby increasing trip lengths (and CO₂ emissions) and reducing the feasibility of travelling there on foot or by cycle [1]. Based on National Travel Survey figures, between 1997 and 2006 the average distance travelled to primary school increased from 1.3 to 1.5 miles, and to secondary school from 2.9 to 3.4 miles [2].

The extra transport costs arising from locational decisions taken in other sectors are not usually factored into their investment decisions. For example, MRC [1, p.19] provides the example of a new £30 million school built in Corby as part of a flagship national government scheme:

“But the new Academy is sited out of town, replacing a previous in-town location, and new pupil bus services cost an additional £300,000 per year. These costs were not attributed to the school development costs.”

Thus, in considering how to encourage more sustainable patterns of personal travel in the future—if we are to make substantially

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more progress than has been achieved in the past—then it will become increasingly necessary to look to cross-sector co-operation and solutions.¹ MRC [1] carried out a study for the UK Commission for Integrated Transport, to examine the extent to which non-transport sectors take into account the transport implications of their decisions, but found very little evidence of this recognition beyond some links between land use and transport planning.² But, even here (page 21):

“The problem has been reframed as a transport problem, not a service issue. Therefore solutions are sought in the provision of additional transport rather than in changing the way that decisions [by the other sectors] are made”.

This paper explores ways in which these cross-sector links that are crucial to achieving more sustainable transport systems and travel patterns can be conceptualised, identified and realised. Section 2 first identifies the various influences that can affect different aspects of travel demand and its realisation. Section 3 takes the example of grocery shopping and shows how this behaviour pattern has changed over time, as a result of developments in non-transport technologies in conjunction with changes in business and social practices. Section 4 illustrates a simple spreadsheet tool that has been developed to explore cross-sector impacts with policy makers, using health centre relocation policy as an example. Section 5 considers what might be done to facilitate cross sector working, to encourage synergies that contribute to the achievement of more sustainable transport. Finally, Section 6 presents some brief conclusions and recommendations.

2. Cross-sector influences on personal travel

There are several components of a given pattern of travel behaviour, each of which is influenced by technologies and prevailing patterns of behaviour in several other sectors. This is illustrated in Table 1.

The table divides travel decisions into four primary components: trip frequency, trip length, mode choice and vehicle type.³ The **trip frequency** for a given purpose depends on the frequency with which the associated activity needs to be carried out, which in turn is influenced by business and social practices, and by whether the underlying activity can be undertaken (at least to some extent) without the need for travel, for example through tele-banking or teleworking. **Trip length** depends on the locations where the activities can be undertaken, which is influenced primarily by business practices (e.g. consolidation or dispersion of site-based facilities), and by local land use policies and spatial patterns: whether densities are high or low, and whether land uses are zoned or mixed.

Mode choice is heavily influenced by policies under the direct control of the transport sector, such as the availability of public transport services (both spatially and temporally) and the cost of transport, as well as the provision made for other modes through the construction of cycle paths, and by the extent to which car use is discouraged through limited parking provision, etc. But it is also influenced by land use policies which affect trip length (as noted above) and by the connectivity of the street network pattern, which

Table 1

Non-transport influences on different aspects of travel behaviour.

Affected travel behaviour	Non-transport influences
Trip frequency	Business policies and social practices Scope for telecommunication substitution
Trip length	Business policies (e.g. dispersed or concentrated provision) Land use patterns (density, mixed use or zoning, etc.)
Mode choice	Land use patterns Street network patterns
Vehicle type (CO ₂ emissions)	Taxation and charging policies Sources of electricity generation

determines the directness with which journeys can be made by different modes and the extent to which bus and tram services can penetrate into residential and commercial areas; here cul-de-sac type developments make it particularly difficult to provide attractive alternatives to car travel (e.g. [4]).

Finally, the choice of private **vehicle type**—affecting, in particular, its level of CO₂ emissions—is affected not only by market availability and pricing, but also by vehicle taxation policies and by any other charges that are emissions-related (e.g. parking and congestion charging: [5], [6]). While, where fully electric vehicles are used, their ‘true’ carbon footprint is totally dependent on the particulars of the manufacturing process and decisions taken in the electricity generation and distribution industries.

The next section illustrates how developments in disparate technological areas coupled with social/business practices in different sectors, can come together to encourage significant changes in everyday behaviour patterns, using the example of grocery shopping behaviour.

