Årsaker til at vi mislykkes i å redusere biltrafikken i byene. En kompleks utfordring

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Vitenskapelig bedømt (refereed) artikkel

Aud Tennøy: Why we fail to reduce urban road traffic volumes: The challenge of double complexity

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A first step toward reducing urban road traffic volumes is to recognise and address the problem as a challenge of double complexity: the complexity of the problem itself and the complexity of the planning and decision making system. Problems of the «organised complexity» kind contain a number of variables which are directly and causally interconnected. Such problems may appear to be irrational and impossible to understand if they are treated as problems of «simplicity» or «disorganised complexity». The study of failure to reduce urban road traffic volumes as a problem of double complexity would involve elucidation of the variables and interconnections of each system as well as the interconnections between the systems. This would enable us to explain why we fail to reduce urban road traffic volumes and understand what needs to be changed in order to succeed.

Key words: Urban planning, traffic volumes, climate, organised complexity

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1. Background

According to the International Panel on Climate Change (IPCC) (2007), greenhouse gas (GHG) emissions have to be reduced by 50 to 80% by 2050 to avoid dramatic and irreversible climate changes. Transport is a large and growing source of GHG emissions. This makes reduction of GHG emissions from urban road transport an important objective in urban planning. The two main approaches to reducing GHG emissions from urban road transport are to reduce GHG emissions per vehicle-kilometre through 'technical fixes' and to reduce total travel distance using motorised vehicles. The focus here will be on the latter.

Reducing urban road traffic volumes is a long-standing objective of many cities and countries, for a number of reasons.[1] In Norway this objective is found in most planning and policy documents concerning land use and transport planning, at all political and administrative levels (Tennøy, 2004a).

The scientific literature and policy and planning documents signal a relatively widespread agreement on the means and strategies that should be applied in the area of land use and transport planning, to achieve a reduction of urban road traffic volumes. Public authorities control, for the most part, the means to reduce urban road traffic volumes. These include public planning, the Planning and Building Act (PBA) and planning and funding of transport infrastructure and services. Still, urban land use and transport systems continue to be planned and developed in ways that cause and allow growth in urban road traffic volumes. This has been well documented in Norway (Office of the Auditor General of Norway (OAGN) 2006, 2007, Norwegian Public Roads Administration (NPRA) 2006, Tennøy 2004a) and elsewhere (Hull 2008, Royal Commission on Environmental Pollution (RCEP) 2007, European Environmental Agency (EEA) 2006).

1. In planning and policy documents it is sometimes unclear whether the objective is to reduce the *growth* in road traffic volumes or to actually reduce road traffic volumes.

An interesting question is *why* we fail to reduce urban road traffic volumes, even though there seems to be a general consensus that it should be done, there appears to be knowledge of how to do it, and public authorities control the most important means to address this problem. I argue here that this is *a problem of double complexity*, and that this double complexity needs to be recognised and addressed if urban road traffic volumes are to be reduced.

1.1 Complexity

Weaver (1948, 1958) discusses science and complexity in general. He distinguishes between three kinds of scientific problems: those of *simplicity* containing few variables which relate directly to each other in their behaviour; those of *disorganised complexity* containing many variables whose behaviour is individually erratic or unknown, but in which average properties can nevertheless be analysed; and those of *organised complexity.* The latter are defined as «situations in which a half-dozen or even several dozen quantities are all varying simultaneously and in subtly interconnected ways». Weaver and other, later authors discussing complexity (e.g. Wilson, 2006, Bar-Yam, 1997) describe complex systems as being composed of a large, but not too large, numbers of parts, which interact strongly with a number of other parts of the system.

Let us suppose that one wants to change something in a complex system by manipulating one or more of its variables in order to activate mechanisms that bring about the wanted change. One would then need to know how the manipulated variable(s) interact with both the variable one wants to change and other variables in the system. These 'other variables' may be directly or indirectly interconnected with the manipulated variable and/or the variable one is trying to change. The various mechanisms activated may reinforce, counteract or not affect the effect one is aiming to produce.

Thus, if one treats a system of organised complexity as a system of simplicity, not realizing that several mechanisms may be activated when manipulating one variable in order to affect another, the effects produced may be different from what was expected based on the knowledge one has about the connections between the manipulated variable and the variable one wants to affect. If one views it as a system of disorganised complexity, on the other hand, where the fine web of interconnections are reduced to statistical categories and aggregated to suitable levels, a number of unexpected direct and indirect effects may occur.

