Sustainable urban mobility, an evolutionary approach

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Abstract

The sustainable mobility approach has many merits. However, and particularly when applied to cities, it also tends to show a lack of recognition of the intrinsic difficulty of change in real-world land use and transport systems. A complementary, evolutionary approach to urban transport planning is introduced in this article as a possible answer to this shortcoming. The focus is not so much on the identification of relevant problems and potential solutions but rather on the challenge of actually bringing about change in an existing, by definition uncertain situation. Examples from the Netherlands illustrate the discussion. There are two main conclusions. The first is that there is a need to better understand the constraints to and opportunities for change determined by local specificities and histories. The second is that it is essential to enhance adaptability and resilience of the urban land use and transport system.

Introduction: sustainability and change

For urban transportation planners these are exciting, but also greatly daunting times. On one side, and in spite of all the hype about dematerialization, transport and other technical networks appear ever more crucial in granting individuals and organizations the access to the increasingly spatially dispersed resources they need to thrive or even just to survive. Successful metaphors as ‘network society’ (Castells, 1996) or ‘age of access’ (Rifkin, 2000) underline this. At the same time, because of an heterogeneous mix of financial and fiscal constraints, environmental awareness and social resistance, the modern ideal of ubiquitous access is being superseded by a much more targeted, largely market and special interest driven transport infrastructure development, effectively ‘splintering’ cities (Marvin and Guy, 1999; Graham & Marvin, 2001).

The resulting picture is that of a growing societal complexity of choices regarding the planning and design of urban transportation networks, which can less and less be regarded as simple technical endeavours. An approach is needed where the existence of conflicting claims to the expansion of transport systems becomes apparent, where technological possibilities and constraints are made visible and debatable, and where the broader economic, social and environmental implications of choices can be addressed. The increasingly popular sustainability-centred approach would seem to go in the right direction, particularly in its most recent, more comprehensive versions. In general terms, the sustainability approach has moved away from an original focus on the preservation of natural resources and towards a broader interpretation of sustainability that also involves economic and social aspects. As far as urban transport is concerned, the negative effects of mobility (energy use, CO₂ emissions, air pollution, traffic noise, etc.) are typically weighted against the access mobility provides to
organizations and individuals (for instance in terms of labour, clients and business relations, or of jobs, services and personal contacts). Following this line of reasoning, a sustainable solution is one that strikes a balance between the positive and negative effects of the urban transport system.

Accordingly, most approaches to sustainable urban mobility set the task in terms of optimisation: how to maximise benefits and minimize costs? Policy documents are typically worded along this line. This is the case even when benefits and costs are defined in a broad fashion, that is, including both economic, social and environmental aspects, and both items that can and cannot be easily given a price tag. In a characteristic passage, WBCSD (2001, pp. 1-7) contends for instance that

“For mobility to be sustainable, it must improve accessibility while avoiding disruptions in societal, environmental, and economic well-being that more than offset the benefits of the accessibility improvements”

The great merit of this approach is to grant a comprehensive, open framework within which policies can be formulated and assessed. However, it also has serious limits. A well-known complication is that of agreeing on definitions and measurements of benefits and costs, because of the intrinsic difficulty of dealing with such issues as distributional or external effects. But there is more than that. A fundamental question is the reliance of the optimisation approach on the assumption that the identification of problems, the generation of and choice between alternatives, and all the following steps towards policy implementation, meet the requirements of a rational decision-making process. However, the rational choice model, first formalized in the 1950s (Simon, 1957; March & Simon, 1958), has since been heavily criticized by a number of authors. Most notably critiques include (Meyer & Miller 2001, pp. 52-68) ’satisficing’ critiques (not all possible alternatives and impacts can be considered), ‘incremental’ critiques (preoccupation with the short-term rather than the long-term characterize policy-making), ‘organizational process’ critiques (organizational structures and cultures disproportionately influence choices), and ‘political bargaining’ critiques (different interests have contrasting views of both ends and means).