3. Influence of different socio-technical clusters on changing patterns of grocery shopping

There is a growing body of literature which recognises the importance of the interplay between technologies and business and social practices in explaining major transitions in patterns of behaviour and consumption. Brand [7] explores the notion of the synchronisation of technologies and business practices as a basis for changing behaviour patterns, while Geels [8] examines the wide range of factors which co-evolved in order to support the widespread adoption of various advances in transport technologies (e.g. the switch from horse drawn transport to the internal combustion engine). A growing literature describes this as the ‘socio-technical approach’. But very little of this literature has explored the effects of developments in non-transport sectors on patterns of travel behaviour. This section applies these principles to explain the emergence of different grocery shopping practices and associated travel patterns, over time.

Fig. 1 illustrates, in a simplified manner, the ways in which grocery shopping would typically have been accomplished in the first half of the twentieth century in more advanced Western countries. Provisions would be sold in a series of small, local, family-owned specialist shops where the premises were constructed from local materials of brick/stone, tile and wood. The shops would obtain most of their supplies of fresh foods from farms or food processing businesses in the surrounding region, with tinned foods coming from further afield. Households would typically shop on a daily basis, carrying their purchases home on foot, and paying for them in cash.

Fig. 2 shows how this traditional pattern had, to a large extent, radically changed by the end of the twentieth century.⁴ Now most grocery shopping is carried out by visiting one supermarket site, offering a very broad product range; the very large building is

¹ Similarly, there is growing recognition in other government sectors of the role that transport can play in helping to meet their objectives, ranging from stimulating economic growth to reducing obesity; but those perspectives are not addressed in this paper.

² Countries such as the UK can require developers to provide a minimum level of non-car access to major new developments, and require planning authorities to apply a ‘sequential test’, to give preference to town centre over out-of-town retail development [3].

³ There are other components of choice, such as timing and route, which are not included in this discussion.

⁴ Although local shopping patterns still exist, the bulk of grocery shopping expenditure is now accounted for by Cluster Two patterns of behaviour.

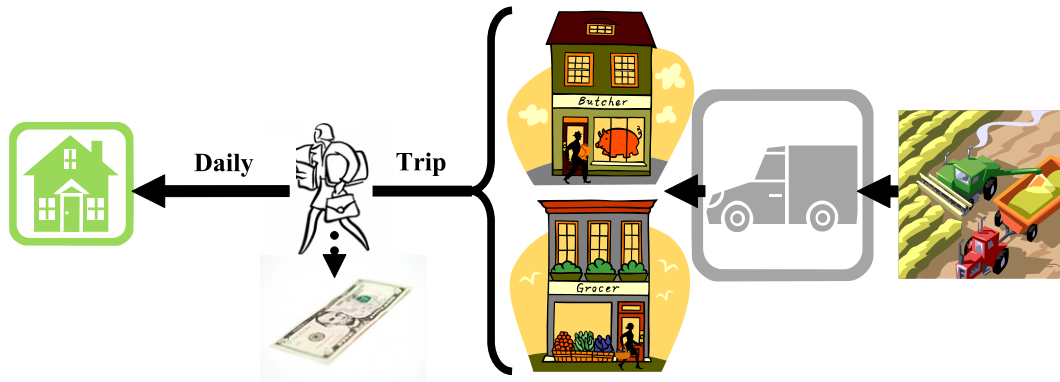


Fig. 1. Socio-technical Cluster One—first half of the twentieth century.