1.2 Double complexity

In planning theory, one distinguishes between theories *in* planning and theories *of* planning (Faludi, 1973). Theories *in* planning deal with the *objects of planning* – the problem itself. An example is the question of how land use and transport systems should be planned and developed in order to reduce urban road traffic volumes. Theories *of* planning deal with the *processes of planning,* including the environment in which the game of planning takes place.

I argue in this article that both *the problem itself* (planning and development of urban land use and transport systems in order to reduce urban road traffic volumes) and *the system* within which the 'solving of the problem' is supposed to take place, are systems of organised complexity. I call this a challenge of *double complexity.* I argue further that in order to achieve a reduction of urban road traffic volumes, this double complexity needs to be recognized and addressed.

The focus here is on daily person travels in urban areas. Much the same reasoning could be applied to travel in non-urban areas, to long distance travel such as holidays and weekend trips and to freight transport.

2. Land use and transport planning in order to reduce urban road traffic volumes as a problem of organised complexity

Jacobs (1961: 442–462) was among the first to discuss 'the kind of problem' cities are as problems of organised complexity, building strongly on Weaver (1958). Jacobs (ibid) analyses the history of city planning and shows how 'planning theorists' first dealt with the city as a problem of simplicity, and later ad-

ded ideas of disorganised complexity. This view of the city, she argues, explains why many theorists consider the city to be almost impossible to analyse and predict, or *irrational*. If one rather understands the city as a problem of organised complexity, she reasons, one finds that: «Although the interrelations of their many factors are complex, there is nothing accidental or irrational about the ways in which these factors affect each other» (Jacobs, 1961:447). The same is true of all parts or features of cities. Thus, understanding the city and its parts as systems of organised complexity should enable us to be more successful in planning and developing the city in the desired directions.

2.1 A problem of organised complexity

How to plan and develop urban land use and transport systems in order to reduce urban road traffic volumes is a problem of organised complexity. Road traffic volumes are defined by the travel behaviour of the population; travel frequencies, travel lengths and choices of transport mode. Travel behaviour is affected by changes in transport systems and in land use. These are mutually interconnected, and are also affected by the resulting changes of traffic volumes. The interconnections are direct and indirect, short term and long term, and dynamic. They constitute a system of organised complexity. Figure 1 shows a simplified illustration of this system. There is no room for describing all of the interactions represented by the arrows in the figure, but some examples are given below.

A number of other factors affect the development of urban road traffic volumes as well, such as economic development, labour force participation, culturally conditioned attitudes and changes in the population. Such factors are kept out of the discussions here, but keeping them in mind adds to the complexity of the system.

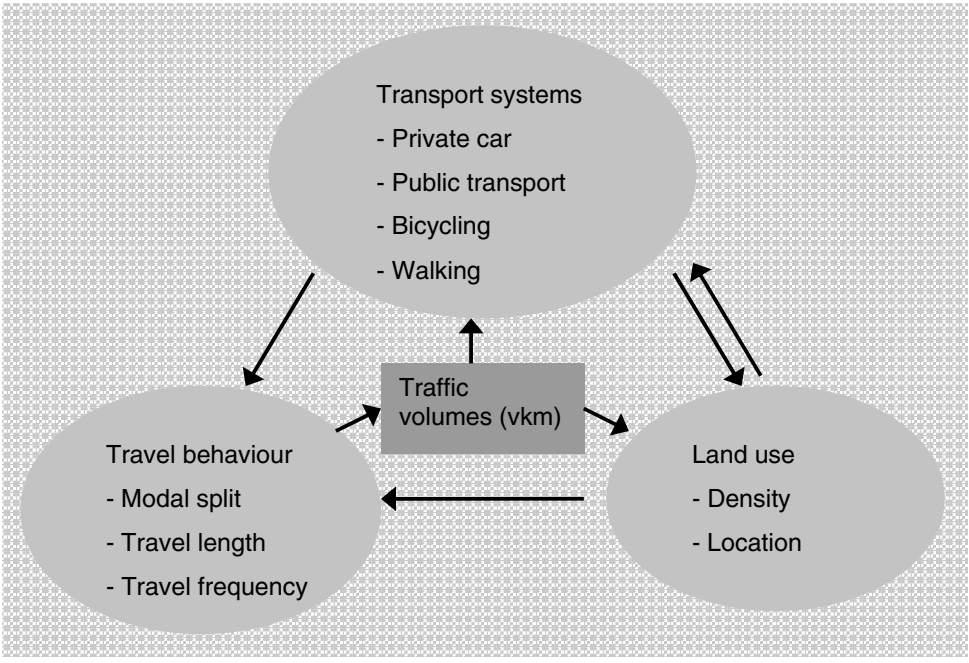

Figure 1: Developments of urban land use, transport systems, travel behaviour and road traffic volumes constitute a system of organised complexity.

