A USERS GUIDE ON SUSTAINABILITY PERFORMANCE MEASURES FOR TRANSPORTATION AGENCIES

J. ZIETSMAN, PH.D, P.E., T. RAMANI, J. POTTER*, V.REEDER**

Texas Transportation Institute, College Station, Texas – 77843, USA
*ICF International, Fairfax, Virginia – 22031, USA
** Cambridge Systematics Inc., Cambridge, Massachusetts -02140, USA

ABSTRACT

Transportation agencies recognize the importance of sustainability in terms of addressing concern for the environment, quality- of- life and economic development, now and into the future. However, transportation agencies often struggle to understand, measure, and apply sustainability concepts in their core activities. Using performance measures can help agencies achieve their goals with respect to sustainability. This paper describes a guidebook developed under the recently completed NCHRP 8-74 project, which was focused on transportation agencies in the USA. The guidebook presents a flexible framework that transportation agencies can use to establish and use sustainability performance measures. It provides an introduction to the basic concepts that link transportation, sustainability and performance measures. It then describes the practical implementation of the sustainability performance measurement framework in a step-by-step manner. Additional guidance and information provided in the guidebook include case study highlights and examples of best practices, examples of measure use and data sources, and a reference compendium of objectives and performance measures for sustainability. The guidebook also provides a "sustainability checklist" to ensure that the framework application is consistent with the basic principles of sustainability. This guidebook therefore provides transportation agencies with the information and resources needed to successfully tailor and implement a sustainability performance measurement system that meets their specific needs. While initially developed from a North America/USA perspective, the paper also discusses the guidebook's applicability to the South African context.

INTRODUCTION

This paper presents research performed under the National Cooperative Highway Research Program project (NCHRP 8-74) titled "Sustainability Performance Measures for State Departments of Transportation and Other Transportation Agencies." The goal of this project is to develop a guidebook for state departments of transportation (DOTs) and other agencies to understand and apply concepts of sustainability through performance measurement, and this guidebook was recently published as NCHRP Report 708 (Zietsman et al, 2011).

The emphasis of this guidebook was on providing DOTs and other transportation agencies with resources to enable them to tailor a performance measurement program for sustainability that is relevant to their specific needs and context. As a means to achieving this goal, a generally-applicable sustainability framework was developed by the authors (Zietsman and Ramani, 2011) as a starting point

This framework addressed the topic of performance measures for sustainability and had the following features:

- Flexible and applicable to a range of transportation agencies;
- Balanced the need for addressing sustainability in a holistic manner, while still being relevant to transportation agencies;
- Defined a set of sustainability principles and a set of broadly-applicable transportation sustainability goals that can be viewed in conjunction with an agency's strategic goals. Defined the typical "focus areas" – planning, programming and project development, construction and maintenance, and system operations, which together cover the range of a transportation agency's possible activities;
- Ensured practical application of the framework through a menu of objectives and performance measures related to the sustainability goals as well as to the focus areas; and
- Allowed for both top-down and bottom-up application within an agency, and provides a beginning point to address the issue of sustainability and to make it accessible and relevant.

BACKGROUND AND RESEARCH CONTEXT

This section of the paper provides a brief overview of the research conducted to establish the context for applying sustainability performance measurement for U.S. transportation agencies. This includes a brief literature review on sustainability, sustainable transportation, and performance measures for sustainability, a more detailed discussion of which is provided in Zietsman and Ramani (2011). This section also discusses the context for addressing sustainability among state DOTs and other transportation agencies in the U.S., and provides a summary of case studies of best practices that were conducted.

Sustainability, Sustainable Transportation, and Performance Measures

The emergence of the terms sustainability and sustainable development can be traced through various sources and publications (Hall, 2006, and Kelly (2009), but a majority of discussions on sustainability to this day are rooted in the "Brundtland" definition of sustainability, i.e., meeting present needs without compromising the needs of future generations (WCED, 1987). The concept of "sustainable transportation" as discussed in the literature generally incorporates the three dimensions of sustainability (also termed as the three Es – environment, economy, and equity/society/employment) and also touches upon the present and future needs articulated in the Brundtland approach.

