Transportation Association of Canada

# Best Practices for the Technical Delivery of Long-Term Planning Studies in Canada

## Final Report

October 2008

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# EXECUTIVE SUMMARY

## A. Introduction

The Transportation Association of Canada (TAC), along with a number of sponsors, commissioned iTRANS Consulting Inc. to conduct the research project, *Best Practices for Technical Delivery of Long-Term Transportation Planning Studies in Canada*. This report describes the findings of the research. The research focused on the analytical tools and associated data that support long-term transportation planning practices of small- and medium-sized communities in Canada. The resultant report is intended to be a guide for municipalities having between 10,000 and 250,000 residents, although – as can be seen from the ensuing text – the results clearly are equally applicable to larger communities; and much of the research in best practices reflects these larger communities. In addition, it is important to note that the research has considered two types of small- and medium-sized communities: self-standing communities, and those that are part of a larger urban region. This is important, because the needs of the two types may differ. The research drew from the literature of best practices in Canada, the United States and overseas; and from an internet survey of Canadian government and municipal agencies.

The consultant completed this research under the guidance of the Project Steering Committee (PSC), comprised of municipal, regional and provincial governments from across Canada.

## B. The Process of Transportation Planning

### Building a Long-term Transportation Planning Study Framework

For the purposes of this study, a long-term transportation plan is a document that identifies the needs for transportation infrastructure, services or programmes for an urban area, commonly over a horizon of 10+ years or even longer. The document identifies priorities and costs magnitude, and typically is the product of an estimation of forecasted traffic or travel, the identification of resultant shortfalls in transportation capacity or services, the generation of alternate scenarios to meet these needs, and the selection of a recommended plan according to an established set of evaluation criteria. The document may be based upon a statement of some desired future condition (vision), and typically is linked with other community attributes and goals (e.g., sustainability, affordability, quality of life or economic development). The document may serve as a guideline, or it may become a legally-binding policy if it is adopted by the relevant authority.

There are a number of long-term transportation plan types that a community should consider in building a transportation planning framework. The major plans cited in this report are:

- Transportation master plans or strategies, including bicycle and pedestrian transportation master plans
- Sub-area or neighbourhood transportation plans

- Corridor planning studies
- Transportation capital programmes / budgets
- Development charge studies
- Transit service or operational plans
- Policy or research / background studies (e.g. funding)
- Travel demand management studies
- Air quality / congestion management studies
- Freight / goods movement plans or strategies
- Environmental assessment studies

Some of these types are triggered by regulatory requirements. Others are initiated to meet a specific identified need. Functionally the different study types are related. Moreover, some communities may link their planning studies via a top-down process, while others may use a bottom-up procedure.

A top-down approach might start with a community plan and TMP, then proceed to implementation studies and, according to priorities agreed through the TMP process, to specific area or facility studies. Special studies, such as a pricing policy, might be developed to support the TMP.

A bottom-up approach might start with a corridor planning study. That study might result in an environmental assessment but under this organizational scheme, the likely need also to address capital budgeting in turn would identify the need for a coordinating, big-picture statement; that is, for a TMP.

### Making Choices and Setting and Measuring Goals: Performance Indicators, Evaluation Measures, and Prioritization Strategies

Performance indicators and evaluation measures work together to give municipalities tools to evaluate the system and identify preferred options, as well as to communicate progress and choices to the public. As described in the introductory chapter, performance indicators describe an attribute of a transportation system’s performance while an evaluation measure is the means used to quantify or qualify the indicator and provide an assessment of that attribute. Communities must develop a system of indicators and evaluation measures that are consistent with their goals, while being measurable and understandable by the public and politicians.

## C. Best Practices in Application of Transportation Planning Tools

As a context to the survey, the study described demand forecasting methods. The description focused on the components of the four-stage model and how they work together, while also outlining other forecasting methods such as activity-based modelling and trends analysis. It summarized the responses to the survey in the area of forecasting methods and tools, describing how approaches to modelling, from the decision whether or not to use a model to the modes looked at and the tools used to simulate them, varies by size and type of municipality or organization. The study also described the challenges and opportunities that surveyed small- and medium-sized municipalities are experiencing or have experienced in attempting to carry out these methods. It also presented a comparative inventory of the commonly used travel demand and micro-simulation modelling tools.

