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Promoting sustainability through national transport planning

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This following special issue of the European Journal of Transport Infrastructure Research (EJTIR) containing 4 scientific papers is the result of the work conducted under the research project 'National Transport Planning – Sustainability, Institutions and Tools' (SUSTAIN) (2012-2017) financed by the Danish Innovation Fund. SUSTAIN was coordinated by first the Department of Transport of the Technical University of Denmark (DTU Transport) and later as the result of a reorganisation of the transport research at DTU by the Department of Management Engineering (DTU Management Engineering). The project was carried out in cooperation with several Danish and international partners.

In SUSTAIN the following definition of national sustainable transport planning (NSTP) was adopted: deliberate, knowledge-based, and strategic endeavours to integrate sustainability principles, criteria and goals in the development, management, regulation and assessment of nationally significant transport systems and services. This paper presents the research outcome by reviewing some of the major findings and seeing these collectively as a basis for promoting sustainability through the formulated research topic of NSTP. This basis includes defining criteria and indicators for use in NSTP combining evidence-based and performance oriented planning approaches. Furthermore, it contains a flexible evaluation framework that includes a decision support model that when informed by criteria and indicators can structure and assist an NSTP practice. This practice can support a planning process aiming at realising a sustainable transport development. Finally, the basis comprises a review of the complex political and administrative fabric in which NSTP is embedded, and thereby it can condition the ability to promote sustainability in practice.

Keywords: *Sustainability, national transport planning, indicators, decision support, governance.*

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1. Introduction

1.1 Sustainability and transport

2015 was a year showing an unprecedented global ability and willingness to respond to global sustainability challenges. In September, the 2030 Agenda for Sustainable Development including the 17 sustainable development goals (SDGs) was decided, and in December the international community adopted the Paris Climate Agreement.

Transport does not feature among the individual SDGs, but transport nevertheless plays a significant role, since accomplishing the goals will rely on advances in sustainable transport. This covers reducing greenhouse gas emissions, providing food security, health and well-being, education, women's employment and empowerment, disabled and elderly people's independence and dignity, as well as affordable and clean energy, sustainable cities, biodiversity and ocean health. Some of the 169 sub-goals include direct references to transport (United Nations, 2016). Such a goal-directed transition will be extremely complicated and challenging, and policy-makers simultaneously will face new disruptive technologies and organisational forms like the sharing economy, autonomous vehicles, and the internet of things, all of which may both enable and constrain efforts to reach sustainability goals (Schiller, 2016; Fagnant & Kockelman, 2015). Concepts, insight and tools can contribute in this complicated process. Addressing the sustainability challenges is a multi-level, multi-actor and multi-sector process (Gudmundsson et al., 2016), where also the national level is of significant importance since the nation state is the most powerful political institution in existence.

A concept that is proposed to inspire policy-makers and planners in the coming years when addressing these challenges is "national sustainable transport planning" (NSTP), which encompasses ways in which national planning processes could be developed to systematically support the integration of sustainability in transport governance. NSTP has been the core topic of the SUSTAIN research project. Internationally, research on national transport planning systems and how they respond to sustainability concerns is limited, and it is not a well-established field of research. The academic ambition of SUSTAIN has been to help establish NSTP as a coherent research topic across the social and technical sciences, while the societal objective has been to promote future-oriented planning for a sustainable transport system in Denmark. The intention of this paper is to contemplate the outcome of such an academic ambition.

1.2 National transport planning

Transport systems encompass extensive, nation-wide infrastructure networks with dedicated types of vehicles operating each network to deliver transport of people and goods. These networks have strategic importance for countries and represent significant economic value. The systems are therefore normally planned for and governed by central government institutions assisted by one or more public agencies and private corporations. These are charged with the provision, operation, management and regulation of transport infrastructures and services. The specific institutional arrangements such as the split or cooperation between public and private ownership differ across countries and have evolved over time and space (Hasselgreen, 2013; ECMT, 2004)