Performance measures are increasingly used by state DOTs and other transportation agencies and have become well established in recent years. There exists a number of resources and publications both relating to performance measures for transportation agencies (Cambridge Systematics, 2000; Cambridge Systematics, 2006), as well as on sustainability performance measures (Litman, 2009; Ramani et al, 2009; Jeon and Amekudzi, 2005).

Context for Applying Sustainability in U.S. Transportation Agencies

Transportation sustainability concerns often extend beyond the organizational boundaries of national, state, and local transportation agencies. Additionally, within an agency, sustainability cuts across many traditional organizational stovepipes, and covers planning, design, and implementation of projects and infrastructure, as well as day-to-day operations and maintenance. Provision of the transportation infrastructure in the U.S. is the shared responsibility of agencies at three scales of governance including national, state, and regional/local levels. The concept of sustainability presents a legislative and organizational

challenge, as its broad environmental, social, and economic reach cuts across organizational and disciplinary lines that exist within the federal, state, and local governments. Progress on transportation sustainability depends on the ability of transportation agencies to acknowledge the overlaps that sustainability exposes among their organizational boundaries and their willingness to collaborate across traditional organizational lines. While the focus of this research is on state DOTs as well as metropolitan planning organizations (MPOs), the needs of other transportation agencies are also a consideration, as is an understanding of how agencies interact with each other (i.e., organizational coordination) and with other elements outside the transportation sphere.

Another issue is the lack of a formal "authorizing environment" addressing sustainability - in the U.S., there is currently no federal regulation that explicitly focuses on sustainability. However, the social and environmental regulations that do exist, such as the National Environmental Policy Act (NEPA), the Americans with Disabilities Act (ADA), and the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), provide a patchwork framework for state DOTs and other transportation agencies to address components or elements of sustainability. While there is currently no regulation on sustainable development, important elements of the concept are expressed in existing environmental, social, and sector-specific regulations. In this context, transportation agencies are already operating under a nonintegrated form of sustainability agenda, whether this is explicitly recognized or not.

However, transportation sustainability concerns flow across traditional organizational boundaries, and sustainability performance measures are needed that can both support the work of individual agencies and provide insight on progress at a broader scale. Within individual transportation agencies, sustainability is influenced by many traditional organizational stovepipes in the project development process. Therefore, the following six "focus areas" were defined to represent generic aspects or functions of transportation agencies as they apply sustainability concepts:

- Planning;
- Programming;
- Project Development;
- Construction;
- Maintenance; and
- Operations.

Identification of Best Practices and Case Studies

The research team conducted detailed case studies to identify best practices for applying sustainability among transportation agencies in the U.S. and worldwide. The findings from the case studies (Zietsman et al, 2011) revealed that the reviewed agencies have adopted a range of working definitions of sustainability. Several agencies focus on the long-range effect of program decisions, including an assessment of the impact on future generations. While some agencies use some version of the triple bottom line to gauge sustainability (i.e., assessing outcomes by environmental, economic, and social criteria), others consider sustainability a primarily environmental metric. Finally, agencies vary in the scope and scale of consideration of sustainability, ranging from a focus on project-level assessments to more program-level or landscape-scale reviews.

The growing experience and success of transportation agencies in integrating sustainability into their work provides several lessons learned that can be useful guidance to other agencies. From a U.S. agency perspective, the following was identified as

contributing to successful implementation of programs for sustainability, including sustainability performance measures:

- Viewing sustainability in the big picture, i.e., recognizing that sustainability is a comprehensive concept;
- Having the presence of a strong and committed leadership, and working with other agencies in the process;
- Committing to a long-term effort and setting appropriate goals and targets;
- Making sufficient resources available; and
- Linking sustainability to funding.