Small- and medium-sized municipalities often have well-developed models or in the case of the smallest (less than 50,000) access to such models; however, they are very limited in simulation of any modes beyond private vehicles and constrained by lack of resources, funding and expertise. There is an identifiable difference between the small municipalities and those "medium-sized" examples between 50,000 and 250,000 in terms of model ownership and software use, although there is less difference in the variety of modes modelled. In the software selection field, EMME (a Canadian travel demand forecasting software) and Synchro (a traffic operations software) are the clear favourites at present, a choice that transcends organization type and size.

## D. Best Practice in Transportation Planning Data Methods

The availability of good, recent data for long-term transportation planning is a significant concern for many of the organizations surveyed. The collection of 'basic' data among respondents of all types generally is pervasive: specifically, road inventory data, traffic counts and demographic data. Other data are commonly collected, such as travel surveys; however, the method and coverage vary by organization type. Sources of data from which a community can draw in the absence of its own data, or from which it can 'transfer' relationships developed by others, are limited by the general absence of large-scale transportation planning databases at the provincial / territorial or national levels. This is in contrast to the United States, where such databases exist and are used for these purposes.

Many respondents noted that data collection is expensive. Some communities are making use of new storage and organization systems, such as GIS, although many feel that they have further to go in effectively implementing these systems. More information regarding trip origin-destination and household travel behaviour would help many organizations. The ability of data collection programmes to meet transportation planning needs varies significantly for each community; however, another observation is applicable to all organizations involved in transportation planning: "… the more data we have, the better the planning we can do." Because of this, the challenges and opportunities facing data collection have wide-ranging implications for all transportation planning applications.

## E. Partnerships and Data Sharing

Transportation data and models are valuable corporate assets that are developed and applied and at a considerable cost. As a 'corporate asset', the value of the data and tools can be enhanced by maximizing their application to other functions, both vertically within the realm of transportation engineering and planning, and horizontally among other planning functions. Both apply to functions within the same organization and among organizations.

Survey respondents confirmed that the data are used vertically for a broad range of transportation applications (including site development, safety and operations), and also horizontally for economic development and planning. The data also are used for performance measures and monitoring, and to address energy concerns. The growing application of public-private partnerships in the delivery of infrastructure and service provides both new opportunities for using these data, as well as challenges in ensuring that changed data needs can be met.

Collaboration and partnership in model development and data collection is a valuable tool for small- and medium-sized communities with limited resources. Opportunities for collaboration exist with regional and provincial bodies, other municipalities, and outside agents and consultants. Each type of partnership has advantages and disadvantages and small- and medium-sized communities should explore these relationships to find the ones that are most advantageous to all parties.

## F. Preparedness for the Future

Survey respondents were asked to comment on how well their analytical tools and data met their needs. Several recurrent needs were apparent, as listed below:

- Staff resources: A lack of staff experienced in modelling and data, need for more training, insufficient staff complement.
- The importance of good data was recognized.
- Need for data sharing and cooperation between different levels of government (to build up data and minimize/share costs)
- Need for appropriate tools and data to account for the increasing importance of alternate modes.
- Lack of funding, or need for sustained funding.
- Need for political and community support for data and modelling initiatives.
- Need for an overall transportation planning strategy with regular updates and regular, complete data collection.

Ways of addressing three emerging topics were identified: these are environmental concerns (including Climate Change), public transit and emerging funding sources.

Finally, TAC was identified as having a potential role in technology transfer and support, related to research and to broadening the knowledge-base in these topics.

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# 1. INTRODUCTION

The Transportation Association of Canada (TAC), along with a number of sponsors, commissioned iTRANS Consulting Inc. to conduct the research project, *Best Practices for Technical Delivery of Long-Term Transportation Planning Studies in Canada*. This report describes the findings of the research. The research focused on the analytical tools and associated data that support long-term transportation planning practices of small- and medium-sized communities in Canada. The resultant report is intended to be a guide for municipalities having between 10,000 and 250,000 residents, although – as can be seen from the ensuing text – the results clearly are equally applicable to larger communities; and much of the research in best practices reflects these larger communities. In addition, it is important to note that the research has considered two types of small- and medium-sized communities: self-standing communities, and those that are part of a larger urban region. This is important, because the needs of the two types may differ.

The guidelines also address two best practice themes; namely, applied innovation and proven, successful practice. These themes are addressed throughout the body of the report.