Transport planning involves the generation of knowledge about transport tendencies and expectations and the use of analytic tools to predict outcomes and support decisions in order to ensure the timely provision of investments and services while limiting the negative impacts of transport. This planning takes place within more or less formalised, nested sets of planning procedures, and with a basis in more or less well established modelling, assessment and decision support methodologies. A typical distinction is between strategic policy planning versus specific infrastructure project appraisal, which is the more prominent approach (Egeland and Perkins, 2017). Another is between ex ante assessment to guide decision investments and ex post assessment to monitor outcomes. A third is between local, regional and national planning levels,

which may all be involved in planning for key policies and projects. Due to the contingency of NSTP drivers (who? – when? – why?) NSTP may best be represented by seeing it as comprising the above mentioned well-known types of planning but also as adaptable within the national context on the basis of actual dynamisms, see the following section as concerns the NSTP dimensions with related interlinkages and the definition of NSTP adopted in SUSTAIN.

Thus, efforts to introduce and pursue sustainability in transport generally occur in the context of these already existing, but continuously evolving national transport policy institutions and planning procedures, often with a more or less explicit intention to modify the modus operandi of various elements to deliver sustainable outcomes.

1.3 Defining and analysing national sustainable transport planning

Within SUSTAIN, national sustainable transport planning has been defined as deliberate, knowledge-based, and strategic endeavours to integrate sustainability principles, criteria and goals in the development, management, regulation and assessment of nationally significant transport systems and services (Sørensen et al., 2013).

To explore the conditions and opportunities for the NSTP concept being adopted as a real framework in practice, a starting point has been taken in cross-disciplinary sustainability research emphasising that significant transition towards sustainability in general is a process that must face three interlinked dimensions: a normative, an analytic and a governance dimension (Voβ et al., 2007; Becker et al., 1997). The generic meaning of each dimension as well as its translation into a national transport-planning context appears in Table 1 below.

Table 1. Transition towards sustainability - three dimensions (Sørensen et al., 2013).

	Transitions towards sustainability	
Dimensions	Generic meaning	Implications for national transport planning
Normative dimension	The basic ethical principles and value-orientations of sustainability	Sustainable transport is based on the environmental, social and economic pillars of sustainability; this implies which goals to pursue in transport.
Analytic dimension	The intellectual tools to determine whether an action is sustainable or not	Knowledge on consequences for sustainability of interventions, e.g. infrastructure and transport service projects and plans, pending on the availability of tools and data.
Governance dimension	The system of governance to promote and implement changes towards sustainability through institutions and policies,	Organisational forms in the transport sector, the set-up of key government institutions, as well as transport planning and implementation procedures and expertise, which promote the integration of sustainability.

Our proposition is that an adequate understanding of national sustainable transport planning (NSTP) will need to employ these three dimensions. The dimensions, however, do not constitute isolated spheres of sustainable planning, but form a whole. From a classic planning perspective, the dimensions could be interpreted as stages in a rational planning process (from formulation of sustainability goals to evaluation of consequences and final decision making by way of an appropriate governance system). However, strategic planning is rather a time cyclic, recurring process (Bryson et al., 2010), implying that the dimensions are interdependent. All three dimensions affect one another. Political processes and new knowledge might contribute to adjust values, goals and interpretations of what sustainable transport could be. Similarly, instruction and feedback from policymakers might contribute to calibration, development or application of new analytic tools just as the values and goals will affect policy making indirectly (via incorporation into knowledge production), but also directly as inspiration and guidance in policy making. On this background NSTP as a research field has been defined as the study of the

integration of sustainability in the normative, analytic and governance dimensions of national transport planning and how the dimensions are interlinked (Sørensen et al., 2013).

While the above considerations of NSTP pertain to understanding the concept of NSTP, this way of conceptualising the field also has shaped the research in SUSTAIN. Research within the SUSTAIN project has been carried out in work packages within each of these dimensions, supported by cross-dimensional work packages to explore ways to understand linkages across dimensions. During the research process, the interdependencies between each dimension have become ever more obvious, and the focus to some extent has changed from the individual dimensions to these interlinkages between the dimensions.

The papers presented in this special issue deal with all three dimensions and their interlinkages. Within the dimensions, specific research questions and tasks were pursued with regard to how each dimension can contribute to the field of NSTP. The emphasis on the interlinkage between the normative and governance dimensions is treated by **Banister**, the interlinkage between the normative and analytic dimensions is treated by **Ramani et al.**, and the interlinkage between the analytic and the governance dimensions is treated by **Salling et al.**. Finally, **Cornet et al.** explore the interlinkages between all three dimensions. The dimensions, their interlinkages and the positions of the papers in this framework are illustrated in Figure 1 below.