Such criticism of the mainstream sustainability approach closely mirrors the more general criticism of urban transport planning and the forecasting techniques on which it is based. The core of this criticism concerns a set of essential, and yet unsupported assumptions (Dimitriou 1992, pp. 48-56). On the transport forecast side these most notably include the assumption that no major, qualitative change will take place in the future in travel behaviour, transport technology, land use and land use transport interaction. On the land use forecast side problematic assumptions need to be made about the future policies of both public and private actors, as well as about the future location behaviour of household and firms. On the policy-implementation side particularly disputable is the more or less implicit assumption that transport and land use policies can be co-ordinated and/or that market forces will warrant such co-ordination. Finally, and connected to the other assumptions, there is the overarching assumption of the existence of a natural state of equilibrium in the transport and land use system.

A more effective approach to sustainable urban mobility should address this fundamental criticism. Indeed, some of it is already making its way into the urban transport planning mainstream. Meyer and Miller (2001), following Wegener (1995), stress the need to improve present land use transportation models. More adequate forecasting models would need to
explore the full range of system responses (short and long run) to a broad variety of policy combinations (transportation, land-use and other), and do this at the level of individual responses (by means of disaggregated behavioural models). However, and quite crucially, Meyer and Miller also recognize that “Even with ‘ideal’ land-use models, uncertainty will still exist with respect to the exact nature of future activity systems. The existence of such uncertainty reinforces the need for a cyclical planning process … [and] Even more fundamental, it argues for the need for flexibility within the transportation system itself” (p. 340).

This paper attempts to take this fundamental level of criticism to its full consequences. Inspiration is primarily found in ‘evolutionary’ theories and methods. Evolutionary approaches seem especially appropriate because they typically both recognize the high level of interdependency between the different component of the system – meaning that short-term, local decisions may have long-term, global implications – and the limits to dealing with such interdependency in a purely rational way, because of irreducible uncertainty. The rest of the paper is devoted to an exploration of this potential. First, some basic theoretical notions concerning the object of sustainable urban mobility policies – change in the urban transport and land use system - will be introduced. Next, a simple model based on these notions will be applied to the discussion of examples in the Netherlands. Finally, a more explicit evolutionary perspective will be adopted in order to draw more general research and policy implications. In the suggested course of action, traditional models and approaches will still have a role. However, they would need to abandon the related ambitions of comprehensiveness and predictability and shift their focus from the identification of optimal solutions to the provision of analytical tools for structuring – through information – an ongoing, ‘exploratory’ societal debate about problems and solutions, policy goals and policy means.

A node-place model

The relationship between transport and urban form has long intrigued scholars. Both historical (Muller 1995, Hoyle & Knowles 1998) and geographical (Cervero 1998, Kenworthy & Laube 1999a, 1999b) analyses document the high degree of interdependency between the two. However, causal links remain difficult to prove. A feedback cycle where changes in transport and land use patterns both influence each other, and where external factors also interfere, is a widely adopted way of illustrating this complex relationship (Manheim 1974, Hanson 1995, Wegener & Fürst 1999, Meyer & Miller 2001). The seminal study of Mitchell and Rapkin (1954) remains one of the most penetrating accounts of the complex dynamics at stake. In their own words, “Just as changes in kind or intensity of land use by establishments bring pressure for changes in the channels of movement, changes in channels tend to affect the distribution of establishments by altering existing paths of movements and avenues of accessibility” (p. 131). The time aspect is particularly important (Batten 1996, Wegener & Fürst 1999): while the activity and mobility patterns of individual actors can adapt quite rapidly (in some cases even on a day-to-day basis), changes in the shape of transportation networks and in urban morphology are of a much long term nature (in the order of decennia).

The node-place model introduced by the author (Bertolini 1999, see Figure 3) provides an analytical framework to further penetrate this dynamics. The basic idea underlying the model is that – in line with thinking informing the transport land use feedback cycle - improving transport provision in a location (or its node-value) will, because of improved accessibility, create conditions favourable to the further intensification and diversification of land uses there. In its turn, intensification and diversification of land uses in a location (or increase in its
place-value) will, because of growth in the demand for connections, create conditions favourable to the further development of infrastructure there. The emphasis on ‘conditions’ is important, as it implies a distinction between the existing of a development potential, and its actual realization, which will by and large depend on other than transport and land use features. As we will see, realization of the potential may or may not occur, and development can take different directions.