This document creates opportunities for TAC, regional or provincial planning authorities, individual municipalities and other agencies to address these needs and provide for better local transportation planning. Through these, the guidelines have three main applications:

1. A reference book of available transportation methods, tools and data
2. A benchmarking tool for what the current practices are across Canada
3. A summary of needs that organizations have the opportunity to address

The consultant completed this research under the guidance of the Project Steering Committee (PSC), comprised of municipal, regional and provincial governments from across Canada. The research drew from the literature of best practices in Canada, the United States and overseas; and from an internet survey of Canadian government and municipal agencies.

The remainder of this introductory chapter describes the project background, the study purpose and scope, and the study method. An outline of the survey of practitioners follows. Finally, Chapter 1 closes with a description of the organization of the remainder of the report, acknowledgements, a disclaimer, and definitions of key terms.

## 1.1 Why Is This Important?

Canada contains many different types and structures of communities, in sizes ranging from very small villages to large metropolises. These communities can be independent, charged with their own transportation planning; or they can be part of larger regions with whose governments they manage some or all transportation planning activities. These two types of communities, and the range of the transportation and planning issues they face today, are exemplified in the four sidebars below.

### 1. Changing Communities, Complex Needs

"… the city is undergoing very different changes. Many of the new towns that flourished in the Industrial Revolution and the manufacturing era that followed have been losing population…. Some cities retain their role as administrative centres, by virtue of their political status. Some are still trading hubs, by virtue of their geographical position. Some endure, simply because they have reached an equilibrium. But others struggle. … Some of what the city provided (shops, factories) can now be offered in suburban malls or industrial parks – or in low-cost urban rivals in the developing world…. Technology, which has usually favoured urban progress, now enables people to work in rural bliss on home computers. No wonder so many cities find that in order to flourish they have to reinvent themselves. … Planning is needed if infrastructure is to work, the local economy is to fit in with the regional and national economies and if health, education and other social policies are to be suitable for the people they must serve." (Grimond, J., 2007)

### 2. "Growing Up, Not Out"

The City of Kelowna is a fast-growing community in British Columbia's Okanagan region. This medium-sized city of 107,000 residents[1] is known for its recreational amenities and attractive climate, and is a commercial hub for the region. Kelowna is revising its Official Community (land use) Plan to 2030. Kelowna is centred in the Regional District of Central Okanagan, which had a 2006 population of 162,000. The plan, entitled "Greening our future," promotes sustainable development, preservation of the City's natural environment, reduction of gridlock and economic growth. A key issue is the accommodation of expected new growth: By 2030, the City's population is projected to grow to 158,000 (48% over 2006) and the Regional District to 233,000 (44%).[2] To this end, densification is proposed in the city's core and at three other nodes. The concurrent Comprehensive Development Zone plan for downtown Kelowna envisions 13 high-rise structures, some up to 30 storeys high, in a four-block area.[3] At the same time, a citizen's group has expressed concern with the impact that a high-density core would have on the city's "character" and proposes instead the control of growth by limiting the number of planning permits given to developers. (Atkinson, C, 2007)

### 3. Amenity Migrants

"Amenity migration is broadly defined as the movement of people to places they find attractive for non-economic reasons… the motives [include]: superior natural environment;
economic gain (in-migration corresponds with economic growth in local and regional economic activity); leisure and learning (spiritual and personal growth through a return to nature); and urban life abandonment (seeking quality-of-life experience through a renewed sense of place).

"There is a growing migration to mountain areas for the remaining concentrations of our planet's distinct natural environments and cultures. … left unplanned, it has the potential to threaten mountain ecologies and their human communities. [there is a] growing number of affluent baby boomers seeking permanent or recreational residency in our amenity-rich regions. … For planners working of for the good of the community, creating a balance between economic prosperity and environmental protection can be a daunting tasks, but is key to successfully planning for and accommodating amenity migrants." (Wallace, D., 2008)

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1 See 2006 Census of Canada (http://www12.statcan.ca/english/census06/release/release_popdwell.cfm)

2 See www.kelowna2030.ca

3 http://www.kelowna.ca/CM/Page1280.aspx

### 4. The City Between: Micropoli, Aerotropoli and City-Regions

“Like the economic and communications networks that now dominate our lives, our new cities are now polycentric and ‘multi-nodal’ or ‘fractal’ – bunches of units with patterns repeated on every scale. They look more like land-eating Los Angeles than hemmed-in Hong Kong, with blended centres and peripheries and ragged boundaries between the natural world and built space. Any economic or moral divide between the ‘urban’ commercial, political and social institutions and the ‘suburban’ or ‘rural’ residential world has disappeared and the resulting scatter of areas for living, work and pleasure creates complex and unpredictable traffic patterns.