DEVELOPING A FRAMEWORK FOR SUSTAINABILITY PERFORMANCE MEASUREMENT

Principles of Sustainability

In the approach to sustainability in the guidebook, the authors posit that transportation agencies need to conceptualize a holistic view of sustainability (i.e., "transportation in support of sustainability") as opposed to thinking about sustainability with a narrow focus (i.e., "sustainable transportation"). In this context, it is important to understand the basic principles of sustainability, which are defined as follows for the purposes of this research:

Sustainability entails meeting human needs for the present and future, while:

- Preserving and restoring environmental and ecological systems;
- Fostering community health and vitality;
- Promoting economic development and prosperity; and
- Ensuring equity between and among population groups and over generations.

These principles were assembled based on a review of foundational literature and documents on sustainability, sustainable development, and sustainability in transportation. To develop a better understanding of sustainability, transportation agencies should consider these principles and debate how they relate to a specific organization. The principles as described above should also form the basis for any definition or conceptualization of sustainability that a transportation agency chooses to adopt.

The principles listed previously are phrased slightly differently from the traditional "triple bottom line" approach, with equity being separated out from the social/quality of life aspects of sustainability encapsulated in the "community health and vitality" principle. The treatment of equity - within and across generations - is an important aspect of sustainability which is often neglected in discussions of sustainability because it is the most difficult to quantify and address. It is imperative that equity be treated as an integrated part of the principles of sustainability to better address the distribution of economic and environmental benefits and community health and vitality improvements, which are represented in the other principles of sustainability.

Figure 1 shows a visual representation of how the principle of equity is viewed as reinforcing the environmental, economic, and social dimensions of sustainability, which are represented as a three-legged sustainability stool. Equity is not seen as a separate leg of the stool; instead it is seen as an overarching principle that plays a major part in each of the other principles.

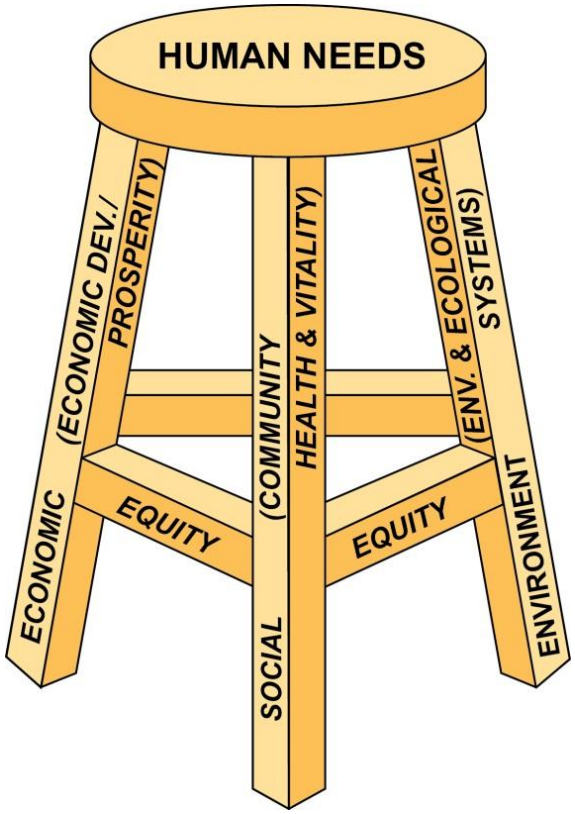

FIGURE 1. Principles of Sustainability and the Significance of Equity.

The Sustainability Performance Measurement (SPM) Framework

While promoting a holistic approach to sustainability, it is recognized that the principles of sustainability need to be translated to transportation-related goals, objectives and performance measures. In general, sustainability performance measures are considered to differ from conventional performance measures due to their linkage to these sustainability goals and objectives. However, this research emphasizes that no single performance measure can truly be a "sustainability performance measure" in isolation – by definition, sustainability requires an integrated set of measures to be applied. Figure 2 presents a framework diagram. The following is a description of the basic framework components.