Figure 3: The node-place model

Five ideal-typical situations can be distinguished in the model. Along the middle line are ‘balanced’ locations, where node and place values are equally strong. At the top of the line are areas ‘under stress’. Here the intensity and diversity of both mobility flows and urban activities is maximal. This indicates that the potential for land use development is highest (strong node) and that it has been realized (strong place). The same can be said about the potential for transport development. However, these are also locations where the great concentrations of flows and area-based activities mean that there is an equally great chance of conflicts between multiple claims on the limited space and that further development might become increasingly problematic. At the bottom of the middle line is a third ideal-typical situation, represented by the ‘dependent’ areas. The struggle for space is minimal here, but the demand for transportation services from area residents, workers and other users and the demand for urban activities from travellers are both so low that supply can be held in place only by the intervention of other factors (such as peculiarities in the topography of the area or in the morphology of the transportation networks, external subsidies, etc.). Finally, two ‘unbalanced’ situations can be identified. On one side - at the top left of the diagram –are the ‘unbalanced nodes’, areas where transportation supply is relatively much more developed than urban activities (think for instance at a newly opened out-of-town railway station or motorway outlet). On the other side - at the bottom right of the diagram - are the ‘unbalanced places’, where the opposite is true (think at an historic, relatively difficult to access city centre).
The latter two are particularly interesting location-types. It can be assumed that, following the transport land use feed back cycle, they will show a strong tendency to move towards a more balanced state. However, and this is crucial, this could always happen in two radically different ways. An ‘unbalanced node’ could either increase its place-value (for instance by attracting property development, option a in Figure 3) or decrease its node-value (perhaps through reduction in the level of transportation services, option b). A reverse reasoning can be applied to an ‘unbalanced place’: either will the level of connection be increased (option c) or a lower-density, and possibly qualitatively different functional mix will be developed (option d). The emergence of ‘unbalanced’ nodes and places, either as a deliberate policy move or as the result of autonomous trends, can be seen as an essential factor in the development of the urban transport and land use system: without unbalanced situations, there will be no change at all. At the same time the fact that the system can react in different ways, means that different, or even divergent development-paths are possible.

**Development paths**

With the help of the node-place model both up- and down-grading processes of either single locations and nodes or of entire urban regions can be studied. In this way, some insight can be provided in the nature of change in the urban transport and land use system. For this purpose, let us now consider an application of the model to station-areas in the Amsterdam and Utrecht urban regions in the Netherlands (Figure 4, 5 and 6; for methodological details see Bertolini 1999).

In the Amsterdam urban region (Figure 5) there are both examples of station-areas under stress, of dependent locations and several unbalanced nodes and places. Patterns of development in the years since 1997, when this analysis was made, – while not quantitatively measured yet - seem to confirm the characterization of the different locations: for instance, ‘under stress’ Central Station has been struggling with the great complexity of further development there, ‘dependent’ Vlugtlaan has been closed-down because not economically viable, and it is the unbalanced station-areas that have shown the greatest development dynamics. Both striking upgrading processes and downgrading processes are underway there.

In the Utrecht urban region (Figure 6) there is a much more limited variety of station-area types. The system is dominated by a single location (Central Station). The rest follows at great distance. Also in the Utrecht region development patterns since 1997 seem to confirm the characterization of locations. Development efforts have been mainly directed at Central Station. However, the difficulty of transformation there has meant that not much has been achieved on the ground. At the same time, little – if any – development activity has touched the many ‘dependent’ station-areas in the region.
Figure 4: The Amsterdam and Utrecht urban regions
Figure 5: Application of the node-place model to station areas in the Amsterdam region, 1997 data