“[Termed] ‘the city between,’ [these are] areas outside traditional urban centres but not dependent upon them as ‘suburbs,’ ‘edge cities’ and ‘sprawl’ are…. Lebanon [New Hampshire, USA] along with four other… towns [comprise one such area]. With populations of between 10,000 and 49,999 … the towns are socially and economically integrated. Decisions and policies made in one might affect all the others. Residents of Norwich and Lebanon work in Hanover’s Dartmouth College and hospital and everyone shops in Lebanon’s strip malls. In essence, the five towns operate like an exploded traditional city, which residents move across in a variety of ways. “The US Census describes these communities as *“micropolitan”* areas, of which there are now 565 across the country.

*Aerotropoli* “describe the city-like commercial activity and housing that settles around airports.” US examples include Aurora County, Colorado, anchored by Denver International Airport, and Fairfax County, Virginia, with Dulles International Airport – both are among the fastest-growing regions in the US. The area centred about Pearson International Airport has the Greater Toronto Area’s second largest concentration of jobs, after the Toronto CBD. “Aerotropoli are created when the communities surrounding an airport fuse economically and socially, if not administratively, changing the original dependent or satellite relationship with the big city served by the facility. [Residents of these places] commute to their own business parks, shop in their own malls, organise their own police forces and take college courses at their own branches of [the] university.

“In Italy, local activists are pushing for official recognition of and coherent planning for the Veneto *city-region* [Milan-Venice-Trieste]. Most important is improving direct transport links between its three cities since the nearby [expressway] is now paralysed not only by the long-distance traffic for which it was intended by also by local commuting to the famed, small industries scattered through the region, weekenders queuing for access to beaches on the Venetian lagoon and shoppers on their way to the area’s new hypermarkets and multiplexes.

“More often than not, [these new urban entities] straddle municipal, regional and even international borders. This makes traffic and transport unusually difficult to manage and taxes inadequate infrastructure…. Problems afflicting one jurisdiction might originate in another that has neither the interest nor will to solve them.

“… the urban areas where we live today have grown from the bottom up, following neither ideological nor stylistic planning…. An existing road attracts a factory, which needs workers, who settle and need schools and shops, creating employment, institutions and ‘social richness.’ The result gives an unplanned impression but it has arisen out of innumerable and – considered on their own – rational decisions.” (Johnson, M., 2007)

This project focuses on transportation planning for small- and medium-sized communities; that is, communities with populations between 10,000 and 250,000 residents and with all types of planning structures. However, in many cases, either the appropriate analytical tools (models) and data do not exist, or planners are forced to adapt tools and data from other applications. Either way, the specific technical needs of small- and medium-sized communities are not well served: Because of their size, these communities often face different transportation planning challenges - and opportunities - than their larger counterparts must address.

These differences can be grouped into two categories: Demographic and socio-economic conditions; and urban form.

Key **demographic and socio-economic differences** are: (Schutz, J. B. & TRB, 2007) (Yan, S., 1998)

- Household characteristics tend to be more homogeneous. These include household size and income.
- Transit tends to play a smaller role in the transportation system.
- Any single industry or institute can be a significant trip producer or attraction, thus warranting special consideration when modelling travel. Some common Canadian examples are pulp and paper mills, marine ports, military bases, universities or community colleges, hospitals, prisons, regional shopping centres, resorts, and casinos and other special tourist attractions.

At the same time, these characteristics are changing. For example, in the United States, whereas traditionally new immigrants have tended to settle in larger urban areas, there is now evidence of a growing population of immigrants locating in small- and medium-sized communities, as they follow job opportunities in agriculture and resource development. One implication is that once-homogeneous household characteristics are changing, with higher average numbers of occupants and of workers per household, lower average household incomes and lower motorization rates (the latter presenting an additional mobility challenge in smaller communities that have little or no transit service). (Bricka, S., 2004) All of these reflect economic conditions common to lower income immigrants, as well as to domestic migrants, who move from one part of the country to another. No information is available regarding the situation in Canada. However, clearly parallels may be drawn.