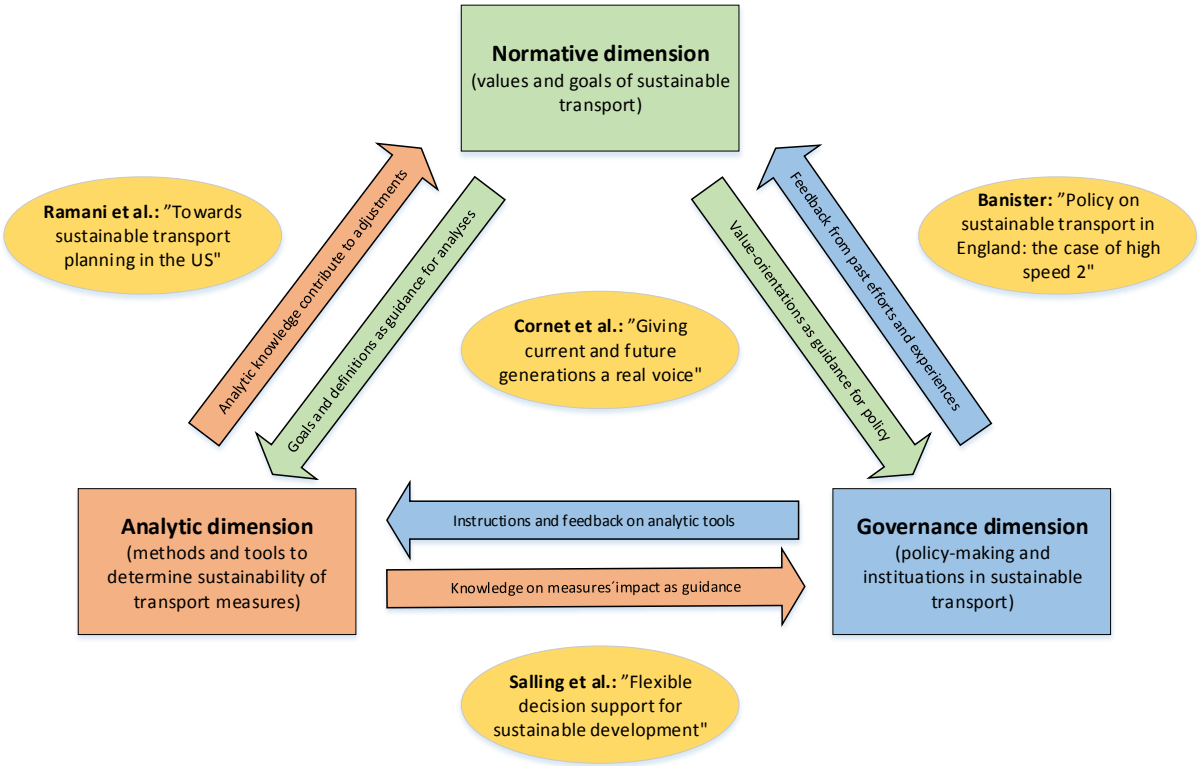

Figure 1. National sustainable transport planning (NSTP) – dimensions and interlinkages (Sørensen et al., 2013), with the four papers of this special issue inserted and shown in yellow about NSTP findings.

After this introductory section, section 2 will present the three core elements of NSTP and provide appetisers for the in-depth elaborations in the subsequent papers. The final section 3 interconnects the dimensions with a perspective for further research.

2. Sustainability, institutions and tools

2.1 Sustainability

National sustainable transport planning involves the application of sustainability-oriented concepts, goals and evidence to the field of transport policy and planning. Attempts in this regard can be observed around the world through a growing number of transport policy documents and planning frameworks with an emphasis on sustainability emerging (and occasionally retreating) since the 1990s with Denmark as an early mover (Trafikministeriet, 1990, see also UK Highways Agency, 2012; Transport Canada, 2011; Transportministeriet, 2008). In parallel, technical and academic literature have explored conceptual approaches to sustainable transport planning, methods for sustainable transport assessment, but also critical examinations of transport agency efforts, planning systems, or policy regimes, from a sustainability point of view (Gudmundsson et al., 2016; Bueno et al., 2015; Booz Allen Hamilton, 2014; Meunier, 2012; Jeon and Amekudzi, 2005).