The way in which transport systems are developed affects competition between the various modes of transport and thus travel behaviour and road traffic volumes (see e.g. EEA, 2007, Noland and Lem, 2001, Cairns et al, 1998, SACTRA, 1994, Kenworthy, 1990, Downs, 1962). If travel by public transport, bike or foot becomes relatively better than the private car (that is faster, cheaper, more comfortable, safer etc.), this would influence travel behaviour and lead to a decrease in urban road traffic volumes. The opposite would occur if travel by car became faster, cheaper etc. (for example due to increased road capacity).

Reduced travel resistance will also affect the travel behaviour in other ways, by generating trips that would otherwise not have been made and thus affecting travel frequency, and by favouring destinations that are further away and thus affecting travel length.

A number of studies have shown that both travel length and modal choice are directly affected by whether urban development occurs as sprawl or densification and by the location of various activities in relation to each other (EEA, 2007, Næss, 2006, 2001, Noland and Lem, 2001, Strømmen, 2001, Newman and Kenworthy, 1989, Owens, 1986). Short distances and sensible location[2] reduce total transport demand, allow more journeys to be done by bike and by foot, and help public transport services to be performed more efficiently and competitively. Næss (2006) has shown that average trip lengths are shorter and car use is lower when residences are more centrally located. This relationship seems to be even stronger when it comes to location of working places, especially on the modal split (Strømmen, 2001).

The indirect and long term interactions between development of urban land use, transport systems, travel behaviour and traffic volumes tend to be overlooked, for example in model-based analyses of transport (Tennøy, 2004b). New road capacity reduces travel time by car, at least in the short time perspective, and allow households, businesses etc. to locate less centrally and more car dependently, as they can travel greater distances without spending more time (Engebretsen and Vågane, 2008, SACTRA, 1994, Kenworthy, 1990). This results in longer journeys and in the private car being more competitive, for reasons discussed above. This is turn changes travel behaviour and urban road traffic volumes illustrated in Figure 2. In the long term, the induced road traffic may cause congestion which creates a call for increased road capacity.

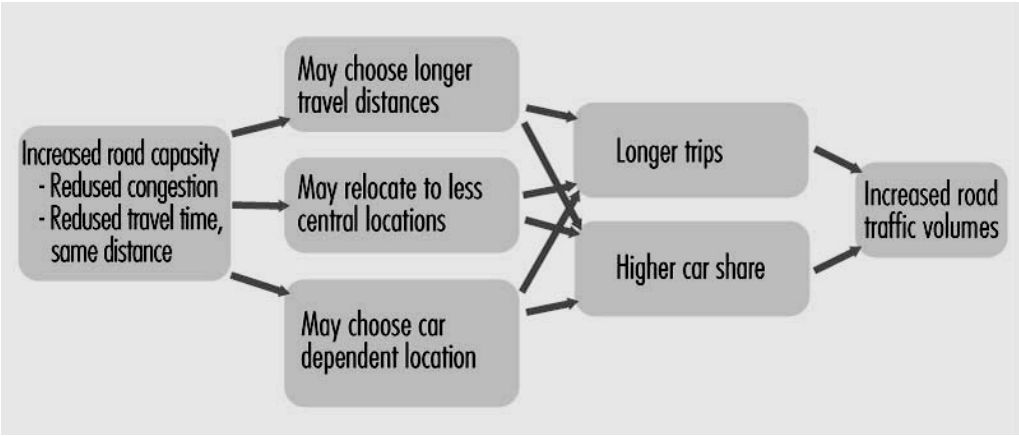

Figure 2: Increased road capacity affects land use development, resulting in changes in travel behaviour and increased urban road traffic volumes.

2. 'Sensible location' is here understood solely in relation to the objective of reducing urban road traffic volumes. There are several ways of understanding what is sensible location.