Also in the United States, the 1990s saw the reversal of decades of rural population loss, as old and young alike were drawn to rural areas by improved amenities and the "promise of a rural life style." One result was that rural counties remote from large urban areas grew faster than adjacent counties. The latter still grew, as a function of sprawl and the desire of workers to find cheaper housing. (Rosenbloom, S., 2003) One implication is that commuting distances may increase; and these will be dominated by the auto trip. Schutz notes that "quality of life" concerns, such as congestion and the environmental impacts of growth –

concerns that are associated typically with large urban areas – have become significant issues in small- and medium-sized communities as well.(Schutz, J. B. & TRB, 2007) Again, parallels could be drawn to the Canadian situation.

Finally, the aging of the population manifests itself in different ways in smaller communities. Hildebrand et al. note that the elderly who live in rural areas tend to keep their driver's licenses longer than their counterparts in urban areas, due to a lack of transportation alternatives (among other reasons). Consequently, they experience the highest accident rates of any age group. (Hildebrand, E. D., Gordon, M. J., & Hanson, T., 2004) Although the specific reference is to elderly residents of rural areas, the lack of transportation alternatives to, from and within smaller communities could result in similar difficulties. (The authors also note the difficulties in reaching and surveying the rural elderly, in order to capture their specific travel requirements.) (Hildebrand, E. D., Gordon, M. J., & Hanson, T., 2004)

Key **urban form differences** are:

- Smaller communities in larger urban areas are relatively newer, and can have a less structured street network. (Yan, S., 1998)
- Development is occurring at the urban fringe and in rural areas, but often without the supporting infrastructure. As a result, the existing collector / arterial network may not be sufficient to accommodate the impacts of the new development.(Schutz, J. B. & TRB, 2007)
- The reversal of rural population losses in the United States has generated "rural sprawl," as housing and jobs move into or near rural or small urban areas. (Rosenbloom, S., 2003) Moreover, in some parts of Canada, cheaper land values in unincorporated areas just outside towns has resulted in rapid growth of these (unserviced) areas, at the same time that the town is stagnant.

There are also differences in the **delivery of transportation planning services** by or for small- and medium-sized communities. Although communities exist in different contexts and with different relationships to surrounding regional and provincial bodies, most face some combination of the following challenges, as stated by Schutz (Schutz, J. B. & TRB, 2007):

- Lack of resources
- Education for staff and stakeholders
- Communications and information overload
- Technology, both in-house and applications

Yan also notes that small urban area models are expected both to serve long-range transportation planning needs and to assist in short-range traffic operations analysis.(Yan, S.,

1998) In other words, there is a multiple role for the models (and, it follows, the underlying data) for which, in communities with more resources, separate and more appropriate tools would be provided.

The specific reference is to small communities, although these points clearly are applicable to medium-sized communities as well.

Moreover, as the demands of planning change, new funding or regulatory requirements arise and new issues emerge on the public and political agenda, it is important that these communities have the resources they require to meet the transportation needs of their residents. TAC identified a need to provide a guide to best practices for these communities, and this report is the product of the resulting research. The report is targeted at a wide audience, including senior municipal management charged with making planning and budgetary decisions; municipal transportation planners and engineers; consultants; the research community; and implementers of transportation infrastructure and services. While TAC intended for the guide to be technically rigorous – that is, it has a technical focus in modelling, analysis and data for transportation planning - it also has been written to address the broader context.

## 1.2 Study Purpose and Scope

The purpose of the research is to develop a guide of best practices for the *technical* delivery of transportation planning studies in small- to medium-sized communities in Canada. The research was intended to achieve four objectives that had been specified in TAC's Terms of Reference:

1. **Identify common transportation planning studies required by Canadian municipal planning agencies.** These studies identify the applications for which the analytical tools and data are needed. They refer to the types of transportation planning studies that are conducted or that are needed, particularly by (but not necessarily limited to) small- to medium-sized Canadian municipal planning agencies. The studies include transportation master plans, sub-regional / secondary plans, corridor studies and environmental assessment studies, policy studies, and the like. Also taken into account are the role or linkage of these transportation planning studies with other initiatives, including land use plans, financial planning, sustainable development plans (e.g., environmental master plans), environmental preservation (which could include but is not limited to environmental assessments or air quality mitigation), and economic development plans (which, by extension, implies taking multi-modal urban and inter-urban goods movement into account).