Figure 6: Application of the node-place model to station areas in the Utrecht region, 1997 data
From a system perspective, most interesting are the cumulative patterns of development at the level of the two urban regions (compare Figure 5 and 6). The Amsterdam region shows a clustering in the centre of the ‘balance’ line, the Utrecht agglomeration a clustering at the bottom, with the sole exception of Utrecht Central Station. This is a crucial difference. As already contended, areas at the very top of the middle line can offer high opportunities for development but may also bring about the most intense conflicts. The (relative) borders of growth will be reached there before than in areas with lower node and place values. It becomes then important to have in supply alternative areas with adequate public transport connections, if growth is not to be diverted to areas not well connected to the railway network. Amsterdam has those alternative station areas, Utrecht does not. As a result, in Amsterdam the polycentric, public transport oriented pattern documented in Figure 5 is being reinforced, while in Utrecht development has rather concentrated in peripheral areas with poor public transport access. The implications are evident, and indeed Table 1 shows that the Utrecht region has a higher, and more rapidly growing car-dependency than the Amsterdam region, while the reverse applies to public transport orientation.

Table 1: Modal split in the Amsterdam and Utrecht urban regions, on the basis of all the trips made by the inhabitants. Source: CBS

<table>
<thead>
<tr>
<th></th>
<th>Amsterdam</th>
<th></th>
<th>Utrecht</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>City</td>
<td>City + Region</td>
<td>City</td>
<td>City + Region</td>
</tr>
<tr>
<td>1995/96</td>
<td>29.1</td>
<td>31.0</td>
<td>39.8</td>
<td>42.2</td>
</tr>
<tr>
<td>2000/01</td>
<td>32.1</td>
<td>36.1</td>
<td>44.7</td>
<td>47.4</td>
</tr>
<tr>
<td>Car</td>
<td>16.0</td>
<td>14.7</td>
<td>10.2</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>11.2</td>
<td>9.0</td>
<td>5.8</td>
<td>4.8</td>
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<tr>
<td>P. Tr.</td>
<td>24.8</td>
<td>24.8</td>
<td>23.9</td>
<td>23.7</td>
</tr>
<tr>
<td></td>
<td>28.7</td>
<td>29.6</td>
<td>26.8</td>
<td>27.4</td>
</tr>
<tr>
<td>Bicycle</td>
<td>28.5</td>
<td>26.2</td>
<td>24.0</td>
<td>21.8</td>
</tr>
<tr>
<td></td>
<td>26.5</td>
<td>22.8</td>
<td>20.5</td>
<td>18.1</td>
</tr>
<tr>
<td>Walking</td>
<td>1.6</td>
<td>2.0</td>
<td>2.1</td>
<td>2.2</td>
</tr>
<tr>
<td>Other</td>
<td>1.6</td>
<td>2.5</td>
<td>2.3</td>
<td>2.7</td>
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Conditions for change

From the change-centred perspective advocated in this article, it is important to identify the conditions determining these different development paths. In a situation where many broader context factors are similar, a striking difference between Amsterdam and Utrecht is that between the morphology of the two railway networks: a combination of a radial and a tangential network in Amsterdam and a strongly radial network in Utrecht (see Figure 4). The more articulated railway network in Amsterdam has been an essential condition in allowing the emergence of a public transport orientated polycentrism there. This fact supports the frequently heard plea for the development of tangential public transport lines (see for instance Hall & Ward 1998), and with successful models of transit metropolises such as Tokyo or Singapore (Cervero 1998). However, it also stresses how much of a long-term, only partially controllable process the shaping of conditions conducive to a particular urban transport and land use development pattern is.

The present network morphology in Amsterdam is the result of a very long chain of decisions and actions, often unconsciously or unwillingly contributing to the final result (Poelstra
This is especially the case with the development of its most crucial piece: the railway tangents. Decisions and actions contributing to this development include land reservations for a – never materialized - railway freight line around the city as early as the beginning of the XX century, and the opening – starting in the 1970s and profiting of those rights of way – of new links to connect the airport of Schiphol to the national railway network. The desirability of locations along the thus emerged railway tangents was further and decisively reinforced by the realization – envisaged since the 1960s and implemented since the 1970s - of a motorway ring along the same routes. Intriguingly, most if not all of the above-mentioned developments were unrelated to any deliberate attempt at developing a multi-modal, polycentric urban system in Amsterdam and the region. The only major transport infrastructure that consciously sought to support such a pattern is the metro ring line - running along the railway tangents and the motorway ring and connecting all the major peripheral development centres -, opened as late as 1997.