A common concern for both planning and research is in fact how to verify sustainability (or lack of it) in transport planning for a transport plan, an individual infrastructure project or a whole transport system. In short, how to measure 'transport sustainability'? How to address this problem has been the subject of discussion in the literature, and different ways to make sustainability operational in transport planning have emerged (Gudmundsson et al., 2016; Cornet and Gudmundsson 2015; Holden et al., 2013; Banister, 2008; Jeon and Amekudzi, 2005).

In SUSTAIN this issue has been treated by using of sustainability criteria, objectives, and indicators as key elements in planning. Sustainability operationalized in this way draws on two overlapping planning approaches. One can be called evidence-based policy making, emphasizing the use of scientific data and analytic models for the assessment and selection of effective policy measures or projects (De Marchi et al., 2016; Faludi and Waterhut, 2006). Transport planning is one of the areas where this tendency has achieved a strong presence, e.g. via the application of new generations of transport modelling tools and assessment methods such as cost-benefit and multi-criteria analysis as decision support (Lorenc et al., 2014, Mackie et al., 2014; Barfod, 2012; Leleur, 2012). The other can be called a strategic performance-oriented planning approach (Zietsman and Ramani, 2011; Marsden et al., 2006). Performance oriented planning basically means a systematic goal oriented approach to governing and managing public policies involving the definition of strategic long-term goals, short term incremental performance targets, and the use of performance indicators to track progress and manage program efforts or contractor activities according to performance (Cambridge Systematics, 2006).

While neither approach has any intrinsic relation to sustainability, these approaches nevertheless combine normative and analytic opportunities for letting broad or vague sustainability aims become operational and manageable. The general approach in planning for sustainability in this way starts from universal definitions, principles, or concepts of sustainable development, most prominently the definition adopted by the Brundtland Commission (WCED, 1987) emphasising meeting the needs of both future and present generations. Such concepts form the basis for more operational criteria, objectives and associated performance indicators to inform the selection of projects or the evaluation of policies. Some sustainability criteria, objectives and indicators have an analytic basis in scientific disciplines such as ecology, climate science, or economics, while others have a more normative, political basis such as the earlier mentioned 17 Sustainable Development Goals adopted by the United Nations (2015). In fact, sustainability criteria and objectives often represent a mix of science and policy which, for example, is the case of the Paris Climate Agreement to limit global temperature increases to well below 2 degrees Celsius above pre-industrial levels (United Nations, 2015).

Applying universal sustainability criteria and objectives directly to assess transport policies and projects is sometimes possible but not always ideal. The transport-related services and impacts need to be especially in focus when transport is planned with a sustainable development

perspective. A common way to do this is via definitions, criteria, and indicators to measure for 'sustainable transport' as proposed in the literature (e.g. Gudmundsson et al., 2016; Holden et al., 2013; Jeon and Amekudzi, 2005). In SUSTAIN **Cornet et al.** have established a more dedicated framework for sustainability assessment of the UK high speed rail HS2 project. This framework involves 28 criteria divided into direct project impacts and wider social and environmental impacts.

The evidence approach invites the application of analytic models to calculate and verify the achievement of desirable developments for each topic and indicator such as greenhouse gas emissions or infrastructure life cycle costs, and to use methods such as multi-criteria analysis to aggregate these impacts into overall 'sustainability' scores to support ex ante decision making (Bueno et al., 2015). The performance approach offers a way to let normative principles or goals for sustainability take shape in frameworks for performance goals, targets and indicators in the agencies conducting transport planning, see **Ramani et al.**.

2.2 Assessment tools

The SUSTAIN project has developed a flexible decision-support tool to assess sustainability indicators together with conventional socio-economic impacts. The tool is referred to as the SUSTAIN Framework Model (SFM) and is outlined in **Salling et al.**. The aim of SFM is two-fold: firstly to provide decision support for those participating in the decision process and to embed sustainability concerns into the decision support, and secondly to provide transparent decision support which is able to justify the decision for those not participating in the process.