   These 'requirements' were identified through a combination of online surveys of Canadian agencies that are involved in municipal transportation planning. These comprised all municipalities having a population of at least 10,000; regional governments or transportation authorities; transit operators that have a mandate for transportation planning in the municipality they serve; and, Provincial / Territorial ministries of transportation, Other information sources comprised follow-up telephone interviews with selected organizations, a review of the applicable legislation, the consultant's experiences in the preparation of such plans, and a review of emerging issues and best practices - such as sustainable transportation – and new funding programmes for urban transportation infrastructure and services.

2. **Identify common and accepted methods for completing such studies, including modelling tools frequently used by Canadian and U.S. municipal planning agencies.** This refers to the associated *technical* requirements for the identified studies – that is, common and accepted analytical methods that are used for these studies in Canada and the United States, with a focus on 'best practices.'

   The United States provides important insight for Canadian practices in four ways.

   a) Several guidelines have been developed over the years for general practice. Two were intended primarily for smaller communities. NCHRP Report 187 (1978) provided "quick response" demand estimation techniques and "transferable parameters" for application in sketch planning and in communities that lacked resources, models or data.(Sosslau, A. B. & et.al., 1978) NCHRP Report 365 (1998) updated the techniques and parameters and, although broadly applicable to communities of all sizes, it was specifically intended for transportation planning in "smaller" communities.(Martin, W & McGuckin, N., 1998) Although these guidelines may no longer represent 'best practice' in all aspects (in that specific topics have been superseded by new research and developments), they continue to be used widely in practice.

   b) There is a growing body of practical research in the United States on transportation planning methods that are specific to small- and medium-sized communities. Some of this research provides useful references that could be applied directly to Canada – for example, the development of travel models for similarly sized communities.

   c) Several national or state-wide data sets are available to transportation planners and researchers. For example, the National Household Travel Survey provides a nation-wide database of travel behaviour. The U.S. literature also provides examples of potential uses or guidelines for applying or transferring these data to communities of different sizes.

   d) The U.S. literature provides examples of case studies and alternate perspectives; that is, as 'bottom-up' initiatives that were designed to address specific needs over and above – or in the absence of - the formal 'top-down,' legislated requirements. This is important because it identifies possible future partners with whom municipalities can share data collection or analytical costs – in addition to providing ways to resonate with the public, local businesses and political decision-makers. For example, many U.S. municipalities and states are addressing Climate Change in the absence of a national framework. They are focusing on bottom-up actions that they can control;

they have linked these to energy conservation and security; and, they have established a contextual connection between Climate Change and long-standing existing efforts in air quality enhancement and congestion mitigation.

These methods were identified through online surveys, follow-up telephone interviews, a literature review of practices and direct contact with specific known 'best practices' organizations in Canada and the United States.

3. **Provide a qualitative and quantitative evaluation of each tool in terms of its applicability to different sized communities, its data collection requirements, its ease of use, its degree of sophistication, its forecasting capabilities; and its history of customer satisfaction.** This refers to the means of evaluating analytical tools and models that could support the identified study needs and technical requirements. For this, the consultant developed a framework that accounted for the technical specifications, as provided by model developers, and for how governments actually used the models (i.e., the 'whats,' 'hows' and 'why's of their experiences). Much of the latter was drawn from an internet survey that was developed specifically for this research.

4. **Identify data collection protocols to support the tools (e.g., frequency and format of data collections, etc.).** This refers to the identification of the components and contents of existing (or required) databases; but also to the data protocols and data platforms that are used.

## 1.3 Study Method

iTRANS conducted two major categories of activities to complete this research: a survey of practitioners and a literature review. Work on these two categories of activities occurred simultaneously and this report presents the resultant information from both. Further information concerning the survey of the practitioners is presented in **Section 1.4**, while information about the literature review and the integration of the two information sources is provided in the following paragraphs.

The literature review began with the collection of relevant documents. iTRANS reviewed key documents provided by TAC and also completed searches for documents from the following internet libraries and reference lists:

- TAC library
- Transportation Research Information Services (TRIS) Database
- Transit Cooperative Research Program (TCRP)
- Victoria Transportation Policy Institute (VTPI)

In addition, the authors consulted practitioners in the field of transportation planning for small and medium-sized communities across North America to gain knowledge of best practices. This included communication with members of the U.S. Transportation Research Board's Committee on *Transportation Planning for Small and Medium-Sized Communities* as well as an email list-serve information request to the U.S. Travel Model Improvement Program (TMIP). These sources provided valuable insights and documents that would not have been accessible in any other way. Further to these sources, the authors consulted the iTRANS library as well as the personal libraries of the project team.