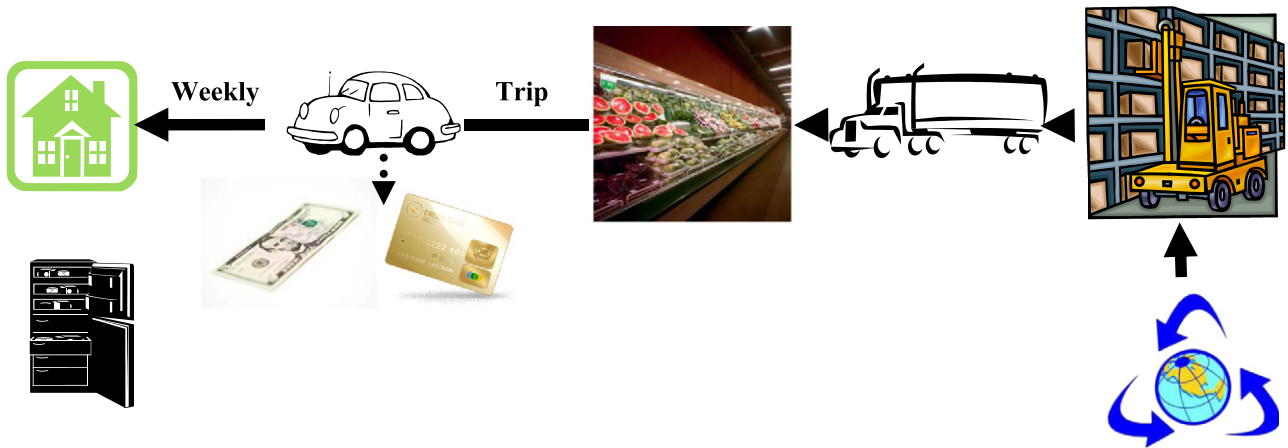


Fig. 2. Socio-technical Cluster Two—late twentieth century.

constructed using a steel frame and cladding and is typically located on the edge of town or outside the built up area close to a high speed road network. Products are now sourced from around the world, using global communications systems and delivered using advanced logistics. Most people make weekly grocery shopping trips by car, which have sufficient storage space to carry this size and weight of goods. Payment is made either using cash or credit card.

However, underpinning this socio-technical cluster is the invention of the fridge-freezer, without which it would not be possible to have global supply chains, nor for households to store fresh foods for a period of a week, or much longer in the case of frozen foods. And, at a higher level, most of this would not have been possible without the widespread availability of electricity.

Finally, Fig. 3 shows an emerging pattern of shopping behaviour, in which the weekly shopping trip to the supermarket by car is replaced by deliveries, on demand, from the supermarket's distribution centre directly to the household, using small vans.⁵ This shift in grocery shopping behaviour is due primarily to two non-transport technological developments: the widespread availability of fast broadband connections in people's homes, and the facility for electronic payment by credit card.

Table 2 summarises the main differences between the three socio-technical clusters, and their implications for grocery shopping patterns. As can be seen, while the use of cars for weekly grocery shopping—still the dominant pattern in many more economically advanced countries—is clearly possible due to high levels of car ownership, this

is a necessary but not a sufficient condition. Without advances in building construction materials, global logistics and associated communications, and particularly in cooling/freezing technologies, then most shopping trips would still be likely to be made on a daily basis to local shops—regardless of the availability of a car.

The key lesson for transport policy development arising from this analysis is that the fundamental changes in grocery consumption patterns in favour of car-based shopping that were observed in the latter part of the twentieth century—with major negative consequences for sustainable transport—were the result of a combination of changes in technologies in various non-transport sectors and associated changes in business and social practices. So, in particular, the common late twentieth-century practice of households undertaking a weekly (or less frequent) major grocery shopping trip by car did not arise simply because of high levels of car ownership. This development also depended on scale efficiencies in the retail sector (due both to advances in building construction methods and in international logistics), and the possession in each home of a refrigerator/freezer.

Similarly, the now emergent move towards internet shopping and home delivery is dependent not only on the development of the internet and in-home broadband connections, but also the development of credit/debit card technology that facilitates remote electronic payment.

The implication of this analysis is that, in order to achieve major improvements in levels of sustainable travel patterns in the future, policy makers should be looking to encourage new forms of cross-sector, socio-technical clusters and associated business/social practices that facilitate more sustainable patterns of behaviour in general.

⁵ In the UK, annual shopping trips declined by 18% between 1995/97 and 2010 [9].