In most decision problems there are many alternatives, many uncertainties, many stakeholders and many consequences (Walker, 2000). Together with the fact that there is usually no single decision-maker, this means that achieving consensus will be based on a number of criteria (and indicators) which make multi-criteria decision analysis (MCDA) a useful tool. It means that the cost-benefit analysis (CBA), for years the dominant assessment methodology in transport planning, can be complemented by MCDA. As recent research has shown the often unnoticed biases and inaccuracies of CBA (Næss et al., 2012; van Wee, 2012) make it relevant to adopt a methodology that can remedy this deficiency of CBA. This issue is further treated by **Cornet et al.**.

The SFM consists of three main elements: the planning workshop, the criteria (and indicators) and the SUSTAIN-DSS model which contains a CBA-module, an MCDA-module and a quantitative risk analysis (Feasibility Risk Assessment – FRA) module (further elaborated in **Salling et al.**). Focus is as mentioned on allowing for stakeholder involvement in the process in order to obtain informed and transparent decision support. Figure 2 depicts how the three elements interact under the framework.

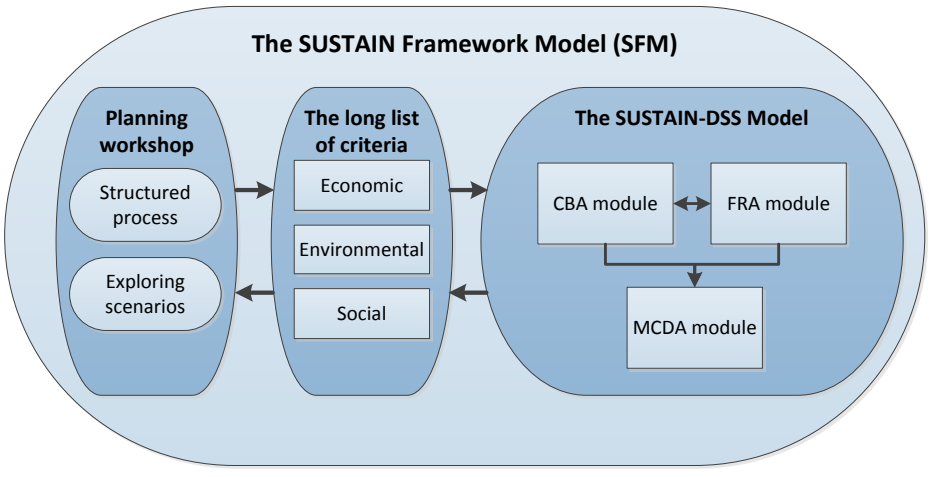

Figure 2. The SUSTAIN Framework Model indicated by its main elements.

A conventional project appraisal leaves very little room for inclusion of a wider set of planning criteria in the decision-making process. Whether the SFM outlined above generally provides a valid approach for national sustainable transport planning evidently needs to be determined. However, it is clear that just by including planning criteria as presented and seeking to accommodate 'an alternative approach' provide the decision-makers with a powerful tool to address and assess sustainability. Thus, transport planning and decision support in the context of sustainable development can undergo a rethinking on how to provide sound decision support. Specifically, the challenge is to seek national and global consensus on how to embed such non-quantifiable effects in transportation planning and policy-making towards a sustainable transport development without comprising the overall objective of mobility.

2.3 Transport governance (institutions)

Governance frameworks, and institutions and organisational modes of delivery may have a large impact on the way sustainable national transport planning is carried out. By "governance" here is meant the laws, rules, and forms of interaction between government and society that allow public policy to be implemented. "Organisational modes of delivery" are the specific institutional and organisational forms that transport companies take, be it a state owned enterprise (SOE), a public-private partnership (PPP) or a privatized company within a regulatory framework.