- **Fundamental components**—these elements are required for the step-by-step application of the framework, and include understanding sustainability (through the basic principles); developing appropriate goals, objectives, and performance measures; and implementing the performance measures.
- **Overarching components**—these are elements that need to be considered throughout the framework application process, such as stakeholder involvement.
- **Auxiliary components**—these are related but optional components that can be used to supplement the framework application process, for example, the use of an organizational definition of sustainability or employee-based initiatives for sustainability.

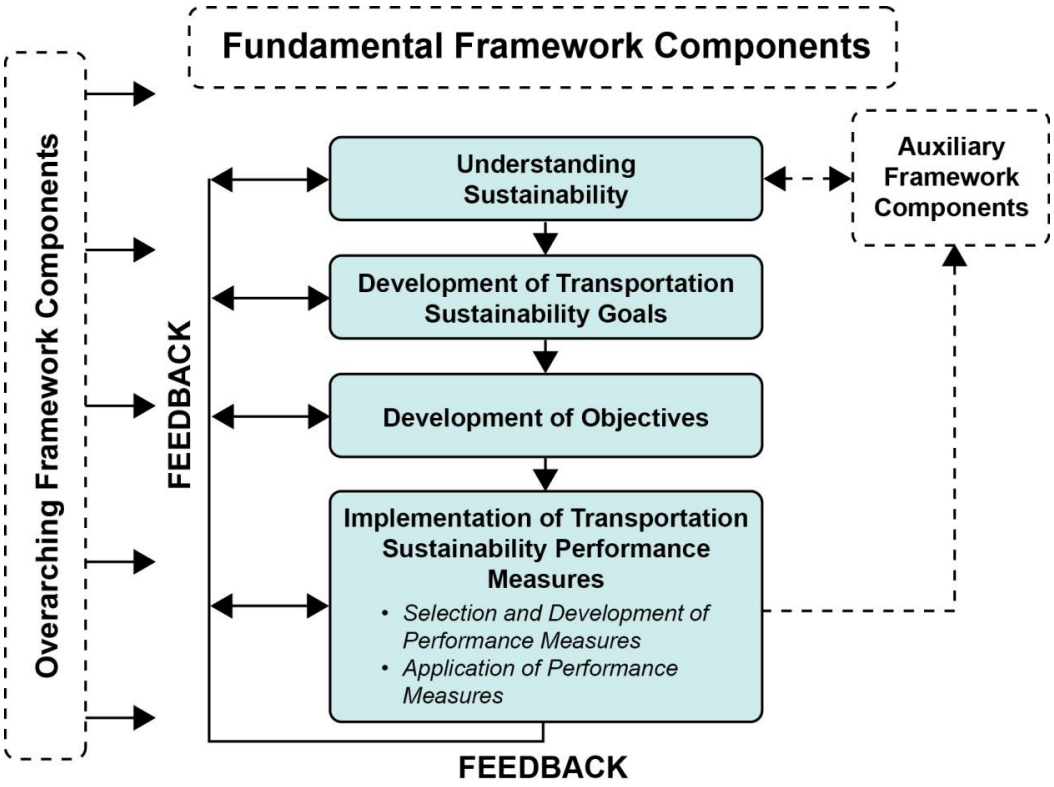

FIGURE 2. The Sustainability Performance Measurement Framework

IMPLEMENTING THE SPM FRAMEWORK

Every transportation agency brings different resources, goals, and challenges to incorporating sustainability, and there is a need to develop a practical approach to implementing the flexible framework defined in this research. The contents of the guidebook were developed based on the case studies, understanding of best practices, and the context for sustainability, and aimed to provide the resources for DOTs and similar agencies. The following points summarize the approach and main features identified as being important to provide comprehensive guidance on sustainability:

- An overview of the basics of sustainability, to describe how they relate to the work of transportation agencies, and orient any user to the principles of sustainability;
- Discuss the need to take a practical, phased approach to implementing sustainability performance measurement. Agencies should assess how to take advantage of the data and processes currently in place;
- An understanding of how to apply the general sustainability principles within an agency's specific transportation context, by setting their own goals or adapting recommended goals;
- Understanding and using each of the components of the SPM framework to fit the agency's needs, or to turn to a specific step in the process;
- A phased approach to developing sustainability performance measures involves defining what an agency wants to accomplish and to understand the starting point. The approach to sustainability performance measurement should evolve over time; and
- Successful implementation of the sustainability performance measurement framework requires an agency to consider the overall context in terms of the type and scale of performance measurement application.

Additionally, there are many other resources provided, including a "compendium" of performance measures and a sustainability checklist, which are described in this section.

Other materials provided in the guidebook, but not discussed here, include detailed case studies and examples of data and performance measures. The practical application of sustainability performance measures is discussed in the context of specific "application types" which are also discussed in this section.

Compendium of Sustainability Performance Measures

The sustainability performance measures compendium is intended to provide agencies with proposed goals, objectives, and performance measures that can be used to apply the SPM framework. The compendium offers examples of what those objectives and measures might be and how they fit together. Depending on agency type, context, focus, and organizational structure, the goals, objectives, and measures can be adjusted to fit with the localized need. A set of 11 recommended goals for sustainability were used as the foundation for identifying the objectives and measures. Under each goal, a set of objectives were developed for the six focus areas previously mentioned (ranging from planning to operations).

The performance measures compendium essentially serves as a source table of goals, objectives, and measures available to agencies as a resource for identifying or utilizing the performance measures. The performance measures included in the compendium were chosen to support the set of selected objectives. They were compiled from the literature review, case study agency examples, and experience of the project team. After the objectives and measures were identified, the database was compiled and reviewed for consistency, redundancy, use of language, and other potential issues. After this review was complete, the project team consolidated the measures and created a set of classifications to add functionality and depth to the compendium. The following describes the classifications.

1. Focus area—As previously mentioned, the objectives are developed for six focus areas: planning, programming, project development, construction, maintenance, and operations. The measures are also developed and classified per focus area.
2. Measure type—This classification includes two dimensions: whether the measure is applicable at the organizational level (e.g., is not specific to the transportation function of a transportation agency, such as an employee telecommuting policy, which can be instituted by any agency, not necessarily a transportation agency); and whether it is an outcome, output, or process measure.
3. Program relevance—This classification provides further information on how each measure may support other considerations for a transportation agency in the following areas: Freight, Transit, Bicycle/Pedestrian, Safety, Land Use.
4. Principles—This classification links each of the measures to one or more of the four sustainability principles identified in the framework.

Application of Sustainability Performance Measures

This users guide seeks to provide guidance for transportation agencies desiring to implement performance measurement for sustainability. Performance measurement application is particularly important in attempting to address what agencies, stakeholders, decision makers, or others might wish to know about a transportation agency's practices or results. The most common questions would relate to:

- Is the agency improving in making sustainability part of its policies, programs, and practices?
- Is the agency, or one or more of its programs, functions, or actions, achieving a desired level of sustainability?
- How do two or more alternative options compare relative to the agency's desired sustainability objectives (for the agency or specific program, practice, or action)?

- Are an agency's actions meeting its goals for those types of actions?

These questions can be addressed through the following five application types:

- Description;
- Evaluation;
- Accountability;
- Decision support; and
- Communication.

These five application types, identified through the literature review and case studies, cover the range of possible scenarios of what an agency might want to do in terms of selecting and applying performance measures (in this case, specifically relating to sustainability). Note that these application types are not mutually exclusive; some performance measures may be used for more than one application. While some may be applied sequentially, they could also be used independently, as Figure 3 illustrates. Some applications derive logically from one another (for example, evaluation can be viewed as an extension of description; similarly, accountability or decision support follows logically from an evaluation exercise). Communication, on the other hand, is more an overarching application that is implied in the use of other applications but is also an application in itself. These five types of applications form the basis for how performance measurement will be applied and are described briefly below with generic examples. There are many real-life examples of transportation agencies using performance measures in the five types of applications, both in terms of sustainability performance measures and other performance measures.