If it took Amsterdam so long, including a not insignificant portion of chance, a more than legitimate question is if also Utrecht should, and could, pursue a similar development pattern, all its theoretical advantages notwithstanding. The gap between the model and the reality may be such there that an alternative, and possibly more incremental strategy could be more sensible. Interestingly enough, this is the approach adopted by the Utrecht regional transport plan now under discussion, where an incremental development of public transport tangents is proposed. The idea is to start with bus services during rush-hour, and later move on to regular bus lines, leaving the option of building dedicated infrastructure open and dependent on the evolution of actual demand (Bestuur Regio Utrecht 2003).

What is true of the differences between Amsterdam and Utrecht is, arguably, even truer when the transfer of solutions between cities in different national or even continental contexts is contemplated. This recognition should lead to some serious questioning of much mainstream sustainable urban mobility literature. How much of a solution is for instance ‘Transit Oriented Development’ of the type being proposed by Calthorpe (1993) and most notably applied in European cities as Stockholm and Copenhagen for car-dependent cities in North America? Haven’t the United States and Canada gone too far in dispersing land uses? And how about exploding, resource-poor cities in the developing world? Will they ever have enough means to develop the extensive public transport networks required by such a model? The point is not to exclude that the answers could still be in the affirmative. However, the great complications and the very long term nature of any transition to a significantly different transport and land use pattern should be more carefully appreciated than in much debates is the case. At the same time, more effort should go in understanding the potential for more incremental, more situation-specific, less orthodox strategies, as for instance documented by successful public transport-based approaches in cities as diverse as Ottawa in Canada, Curitiba in Brazil, Karlsruhe in Germany, or Mexico City (all discussed in Cervero 1998), but not necessarily excluding car-based approaches as for instance captured in Webber’s (1986) concept of ‘automobility for everyone’.

But there is more: the intrinsic limits to the predictability of development in the long term, as represented by the different possible development trajectories in the node-place model and the complex interplay of historical legacies and unforeseen opportunities in Amsterdam and Utrecht, should be a reminder of the importance of also leaving options open and allowing for the unexpected. The Amsterdam case can also be read as a successful example of one way of doing this, that is, by reserving space for infrastructure in strategic locations, independently of what will be eventually built. The rich system of urban railway, motorway and metro tangents
which is now in place was never planned in this form, but emerged gradually, largely thanks
to the generous, strategically placed rights of way of almost a hundred years earlier.

Towards an evolutionary approach

The way of looking at the interaction between transport and land use changes introduced
above has many analogies with the sort of evolutionary thinking that is being developed in the
social sciences and most explicitly in economics (Nelson & Winter 1982, Dosi & Nelson
can be also found in works applying theories and methods of the emerging science of
complexity -and particularly the concept of self-organization - to the analysis of urban
development (Allen 1997, Portugali 1999). A third source of inspiration is represented by
studies of technological change, which have often focussed on transportation (Grübler 1990,
1998).

Characteristically in all the above streams of work, the assumption of (a single) equilibrium as
‘natural’ state of the system is questioned, and attention is rather directed to far-from-
equilibrium processes of change. It is acknowledged that different actors can react differently
to similar perturbations, depending on the local context and on personal features. Individual
decisions and actions eventually cumulate into development processes that are both path-
dependent – as earlier experiences largely determine the response to new stimuli – and
unpredictable – as even small, local differences can have big, global consequences.
Underlying this thinking is the recognition that social systems are complex systems, that is,
that they are systems characterized by a high degree of interdependency between a wide range
of components and processes. Such complexity fundamentally bounds the rationality of
actors.