It should be noted that in no case were confidential or proprietary data used or accessed without permission.

This report presents information gathered during the literature review portion of the project unified with the information from the survey of practitioners. Both portions of the project supplied relevant information that is best understood when considered together. Throughout the report, the authors have presented best practices from the literature along with examples and statistics on the same subject from the practitioners' survey.

## 1.4 Survey of Practitioners

The consultant, under the guidance of the PSC, developed an online survey of questions to probe practitioners and glean the most important information about long-term transportation planning. The survey questions addressed a wide range of topics, including information about the practitioner's community, long-term transportation methods, tools and data collection practices, and information about integration with other activities and organizations, as well as other pertinent information. The survey included a number of types of questions, including single response questions, selection of all that apply, and some questions that were qualitative and open ended. In both single- and multiple-choice selection questions throughout the survey, the respondent had the option of utilizing the "other" choice and providing further explanation in the space provided. The final survey text had five distinct sections, which are described below:

1. **Community Profile and Planning Framework**. The survey began by identifying respondents and asking for community information. It first asked respondents to identify themselves, in confidence, in order to allow for possible follow-up in the case that this was needed for clarification or to solicit further information, reports, etc. Following this, Section 1 asked respondents to provide key information about their communities and the type of planning studies they do.

2. **Long-Term Transportation Planning Study Analytical Methods and Tools.** This section asked respondents about technical aspects of transportation studies including evaluation indicators, evaluation measures, and the parameters and structure of any travel demand forecasting models or other analytical methods of estimating future travel demand utilized. The section was divided into three parts. The first section asked about issues and decisions that must be addressed in long-term transportation planning studies.

The second section included questions about information requirements for evaluation and decision-making. Finally, the third section addressed the analytical methods and tools used to supply the required information.

3. **Data Collection Protocols.** This section asked respondents to describe their data collection programs and data storage methods.

4. **Interface With Other Planning Applications.** This section included questions about complementary uses of the transportation planning tools, the results of transportation planning studies, and the application of transportation data.

5. **Lessons Learned.** The survey concluded by asking the respondents to assess how well their existing tools, models and data meet their planning needs. Whereas the preceding four sections were primarily quantitative and factual in nature, this section solicited opinions and qualitative input. This section also included questions about political and public pressure issues, success stories, and the position of TAC in fulfilling the community's needs. Further, this section also included questions designed to determine the needs of practitioners in small- and medium-sized communities in Canada.

The consultant team prepared and refined several drafts of the questionnaire, following feedback received from the PSC, before realizing the final version, as summarized above. The final survey 'script' is presented in **Appendix A**.

*Vovici*, a commercial online survey software that allows users to create and analyze data from surveys, served as the survey platform. A team of testers, including members of the PSC as well as selected external public agencies, reviewed the online survey to suggest further refinement before release. To increase the usability and reduce time commitment for respondents, the project team formulated the survey to branch to questions that were applicable to specific practitioners, omitting irrelevant questions. Respondents could access the online survey in either English or French.

The consultant team distributed the survey to communities as listed on a previously defined contact list. This contact list was created by the consultant and the PSC using Statistics Canada lists of municipalities, TAC member contact information, CUTA member contact information, and contact information gained from the PSC and consultant team members' existing contact databases. The list included communities with populations between 10,000 and 250,000 in all Statistics Canada Census Area (CA) division types. The contact list also included larger communities, including all of Canada's major cities with populations over 250,000. The contact list also took into account those transit authorities that were responsible for municipal transportation planning, or for which no other local contact was available; based on CUTA membership. The final list included representatives from over 400 organizations. **Appendix C** contains the complete contact list, which iTRANS has provided to TAC under separate cover, in spreadsheet format.

All contacts received a link to the online survey, along with information about the project and detailed instructions through email. Contacts received emails written in either English or French, depending on their geographic location. If these emails were undeliverable, the consultant attempted to find a new contact at the organization. Emails were successfully delivered to contacts at approximately 97% of all organizations. Two reminder notices were sent to those contacts who had not yet responded. Further to these emails, TAC sent letters, in either English or French, to all contacts to remind them to complete the survey. Finally, members of the consultant team and the PSC personally contacted a number of the contacts by telephone and email to encourage them to complete the survey.