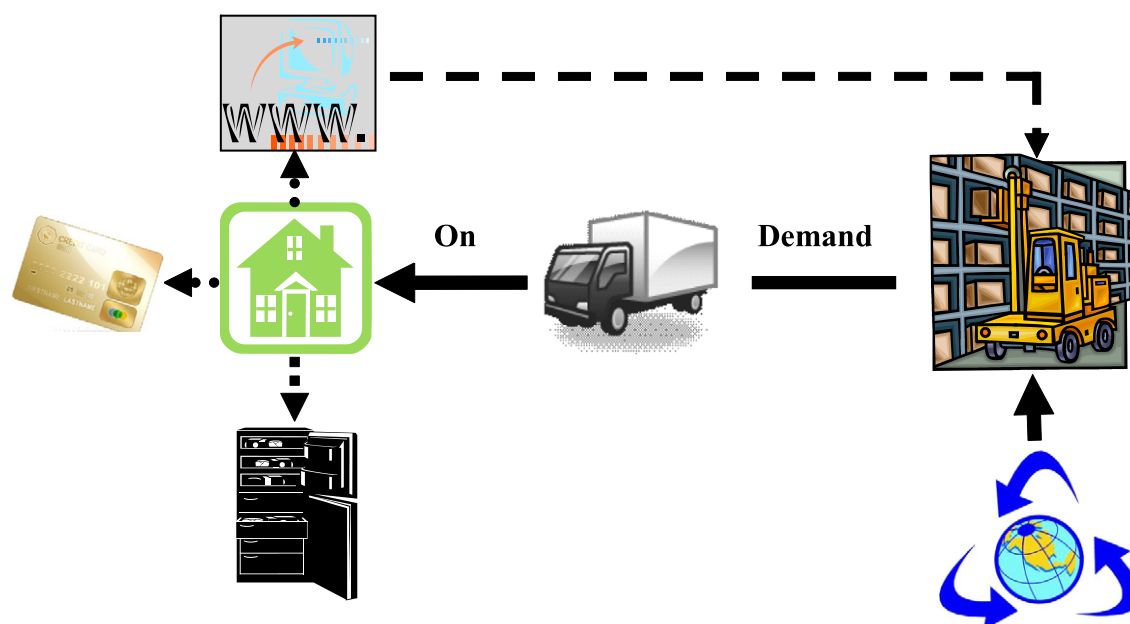


Fig. 3. Socio-technical Cluster Three—emerging pattern.

4. A tool to assist in assessing potential cross-sector impacts

As part of the UK university-led 'DISTILLATE' project, which was designed to provide local government authorities with new decision support tools, a study was carried out in South Yorkshire to look at the problems faced by socially disadvantaged residents in semi-rural, ex-coalmining areas when attempting to access various kinds of goods and services [10]. This included extensive interviews with local residents, while another part of this study involved engaging with the local service providers (e.g. health, education, social service, retail, police, and public transport operators), to examine how they planned service provision and the extent to which they were aware of the problems that users faced in accessing their services.

One major finding from this research was that local residents suffered from the fact that there was very little dialogue or co-ordination between different service providers, as a consequence of which they often found it difficult to organise their activity/travel patterns and suffered hardship when things did not go according to plan. For example, children from poorer households between the ages of 16 and 18 received a government grant to encourage them to stay in full-time education; but this grant was not paid if students arrived late

at college, due to the delay or cancellation of their bus service. This largely reflected the prevalence of 'silo' thinking within the different public and private sector agencies, which was encouraged by a narrow organisational focus on meeting set targets—whether this was reducing health appointment waiting times, or meeting profit targets.

The workshop with service providers identified the fact that there was very little cross-sector dialogue, and no simple tools for exploring the knock-on effects of decisions taken in one sector on other sectors, including transport. It was recognised that a major opportunity to address cross agency problems particularly arose at times when an agency was planning to revise its patterns of service delivery. Were all relevant agencies to be involved at the earliest stages of each sector's project planning, then there were felt to be opportunities to modify proposals, at minimal cost, in order at worst to minimise external costs and, at best, to identify synergies that could result in 'win-win' outcomes for most or all of the affected agencies. It was agreed that a simple, interactive tool would help those involved to think through potential impacts and possible amelioration measures.

Given a lack of quantitative data on impacts, it seemed most practical and useful to develop a simple visual, qualitative tool to help to trace through potential consequences, which might at a future date be developed into something more quantitative and comprehensive.

The more specific objectives of the cross-sector impacts tool that was developed to meet this requirement were to:

1. Identify the potential wider consequences for other agencies of a decision taken by one agency; and
2. Indicate which other sectors might be impacted—beneficially or adversely—by each of the identified consequences.

The aim was to develop an exploratory tool that would enable agencies to explore potential impacts for themselves (using either a graphical 'mind mapping format' for tracing consequences, or a more structured tabular format), or to refer to two examples that have been developed to illustrate the kinds of direct and indirect impacts on other agencies that might arise from a decision taken by one agency, namely: school consolidation on fewer sites, and the relocation of a primary care centre.