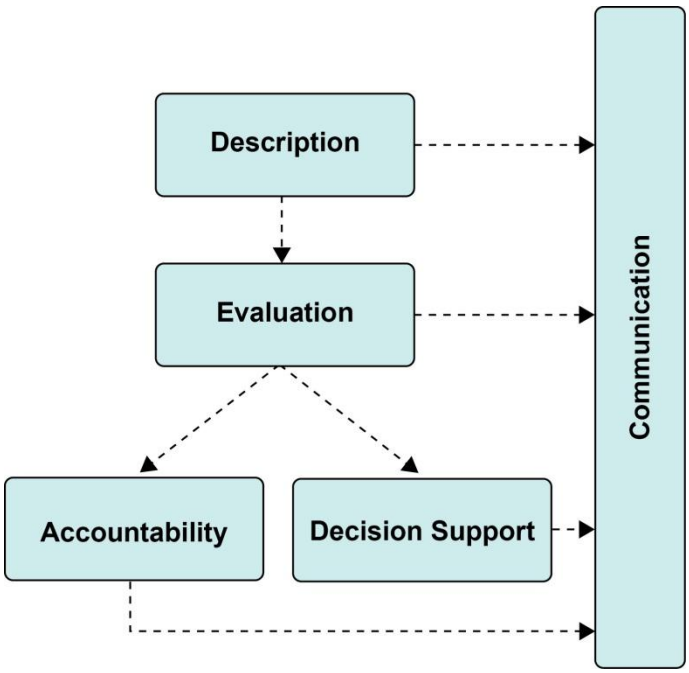

Figure 3. Relationship between Application Types.

A “Checklist” for Sustainability

One of the shortcomings of breaking down the application of sustainability into various measures for specific focus areas is the potential for weakening the integrated and holistic sustainability focus. A “checklist” was developed (Zietsman et al, 2011) to help agencies evaluate the SPM framework as applied and to make refinements and provide feedback. The Yes/No questions in the checklist provide a self-assessment tool that will identify any areas that may need further work or follow-up. The checklist can be used to evaluate the final outcomes and ensure that the set of measures give a valid and complete picture of an agency’s sustainability progress.

APPLICABILITY TO THE SOUTH AFRICAN CONTEXT

While this guidebook was developed for use by transportation agencies in the USA, it has broad applicability in the context of developing nations such as South Africa. The critical transportation issues facing South Africa today include road safety, pollution/air quality, equity/accessibility issues and traffic congestion. All of these aspects are addressed in the goals and performance measures listed in the guidebook, and will provide a useful resource to transportation agencies in developing nations. There has been recent research on sustainability indicators, mostly in Cape Town, for general sustainability indicators as well as more specifically for transportation, see Jennings (2008), Kane (2010), and Swilling (2006). One of the coauthors of this paper has also previously published a report contrasting the use of sustainability indicators for transportation corridors between South Africa and the USA (Zietsman, Rilett, and Kim, 2003), where a major finding was that the goals and performance measures were translatable between different contexts, even if the data used for the performance measures differed. The local priorities assigned to various goals also varied, though the sustainability application framework was similar. The findings from the research are therefore highly applicable to the South African context, and will serve to supplement the ongoing and existing work in this field.

CONCLUDING REMARKS

This paper describes a sustainability user’s guide that outlines a practical approach to the application of performance measurement for sustainability. This was undertaken as part of a research project that developed guidance for state DOTs and other transportation agencies to understand and apply concepts of sustainability through performance measurement. The purpose was to develop a guide that is flexible and can be used by a range of transportation agencies for specific contexts. A generally applicable framework was developed to provide transportation agencies with the tools required to apply sustainability through performance measurement. A key feature of this framework is that it promotes the holistic consideration of transportation and sustainability. The framework defines transportation goals that can be broken down into a menu of objectives and performance measures to cover various transportation contexts. The application of sustainability performance measures for a range of application types—to describe, evaluate, support decisions, promote accountability, or communicate—was also discussed. The research also identified examples, tools, and approaches to applying sustainability. This research equips transportation agencies with background information on sustainability in the context of transportation, and the information and resources needed to successfully tailor and implement a sustainability performance measurement system.