A focus on evolutionary economics can help further develop this argument. While there are
different interpretations within the field, some basic principles of evolutionary economics are
aptly captured by the notion of microevolution as introduced by Nelson & Winter (1982,
discussed in van den Bergh & Fetchenhauer, 2001). According to Nelson & Winter, because
of irreducible uncertainty, the existence of transaction costs and the difficulty of change in the
short-term, firms tend to follow organizational routines, or proven ways of conducting
business, rather than consider each time all possible alternative courses of action. On the other
hand, the evaluation of current routines can lead firms to their adjustments and even
substitution. The results of such searching process are, however, uncertain. Because past
experiences influence both existing routines and the search for new ones, different firms will
typically have different routines and try different alternatives, resulting in a variety of
economic behaviour. Eventually, the actual performance of a firm will constitute the major
incentive to maintaining or changing a routine. Such performance is determined by the
characteristics of the selection environment, that is, the interplay of demand and supply in the
marketplace. The selection environment is not a static entity either, as it will also change as a
result of the accumulation of firm-specific processes. In this sense, there is co-evolution
between the market and individual firms.

The resulting economic reality is one characterized by continuous successions of disturbances
and adaptations, which preclude the attainment of a stable equilibrium. Continuous change
means that initially successful routines can become less efficient or effective, or even have
unexpected consequences. There is no once-and-for-all optimal routine. Furthermore, the
nature of the process underlies the incremental nature of change, and the difficulty of more
than marginally altering an existing routine. The risk that firms be locked-in in a non-optimal routine is therefore always present. The implication is that beyond a certain threshold, marginal change will not suffice and coordinated change will be required. However, because it is uncertain which routine will be able to break the impasse, diversity of and competition among alternatives should be stimulated. It is precisely such redundancy of routines that makes the economic system resilient, that is, capable of continuous performance within changing, uncertain circumstances.

The above conceptualisation of economic reality can be also usefully applied to the object of this paper. Existing transport or land use policies can be seen as organizational routines. Existing transport and land use patterns, and the broader urban economic and social context can be seen as the selection environment in which existing policies must continuously prove their worth and the searching process for better policies takes place. With reference to the challenge of achieving sustainable urban mobility, this analogy suggests that there is no universally valid, optimal policy. While learning from other experiences and from ideal models is important, the value of a solution can only be appreciated in a specific situation. In particular, understanding the unique set of opportunities and constraints determined by a specific historical development path and local configuration of factors is essential. The value of practical experiences and theoretical models should be sought in their providing insight in basic relationships and interdependencies (between land use and transport patterns, and between socio-demographic and economic features and mobility behaviour) – not in their representing a solution to be simply transplanted or directly applied. At the same time, recognition of the unpredictability of the outcome – certainly when the long term is concerned – should result in recognition of the need to look for ways of improving the ability of the system to react and perform in the face of the unforeseen (and unforeseeable).

Conclusions: a research and policy agenda

In this article an evolutionary way of looking at the relationship between urban transport and land uses has been explored, in order to try and go beyond some of the limitations of the sustainable urban mobility approach. This is presently too much centred on ideal models and non-replicable examples and not enough on bringing about change in the variety of real-world urban transport and land use systems. The worth of the proposed approach does not so much lie in the provision of final answers but rather in the identification of better questions.

The more general question is:

How do changes in urban transport and land use features relate to each other in different geographical and historical contexts, and what are the implications for urban transport policy?

More specific questions are:

Which patterns of co-evolution of urban transport and land use patterns can be identified in different geographical and historical contexts? How do differences in co-evolution-paths emerge? How do local choices – as far as the development of urban transport and urban land uses is concerned – relate to each other and to more autonomous trends in determining different outcomes? In particular, what sort of decision processes characterise major transitions in either urban transport or land use patterns? Which actors are involved and which roles they fulfil? What is the role of actors’ perception of problems and solutions in the choices they make? How do these choices affect actual developments?
And finally and most importantly:

Which policy lessons can be learned as far as interdependency (between transport and land use, between the local and the wider context), the cyclical nature of change (the time dimension), the sort of change (incremental or radical), and above all more and less successful strategies to manage change are concerned?