Details of the tool are provided in Ref. [11], and an example of its application in its visualisation 'mind mapping' form is shown in Fig. 4.

Table 2
Comparison of the three clusters and their different travel patterns.

	Building construction	Shop type/ location	Grocery logistics	Home food storage	Grocery ordering	Grocery delivery pattern
STC One	Brick and wood	Small, many, within built up area	Mainly locally sourced	Limited—cool room or marble slab	In person, paying cash	Daily collection on foot
STC Two	Steel frame and cladding	Large, few, often out of town	Globally sourced	Fridge freezer	In person, using cash or card	Weekly collection by car
STC Three	Not used	Not used	Globally sourced	Fridge freezer	By internet, using card	Deliveries direct to home

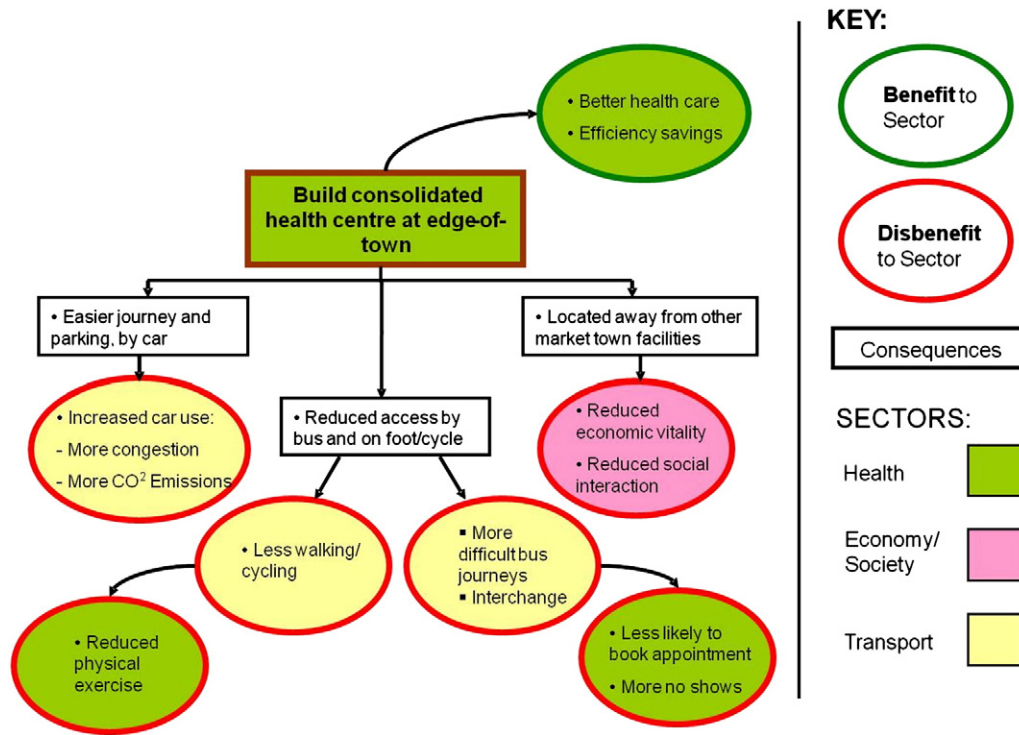


Fig. 4. The wider consequences of consolidating health facilities.

Here there are four components:

- **Policy change:** represented by a text box with a brown border describing the overall policy change that is being considered; the background colour shading is determined by the affected sector.
- **Consequences:** represented by a box with a black border and white background to describe a consequence or consequences of the policy change; consequences are not assigned to a sector.
- **Benefits:** represented by an oval with a green border to record a benefit associated with a consequence; the background colour is determined by the affected sector; and
- **Disbenefits:** represented by an oval with a red border to describe a benefit associated with a consequence; again, the background colour is determined by the affected sector.

Fig. 4 illustrates a range of potential consequences of a proposal to consolidate a series of health care facilities (doctor's surgery, dental surgery, opticians) currently located at different sites in the centre of a small market town, into a purpose-built facility on the edge of the built up area. This was intended to achieve a number of benefits, both for patients and for the health providers themselves, through offering better health care with more modern facilities, while providing some cost savings for the authorities.