Although other kinds of interconnections could be described, these examples are sufficient to demonstrate that development of urban land use, transport systems, travel behaviour and road traffic volumes involves numerous variables that «are all varying simultaneously and in subtly interconnected ways» (Weaver, 1948). They form a system of organised complexity.

2.2 Implementation of means in concert

Oversimplification by considering only two or few of the variables and interconnections of the system may result in implementation of counteracting means, such as improving both road capacity and public transport systems. This could result in growth in urban road traffic volumes because of the increased road capacity, in spite of efforts to reduce them by improving public transport services.

If the problem is understood as a system of organised complexity, means or strategies could be implemented in concert and reinforce each other. This would give greater effects than if the means or strategies were implemented separately. For example, if road capacity is reduced and public transport services improved simultaneously, urban road traffic volumes would be reduced more than if only one of these means were applied.

This knowledge underlies National Policy Guidelines for coordinated land use and transport planning (Ministry of Environment, 1993), as well as recommendations in white papers, sector plans and municipal master plans for means and strategies to reduce urban road traffic volumes or demands (Tennøy, 2004a, Owens and Cowell, 2002). The recommendations may be summed up and simplified as to implement the following means or strategies *in concert*:

- to impose or encourage land use development that creates a lower demand for transport and car use
- to impose physical and fiscal restrictions on car traffic
- to improve public transport services
- to improve conditions for walking and bicycling

As described above, the general picture today is that these means have not been implemented as recommended and road traffic volumes are increasing too. One explanation for this could be that many of those involved in planning and development of urban land use and transport systems do not understand this as a problem of organised complexity. There could also be inadequate knowledge about the many variables involved and how they are causally interconnected. Other explanations concern the planning and decision making processes – 'the system of problem solving'.

3. The system of problem solving as a problem of organised complexity

Planning and decision making processes sometimes appear irrational, both to planning practitioners and to researchers studying planning. In spite of the fact that planning and decision making is carried out in a defined and hierarchical system governed by the Planning and Building Act (PBA), the planning and decision making processes as well as the outcome of these processes are often hard to understand, explain and predict. This is also the case when we examine how the planning system functions in light of the long standing objective of reducing urban road traffic volumes.

In reality, the system of problem solving involves numerous elements of various kinds (actors, sectors, acts, power structures, objectives, values, rationalities, disciplines, knowledge systems etc.), which interact strongly with a number of the others, constituting a system of organised complexity. This system influences how land use and transport systems are planned and developed, and thus the development of urban traffic volumes. Some examples of elements and interactions in this system are briefly discussed below.

3.1 Institutional and organisational factors

The planning system defines the rules of the planning game. It influences all elements in the system of problem solving, as well as the chances that urban land use and transport

planning can be recognised and addressed as a system of organised complexity.

The Norwegian PBA is supposed to coordinate almost everything that is built in society (PBA, 1985:§ 20-1). It defines a hierarchical system with a rather simple structure. At the National level, laws, white papers, policy guidelines etc. are prepared, that are meant to steer the practice of planning and decision making at lower administrative levels. At the municipal level, municipal master plans are developed and adopted as binding. Zoning plans are to be prepared in accordance with the municipal plan for all private and public initiatives with any spatial dimension. Municipal political bodies make political decisions on whether to adopt the zoning plans. The planning is implicitly expected to follow a synoptic planning ideal. Similar systems are found in other countries.

In practice, land use and transport planning within the system of the PBA is not as tidy as it might seem. All administrative levels are involved. Several policy areas and sectors as well as the private sector overlap, and the general public are supposed to participate in the processes. The demands, objectives, values, attitudes, interests and knowledge of the many actors involved are to be coordinated in municipal master plans. The master plans influence zoning plans, initiated by numerous public and private actors. Parts of the transport system, such as public transport services, are planned outside the PBA system.

These conditions make it a challenging task to plan and implement means and strategies for reducing urban road traffic volumes in concert. It is also difficult for the planning authorities to coordinate the many individual planning initiatives in ways that pull in direction of this goal (Hull 2008, Owens and Cowell, 2002, Strand and Moen, 2000).

3.2 Objectives and values

The outcome of planning processes is greatly influenced by the relative prominence of various objectives and values. The many actors involved in land use and transport planning may have different views on the objective of reducing urban road traffic volumes.

Few of the actors initiating projects dealt with by the planning system do it *in order to* reduce urban road traffic volumes. Private and public initiators have other main objectives when entering into these processes, such as earning money or reducing congestion.