The development of the transport sector in OECD-countries has during the last decades meant a move away from organisations within government towards use of SOEs and PPPs as organisational modes of delivery. SOEs are preferable for many transport companies: Government owns them 100% or down to 50% and can thereby direct the company to pursue policies that the government wants to see carried out in practice. Empirically, the transport sector has had experiences with these two modes of delivery. Many transport projects around the world have been organized as PPPs which means that private finance and risk sharing are incorporated into the institutional design of a transport project. The World Bank has defined a PPP as "a long term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility and remuneration is linked to performance". Transport is the sector where most PPPs have been used in Europe and globally (Roumboutos, 2015). Transport projects include bridges, tunnels, railways, light railway, motorways, and metro projects. PPPs have thus become a well-known organisational mode of delivery that brings together the public and the private sector (for recent overviews, see Boardman, Greve and Hodge, 2015; Hodge and Greve, 2017).

The overall picture today for organisational modes of delivery is that we now are witnessing a wider spectrum of organisational forms, and governments now choose from a variety of delivery modes. Consequently, organisations like the OECD (2017) nowadays prefer to talk about "infrastructure governance" and accept that there is no best way to organize infrastructure in the transport sector (or other sectors). Christensen and Greve (2017) have documented a wide spectrum of available organisational forms for transport infrastructure projects in Denmark. The spectrum reaches from SOEs in the Copenhagen Metro company, DSB, the Sund & Baelt company responsible for building and management of the bridge mega-projects in Denmark through the PPP-model at the Kliplev-Sønderborg motorway to the semi-privatized organisation Copenhagen Airport. Thus, Denmark like many other countries has a variety of organisational forms.

The various organisational forms offer a number of possibilities for making sustainability criteria part of a planning thereby connecting to both the normative and analytic dimensions. For SOEs the contract between the government and the company may have sustainability criteria built in. Also, the government can use its persuasive powers and influence as owners to suggest or even direct a company in a sustainable direction. However, at best, it is a negotiation, hardly a direct order. For PPPs (but also SOEs), there are several ways that governments can make sustainability progress. The three main principles are articulation, integration and evaluation.

- Articulation: Governments can articulate sustainability criteria because PPP projects are usually long time in the planning process and will run for 30 years or more once they are established. By inviting private finance as part of the deal and contemplating risk sharing, PPPs present a unique opportunity to consider all future risks, including matters related to sustainable transport.
- Integration: Governments can integrate sustainability in the contracts that govern PPPs. The contract is the key governing tool for PPPs, and since contracts may be signed for up to 30 year projects, getting sustainability demands to be written into a contract which is another opportunity for combining sustainability criteria and PPPs.
- Evaluation: Finally, sustainability criteria can be one of the performance standards that PPP projects will be evaluated against. Therefore, PPP projects can actually encompass sustainability criteria if the institutional design phase gives serious consideration to sustainability.

With transport projects representing the largest share of PPP projects, the possibility of aligning sustainability aspiration with the PPP model is indeed present today. As the term "institutionalized market actor" suggests, sustainability measures will at best have to be negotiated with the companies and their boards and CEOs. The unfolding of specific negotiation will influence and not least be influenced by knowledge "produced" in the normative and analytic NSTP dimensions, see Figure 1. **Banister** treats this interlinkage further with focus on the questionable decision support process concerning the HS2 railway line in the UK.

3. Findings and perspective

The main research structure in SUSTAIN shown in Figure 1 with three dimensions (normative, analytic and governance) and their interlinkages have produced the main findings reviewed in the sections above and further elaborated in the respective papers. An overall synthetic finding of SUSTAIN is that national sustainable transport planning (NSTP) constitutes a complex planning problem. More specifically, NSTP is an adaptive field, which means that change in one dimension will influence the other dimensions. Due to the lack of cause-effect relations that due to the complexity of interactions cannot be clearly mapped, prediction of influences becomes ridden with uncertainty. Furthermore, NSTP is influenced by the more general societal and technological spheres of development where other 'internal developments logics' are not accessible. On this background the findings of SUSTAIN are mainly to be seen as indicative. However, integrating sustainability criteria, goals, indicators, and evidence into the decision architecture of transport policy and planning is found to have a potential as driver behind a transformation towards a sustainable transport development. Such NSTP efforts will allow sustainability to actually influence practice, especially if the decision architecture is linked to mechanisms such as budget allocations, mandated decision support tools, and other core policy management functions such as performance incentives and disincentives. Exemplications is given in **Cornet et al.**.