However, the figure shows that there are also a number of potential negative consequences arising from this proposal, primarily to the transport sector and the local business community, but also to the health authority itself. In particular:

- The new edge-of town location would make it more difficult for people to access healthcare facilities on foot or by cycle, resulting in far fewer doing so; while those arriving from the surrounding area by public transport would often have to change vehicle or a take long walk from the town centre.
- The mode share of car trips would grow, resulting in increased CO₂ emissions, and possibilities of local congestion. Any significant switch from bus to car might threaten the viability of an economically marginal service.

- Local businesses in the town centre would suffer from reduced numbers of customers, as many people currently combined a health visit with local shopping in the centre, and some businesses might have to close. There would also be fewer opportunities for social interaction among the remaining customers.
- Finally, there would be negative indirect effects for the health sector, through reduced physical activity resulting from the fewer trips on foot or by bicycle, and the extra difficulty of getting there for those without access to a car might result in more 'no shows' and provide a disincentive to book an appointment in the first place.

It was not possible to quantify the magnitude of these various consequences and, to the author's knowledge such exercises have not been reported in the literature.

5. Encouraging cross-sector synergies

This paper has sought to argue the case that, in order to achieve a step change in the levels of use of sustainable transport systems in the coming years, it will be necessary to adopt a cross-sector approach, looking to exploit new technologies and encourage changes in social and business practices that will help to support more sustainable travel patterns.

There are many barriers to successfully adopting this approach [12], most of which are institutional and cultural in nature. Three specific suggestions are made in this section that would facilitate cross-sector synergies.

First, each sector should be given direct responsibility for **all** the CO₂ emissions that its actions generate, not only those directly resulting from the sector's primary activity. In an attempt to meet international commitments to reduce greenhouse gas emissions, many governments have started to set sector targets, but these usually only include the core activities delivered by each sector. In the UK, for example, in order to meet CO₂ reduction targets, each government department has been given specific targets which become tighter over time [13]. But this does not include all associated transport activities—the Department of Transport has its own targets that cover 76%

of domestic carbon emissions from transport, even though many of the factors influencing travel behaviour lie outside its control, as demonstrated in this paper.

The proposal made here is that each primary sector should take responsibility for the CO₂ emissions of all the activities it generates. So, for example, the education sector would be responsible for the emissions associated with the transport of its employees, pupils and visitors, as well as the deliveries and services provided to educational sites. While this might increase costs for particular sectors (e.g. education or health), across government as a whole CO₂-related costs should be reduced as a result of them being assigned to the party best able to address them. For example, school location policy might change if the education sector had to bear the full costs of the transport movements which underpin their activities.

This is not such an extreme requirement as might first appear, and is within the protocol for greenhouse gas accounting for the corporate sector being developed by the World Business Council on Sustainable Development [14]. This recognises three levels of accounting:

- Scope 1: Direct emissions associated with company plant and other facilities, and company vehicles;
- Scope 2: Indirect from purchases of fuels, etc. for its own operations (e.g. oil, electricity); and
- Scope 3: All the upstream and downstream emissions from activities associated with the company's operations, from raw material extraction through to consumption and recycling, including all goods and passenger transportation.

Some major companies are already taking wide ranging responsibility for CO₂ emissions directly or indirectly associated with their operations, to a degree not typical in the public sector. For example, the international retailer TESCO [15] has set itself the targets to:

- Halve emissions from its baseline portfolio of buildings by 2020;
- Reduce the emissions of all products sold by 30% by 2020, through working with partners in their supply chains; and
- Helping their customers to reduce their carbon footprint by 50% by 2020.

The **second proposal** is that governments should separate major policy formulation from policy delivery, making the former a cross-sector activity. Currently, it is most common for each government ministry to formulate as well as deliver its own policy, but this makes it difficult to deal with problems that require multi-sector solutions. A more effective approach would be to formulate policy cross sectorally, and then assign the appropriate elements of delivery to each ministry—although to ensure delivery, accountability would need to be audited at the cross-sector level.

One example of how this philosophy has been followed in England is in relation to developing a cross-government initiative to tackle obesity [16]. This document identifies the crucial role to be played by a number of government agencies, including the transport sector through the provision of better cycling and walking facilities. But the key problem lies in ensuring delivery.