While there are as yet no conclusive answers to this last question a more general philosophy can be tentatively sketched on the basis of the evidence and theories discussed in this paper. Economic and social processes shape urban transport infrastructure and patterns of land use, but the latter provide in their turn a still essential physical support to those same processes. This second relationship should be the central matter of concern for urban transportation planners. An urban transport and land use system capable of supporting economic and social change is, in the first place, one capable of changing itself in response to change in the socio-economic environment, that is, it must be an adaptable system. Secondly, an urban transport and land use system capable of supporting economic and social change is one capable of continuing to function in the face of change, that is, it must also be a resilient system. The key question becomes then: which transport and land use policies maximize adaptability and resilience of a given urban transport and land use system?

On a conceptual level, the node-place model introduced in the paper offers a way of analysing the dynamic relationship between the transport and land use features of an urban system. By means of the model, an existing situation can be typified and alternative development paths can be identified, making discussion of the ways in which different policy options affect the adaptability and resilience of the system possible. Adaptability could be assessed through questions such as: if location and/or connection demand change, will the system still be able to satisfy them? Resilience could be assessed through questions such as: if the environmental, social, and/or economic context change, will the system still be able to function?

On a practical level, the Amsterdam case discussed in the paper – while not free of shortcomings (for a more thorough discussion see Bertolini & le Clercq 2003 and le Clercq & Bertolini 2003) - documents some specific ways of achieving adaptability and resilience. In particular, the development of richly interconnected railway and automobile networks, and the concentration of development around the nodes of these networks, has provided – and continues to provide – a viable support to the development of new and the transformation of existing urban activity centres and transportation systems. This structure has both emerged incrementally and - within the limits of what was each time deemed desirable and feasible – has been shaped by policy interventions. The adaptability of the system is best shown by the relative tight feed back cycles between the development of new transportation nodes and that of new concentrations of activities. The resilience of the system in the face of change is best shown by a network topology (the combination of radial and tangential links, both road and rail) that has provided a relatively stable base for the radical shift from a monocentric to a polycentric urban system.

Comparison with the Utrecht case has, on the other hand, warned against any simple replication of the Amsterdam model in a different context. A more directly applicable lesson seems that concerning the decision-making approach. In terms of decision-making, the Amsterdam case can be seen as containing elements of both the incremental model (Lindblom, 1959; Lindblom, 1968; Braybrooke and Lindblom, 1970) and the rational model
(Simon, 1957; March & Simon, 1958). It is incremental in that it shows the decisive role of the existing, historically grown situation in shaping the discussion around problems and solutions (think at decisions concerning single location and infrastructure developments). It is rational in its attempts at drawing implications from the awareness of the long-term implications of decisions, particularly as they might affect (restrict, enhance) the very scope for choice at a later stage (think at decisions around the network topology).

The core-message of this paper is that urban transportation planners should devote more energy to finding ways of promoting adaptability and resilience in the urban land use and transport system. This would allow providers to develop and users to choose between different ways of moving around, both in the shorter and the longer term. The latter appears all the more urgent in the face of real uncertainty about the future viability of the presently dominating urban transport solutions and a tendency not to recognize this by those taking decisions. In this respect, the classic definition of sustainability proposed in the Bruntlandt report (World Commission on Environment and Development 1987) still provides a poignant evaluation criterion: how does a particular transport and land use policy affect the possibility of future generations of making their own transport and land use choices? An exploratory attitude seems essential, as the answer can be different in different contexts, and contexts will keep changing, unpredictably. Mitchell and Rapkin (1956) had in many respects already identified the challenge when they contended that “The design of a new channel or the redesigning of an existing channel of movement should be a process of iteration, in which the proposed facility, the existing land use pattern and its anticipated changes are brought to consonance” (p. 132, emphasis added). Almost 50 years later we seem to still be struggling with the implications of this realization.

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