Thus, it is the duty of the public planning and decision making system to ensure that development will reduce urban road traffic volumes. However, Norwegian studies show that there is less unanimity among planners[3] and politicians regarding how they understand this objective, how important they think it is and how they rate its importance in relation to other objectives, than one could get the impression of, when reading plans and other policy documents (Tennøy, 2008, 2007, 2005).

One can also question the function of political objectives. Sager (1991) found that political objectives may have primarily legitimating functions, by leaving an impression that one is working on solving a problem, even though there might be no real intentions to carry out the actions needed to achieve the objective.

3.3 Contested knowledge

Which knowledge is held, accepted and applied by the actors in land use and transport planning will influence the plans and the traffic volumes. There are reasons to believe that the understanding of the interconnections between development of land use, transport systems and travel behaviour as described in the previous section is not as widely accepted as one could believe from reading planning journals, plans and policy documents. Some likely reasons for this are the multi-disciplinary character of land use and transport planning and the ongoing development of our understanding of the complex interconnections between land use, transport systems, travel behaviour and road traffic volumes.

One could argue that there is a shift of paradigm going on, from an understanding

3. Planners, here and in the rest of the text, means all planners professionally involved in plan making, and not exclusively planners working for planning authorities.

of land use planning and transport planning as simple systems interlinked in rather simple ways, to an understanding of an integrated system of organised complexity as discussed above (see for example Owens, 1995).

Those involved in land use and transport planning and development do not necessarily hold or agree on the knowledge needed in order to view land use and transport planning and development in the framework of the new paradigm. This could be because they obtained their knowledge at a time when land use and transport planning were understood in more simplistic ways, or because they belong to other professional or disciplinary knowledge systems. An implication of the ongoing changes in the understanding of land use and transport planning and development, especially related to the objective of reducing urban road traffic volumes and GHG emissions, may be that there are weaknesses or gaps in the knowledge system.

Empirical research (Tennøy, 2008, 2007, 2005, 2004b) shows that this knowledge is not known and agreed upon by all planners and politicians. The same analyses also indicated possible weaknesses of the knowledge system, such as lacks in the documentation of effects of transport reducing means and lack of accepted or legitimate methodology for doing real life planning analyses that integrate the view of development of land use, transport systems, travel behaviour and traffic volumes as interconnected in a system of organised complexity.

3.4 The question of power

In a situation with competing objectives, and where knowledge is contested, the actors may choose what they consider to be valid knowledge on the basis on ideology, interests or position. This becomes even more relevant in light of the fact that the topic here is reduction of borderless GHG emissions with long term and uncertain impacts. The political wings have different positions in their view of the problem and appropriate solutions (Tennøy, 2007). Flyvbjerg (1998) found that «power *defines* what counts as rationality and knowledge and thereby what counts as reality» (italics in original). In other words, the one who holds power defines what is valid knowledge.

One explanation for why the objective of reduced traffic and emissions is not achieved could thus be that the actors who promote objectives and knowledge supporting development in the direction of reduced urban road traffic volumes are not the most powerful actors in the game. This effect will be enhanced if the planning and decision making system supports other actors than the ones promoting planning and development towards reduced urban road traffic volumes.

Power should here be understood in a wide sense. Lukes (2005) discusses three dimensions of power. The one-dimensional view is straightforward: Who wins and loses in conflicts of interest in planning and decision making situations. The two-dimensional view of power includes ways in which decisions are prevented from being taken, for example, whether and to what extent reducing urban road traffic volumes is put on the agenda in actual planning situations. Lukes introduced the three-dimensional view of power, which includes shaping people's «perceptions, cognitions and preferences in such a way that they accept their role in the existing order of things» (Lukes 2005:28). An example of this aspect of power could be the shaping of underlying assumptions which undermine efforts to reduce GHG emissions, such as the assumption of the necessity of continuous economic growth (Owens and Cowell, 2002).

3.5 Interconnections

There are strong interconnections among the elements of the system of problem solving described here, as well as additional elements such as public participation, political processes etc.. Understanding the system of problem solving as a system of organised complexity may help us to understand and explain why planning and decision making processes are not producing plans that contribute to reduction of urban road traffic volumes. Viewing the system as a system of simplicity constituted mainly by the defined and hierarchical system of planning and decision making, or as a random and irrational system with unpredictable outcomes, does

not give this insight. Substantial research will be needed, however, to achieve a more thorough understanding of this system.