ACKNOWLEDGMENTS
The authors wish to thank, Lori Sundstrom, Senior Program Officer, NCHRP, and all members of the NCHRP project panel (chaired by Wayne Kober) for their guidance and input. We also wish to thank the following members of the research team for their contributions: Henrik Gudmundsson, Ralph Hall, Greg Marsden, Brian Bochner, Joe Crossett, Hugh Louch, Steve Muench, Chris Porter, and Sam Seskin.

REFERENCES

Cambridge Systematics (2000) *A Guidebook for Performance-Based Transportation Planning.* NCHRP 446, Transportation Research Board, Washington, D.C., 2000.

Cambridge Systematics, Inc. (2006) *Task 47: Effective Organization of Performance Measurement.* NCHRP 08-36, Transportation Research Board, Washington, D.C., 2006.

Hall, R. P. (2006) "Understanding and Applying the Concept of Sustainable Development to Transportation Planning and Decision-Making in the U.S." Ph.D. Dissertation, MIT, 2006.

Jennings, L. (2008) *A Pernership Toward Sustainable Transport: The Urban TRAN:SIT Model,* Proceedings of the South African Transport Conference. http://137.215.9.22/bitstream/handle/2263/6150/Jennings.pdf?sequence=1

Jeon, C. and A. Amekudzi. (2005) Addressing Sustainability in Transportation Systems: Definitions, Indicators, and Metrics*. Journal of Infrastructure Systems*, ASCE, March 2005. pp. 31-50.

Kane, L., (2010) Sustainable Transportation Indicators for Cape Town, South Africa.:Advocacy, negotiation and partnership in transport planning practice. *Natural Resources Forum, Volume 34, Issue 4 .*

Kelly, C. (2009) *Origins of Sustainability*. Report for Task 1.1, Appraisal of Sustainability Project Report, Institute for Transport Studies, University of Leeds, Leeds, UK. Working Paper. http://www.its.leeds.ac.uk/projects/sustainability/project_outputs.htm

Litman, T. (2009) *Well-Measured—Developing Indicators for Comprehensive and Sustainable Transport Planning*. Victoria Transport Policy Institute, Victoria, British Columbia, Canada, 2009.

Swilling, M. Sustainability and infrastructure planning in South Africa: a Cape Town case study. *Environment & Urbanization* Vol 18(1) pp 23–50

Ramani, T., J. Zietsman, W.L. Eisele, D. Rosa, D.L. Spillane, B.S. Bochner (2009). *Developing Sustainable Performance Measures for TxDOT's Strategic Plan: Technical Report*. 0-5541-1. Texas Transportation Institute, College Station, TX. April 2009.

WCED (1987), U.N. World Commission on Environment and Development. *Our Common Future: Report of the World Commission on Environment and Development* (A/42/427). 4 August 1987.

Zietsman, J., T.L.Ramani, J.Potter, V.Reeder, J, DeFlorio (2011), *A Guidebook for Sustainability Performance Measurement for Transportation Agencies,* NCHRP Report 708, National Cooperative Highway Research Program, November 2011.

Zietsman,J., T.L.Ramani,(2011) *Sustainability Performance Measures for State DOTs and Other Transportation Agencies – Contractor's Final Report,* Prepared for the National Cooperative Highway Research Program, July 2011.

Zietsman, J., L.R.Rilett, and S. Kim (2003) Sustainable Transportation Performance Measures For Developing Communities South West Region University Transportation Center Report, SWUTC/03/167128-1