Under the normative dimension the evidence- and performance-based approach in its most idealistic conception will allow overarching societal aims (defined by e.g. parliament or government in dialogue with stakeholders and science) to control and steer the activities in transport planning and governance. This with a 'line-of-sight' from overall strategies, to mid-range agency programmes and project priorities, to the day-to-day management of employees. However, in practice such ideals have shown to be difficult if not impossible to realize in full, due to issues such as conflicting goals and interests, agencies acting autonomously, and sheer lack of knowledge of the complex systems being managed and planned for. These are persistent challenges not least for sustainable transport planning. Exemplification is given in **Banister** and **Ramani et al.**.

Under the analytic dimension a key concern with development of the SUSTAIN Framework Model (SFM) has been to embrace various and often conflicting goals and criteria by identifying effective methodologies to undertake comprehensive assessment. This purpose can be met as concerns appraisal methodology with an approach, which involves multi-criteria decision analysis (MCDA). The model developed is so flexible that it can be adapted to a wide range of assessment tasks to be carried out as part of NSTP: policies, programmes, projects etc. Specifically, the SFM approach has the advantage of making conflicting views among stakeholders and/or decision-makers more explicit, thereby permitting better design and monitoring. Furthermore, distributional issues are made explicit since the processes of allocating weights and scores are separated. Decision-makers are therefore free to choose criteria outside the SFM list of criteria and give relatively more weight to the criteria they consider important. Furthermore, the SFM approach allows the examination of different scenarios. The interplay of methodology and process has been demonstrated in Danish and international cases about environmental impact assessment and large infrastructure investment alternatives. An important key point shown by the case studies examined is that a wider assessment using the SFM led to a shift in the most preferred option as compared with assessment based on CBA only. Thereby, the SFM approach makes it both possible and important to carry out appraisal studies based on a comprehensive range of objectives relevant for national sustainable transport planning with these conducted in a flexible way adapted to the specific appraisal problem. In brief, SFM can make sustainability issues explicit which is seen as important in the political process. Exemplification is given in **Salling et al.**.

Under the governance dimension the outlook for NSTP will have to take account of the changed institutional and organisational landscape that exists in a country. The government cannot simply 'demand' sustainable national transport planning and expect all companies to follow suit. One reason is that governments often do not own the transport companies they are supposed to plan or make national strategies for. These companies may sometimes have several other owners than government and rely on other financial models that will not tolerate sustainability measures to be put forward. Of course, sustainability could be implemented in general transport legislation, but many plans and activities will, in reality, have to be complied with by companies that may have a particular organisational form such as a PPP, a SOE or as a private, regulated company which may make them want to pursue their own strategies. As the term "institutionalized market actor" suggests, sustainability measures will at best have to be negotiated with the companies and their boards and CEOs. The complex problem of promoting sustainability then becomes visible as these negotiations will necessarily be influenced by actual values and goals of sustainable transport and analytic knowledge being available. Exemplification is given in **Banister**.

The society will in the coming years continue to experience major technological changes which most likely will change the transport sector dramatically and raise many new issues that cannot be faced with traditional planning approaches. An ambition of the SUSTAIN research project has been to launch NSTP as a research topic. Supported by Danish and international cases, which have been published and disseminated both at national and international conferences, see http://www.sustain.transport.dtu.dk/, this has as a start remedied to some extent the situation with very sparse knowledge about the topic as a research area. As NSTP will – and should – depend on the country-specific context, NTSP will be a challenge for particular countries in particular ways. The SUSTAIN team, being multi-disciplinary in its set-up and comprising social and technical researchers with various specialties relating to transport and planning, finds, however, at the end-stage of the project that the normative-analytic-governance triangle with the interdependencies shown in Figure 1 has been highly supportive for the research work carried out. An NSTP perspective is – together with the particular findings addressed in the sections above – that this triangle could serve also as being supportive for the transport researchers in other upcoming NSTP contexts where the purpose is to promote sustainable transport development specifically as a national endeavour. In conclusion, based on the presented main SUSTAIN results and findings and on the SUSTAIN website, the NSTP topic ought still to be

considered as a young research topic. Needless to say, it is an important one, which deserves to be further explored and developed.

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