4. How to deal with this problem of double complexity

How can this understanding of the problem improve our ability to solve the problem – to bring forward land use and transport plans and developments that contribute to reduction of urban road traffic volumes?

The literature on complexity includes computer modelling of such problems (see e.g. Wilson, 2006, Bar-Yam, 1997, Weaver, 1948), but this is not particularly relevant to our discussion. Other authors promote the extended possibilities to *understand and explain* phenomena that are hard to understand in other ways. Weaver (1948) emphasised that science must learn to deal with problems of organised complexity. He argued that these are ontologically and epistemologically different from other kinds of problems, and that they cannot be dealt with using the techniques and understanding of simplicity and disorganised complexity. Jacobs (1961) argued that cities could only be understood and explained as rational and understandable is they were conceived as problems of organised complexity. RCEP (2007) suggests that what may be needed in order to move forward to deal with the environmental problems of cities is to understand them as the complex problems they in reality are, rather than to see them as simple problems to be solved within a simple system with the help of simple solutions.

Within the meta theory of critical realism, the emancipatory potential of critical social science is emphasised (see for example Danermark et al., 2002). The main idea is that what happens in the world is caused by structures and mechanisms which are not directly perceivable. Only if we acquire knowledge of the existence of these structures and mechanisms, and how they work, can we critically examine them and replace unfavourable structures and mechanisms with more favourable ones.

In line with these authors, we find that if to understand why we fail to reduce urban road traffic volumes, and thus enable us to change land use and transport planning in directions that reduce urban road traffic volumes and GHG emissions, we need to conceptualise and understand both the problem of how to plan and develop urban land use and transport systems in order to reduce urban road traffic volumes, and of the planning and decision making processes, as problems of organised complexity. The interconnections between the systems need to be addressed this way as well.

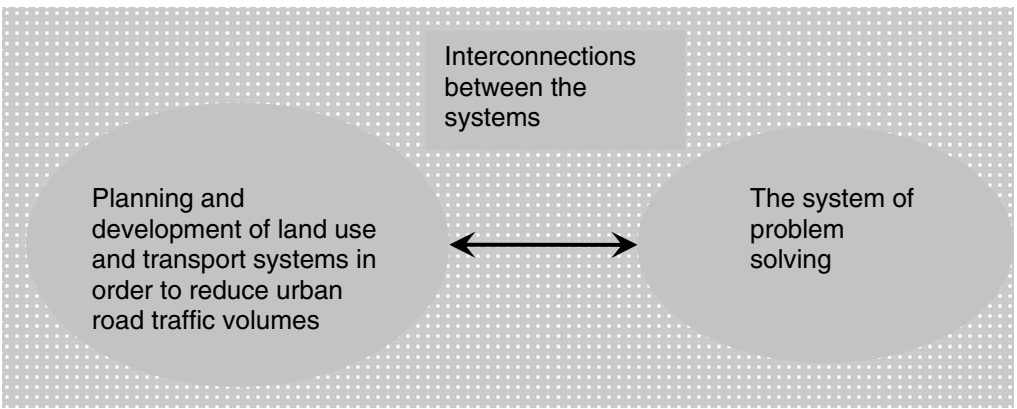

Figure 3: Understanding of the two systems of organised complexity, as well as the interconnections between these systems, need to be improved.

5. Conclusion

In this article, I have argued that the problem of planning and development of urban land use and transport systems in ways that cause and allow reduction of urban road traffic volumes is a problem of double complexity. This is because the problem itself, planning and development of urban land use and transport systems in ways that cause and allow reduction of urban road traffic volumes, as well as the planning and decision making processes, are problems of organised complexity.

I have argued that if to understand why we fail to reduce urban road traffic volumes, and thus to understand what needs to be changed in order to achieve this goal, more knowledge is needed about the two systems of organised complexity, and about the interconnections between them.

In order to bring forward the necessary knowlwdge, two main tasks may be singled out. First, we need to better understand and describe the two systems of organised complexity and the interconnections between them. A model of structures and causal mechanisms is needed which can explain why plans are made and adopted that result in increasing road traffic volumes. Second, we need to analyse the structures, elements, mechanisms of the systems and their interconnections, with the goal of identifying the main obstacles to a reduction of urban road traffic volume and clarifying how these obstacles can be reduced. Much work will be required. Still, if the IPCC predictions are anywhere near reality, it may be argued that this is necessary work.

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