A salutary lesson is provided by the setting up of the Social Exclusion Unit by the Prime Minister in the UK, as a Cabinet Office function to deal with the various elements of social exclusion that were the responsibility of different government departments (education, health, housing, social security, etc.). One of the areas of study initiated by the SEU was an investigation of the influence of transport provision on social exclusion [17]. The Unit recommended the development of a multi-sector approach to Accessibility Planning, but for operational reasons this was given to the Department of Transport to lead on. This resulted in much emphasis being put on improving public transport and developing modelling tools that emphasised the spatial aspects of accessibility at the expense of other important dimensions (e.g. cost, security, access to bus stops). More would have been achieved if responsibility for various aspects of delivery had been explicitly

allocated to different government departments, with this being overseen at a higher level of government.

A recent example of another attempt by government to take a high level, cross-sector perspective is in the appointment of a Minister for Infrastructure and Capital Investment in the Scottish Government [18]. The minister is quoted as saying that ‘his ministerial portfolio had been created so that the Government did not take the “narrow departmental approach to planning our investment”, and that this would allow decisions to be taken about where to spend money “on housing or on roads, where the greatest benefit is”’.

A more limited example of cross sector cooperation is provided by Hamer [19], working in the UK Health Development Agency, who illustrates how local authorities, the National Health Service, the criminal justice system and the voluntary sector have the legal flexibility to pool resources within the Local Strategic Partnerships that were being set up at that time, to better meet their various objectives.

The **third proposal** is that the strategies and schemes proposed by different government departments/ministries should be subject to a common cross-sector appraisal procedure, in order to assist in identifying the impacts of these proposals—both positive and negative—on the objectives that other sectors are seeking to achieve. This idea was proposed in Jones and Lucas [20], and some preliminary work along these lines is reported in Ref [21], where a series of transport demonstration projects was undertaken with the joint involvement of other sectors, in order to maximise the cross sector benefits of the initiatives. An appraisal framework was developed to assess the outcomes, with sets of indicators derived from—and with the agreement of—the transport, environment, health, education, economy and policing sectors.

The UK Department for Transport produced a document to illustrate how transport measures can contribute to meeting the policy objectives of other sectors [22], noting in the Foreword (page 1) that:

“Well planned transport services contribute to the achievement of stronger and safer communities, healthier children and young people, equality and social inclusion, sustainability and better local economies”.

A recent report by the Passenger Transport Executives Group [23] went further and argued (page 1) that “...the transport sector itself bears the vast majority of the costs for interventions whose primary benefits accrue to other policy areas”. But neither document addressed the question raised in this paper, as to how non-transport sectors can contribute to achieving transport policy objectives.

6. Conclusions and recommendations

Many developed countries have made considerable progress in encouraging more sustainable personal travel patterns, but in most cases this has achieved little more than a stabilisation in the hitherto growing proportions of person trips and distances made by private car [24]. Yet many governments have aspirations to increase the proportion of trips made by non-car modes, in order to meet tough CO₂ reduction targets (environment), as well as to contribute to other policy objectives, such as reductions in traffic congestion (transport) and in levels of obesity (health).

This paper argues that achieving such a fundamental change in long established car-based travel patterns is only likely to be realised if a comprehensive cross-sector approach is adopted. Since many of the factors that influence travel behaviour and the choices that people are confronted with (particularly with regard to their trip rates and their travel distances), result from decisions and influences that are under the control of non-transport sectors—in both public and private ownership.

Two broad approaches are suggested for achieving this aim. The first is more research-oriented and involves identifying cross-sector,

socio-technical clusters that might be encouraged to come together in new forms of business and social practices to facilitate new, more sustainable travel patterns. This would be coupled with the development and application of a common, cross-sector appraisal process.

The second involves structural changes within government and major private sector organisations, so that the goal of increased transport sustainability can be realised by pooling resources and aligning objectives across departments and sectors.⁶ It is recognised that, in practice, this is likely to be quite difficult to achieve, as it would require fundamental changes in power structures within government.

However, both these strategies would not only help to facilitate more sustainable travel patterns, but would lead to wider increases in sustainability and efficiency in other parts of the public and private sectors too.

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⁶ The emphasis in this paper has been on the national level; some of the practical problems that need to be addressed if local government in the UK is to play its part in taking a broader, cross-sector approach to delivering sustainable transport solutions are identified by Hull [25].