There were 59 respondents to the survey. These hailed from across Canada at many levels of government and with a wide variety of perspectives on long term transportation planning. The list included municipalities from 10 provinces and territories, including local governments, regional governments and transit authorities, and provincial / territorial governments.

## 1.5 Organization of the Report

This report consists of ten chapters. This structure reflects the available information and it also makes it easy to reference the document. To enhance its accessibility, the document is categorized by topic, with information from the literature review combined with information from the survey practitioners for the given topic. Each chapter first outlines the topic, providing a wide variety of information and concludes with a “Summary and Recommendations” section. This final section contains recommendations for the industry as a whole, as well as a summary of the information found in the chapter. **Chapters 3** through **7** each include a summary of best practices, which outlines the report’s recommended best practices for individual small- and medium-sized communities.

As noted, **Chapter 1: Introduction** includes general information about the background and method of the study, along with other relevant information such as acknowledgements and definitions.

In **Chapter 2: Transportation Planning Context** the authors have included three sub-sections to establish the context of transportation planning. The first sub-section presents the idea of best practices as it applies to this project. This discussion should help readers understand the approach of the authors and better utilize the information contained in this paper. The second sub-section is an introduction to planning in Canada. Because Canada is a large country with diverse planning practices it is useful to understand the similarities and differences in the context in which long-term transportation planning takes place across the country. Finally, the third sub-section introduces the communities that took part in the practitioner’s survey, giving information about their size, and organization type. This final sub-section also includes some basic information about the kind of planning these organizations undertake and the resources they have at their disposal.

The next four chapters present the findings of the literature review and of the practitioners' survey. Each chapter addresses a specific topic. **Chapter 3: The Process of Transportation Planning** describes the types of studies that are applicable to small- and medium-sized communities. These studies determine analytical and data needs, the 'best practices' of which are described respectively in **Chapter 4: Best Practices in Application of Transportation Planning Tools** and **Chapter 5: Best Practice in Transportation Planning Data Methods**. Finally, **Chapter 6: Best Practice For the Interface with Other Planning Applications** addresses linkages of the studies, analytical tools and data with other planning needs.

Political issues and pressures surrounding long-term transportation planning are constantly changing. A range of issues, such as sustainability, budgeting and the environment, has emerged as important concerns for practitioners of long-term transportation planning. In **Chapter 7: Preparedness for the Future** the authors present an overview of these emerging issues, along with explanations of the motivators behind the concerns. The chapter also includes best practices that are on the cutting edge of addressing these topics.

**Chapter 8: Summary** concludes the report. Here, the authors bring together the challenges, opportunities, and conclusions from all preceding sections of the report. This allows for integration of the relevant information and leads to a discussion of possible "next steps." Finally, **Chapter 9: Bibliography** provides a list of sources for further reference.

**Chapter 10: Quick Guide for the Application of Best Practices** is a "stand-alone" guide that summarizes best practices in long-term transportation planning. This guide can be used as a quick reference for practitioners in building their long-term transportation planning framework.

The report is accompanied by three appendices. All are related to the practitioners' survey: **Appendix A** presents the survey questionnaire. **Appendix B** tabulates the survey responses. **Appendix C** lists the contacts and, as noted, is provided separately in spreadsheet format.

## 1.6 Definitions

'Long-term transportation planning' can describe a number of practices, and the associated terms may be understood differently in different contexts. Early in the project, the PSC and the consultant clarified some key terms. iTRANS then provided these definitions to survey respondents and by also including them at this stage of the report, the authors hope to promote understanding and secure consistency in the interpretation of the data. This is important, because some of the terms are often confused: they may be related, but are not interchangeable. Moreover, some terms have more than one definition, depending upon the source and the application. Accordingly, the definitions discussed below focus on the specific needs of this research. This matters, because it impacts the application of the resulting information; as a result, the definitions discussed below focus on the specific perspective and needs of this research; that is, on long-term transportation planning.

- **Long-term Transportation Plan** – A document that identifies the needs for transportation infrastructure, services or programmes for an urban area, commonly over a horizon of 10+ years or even longer. The document identifies priorities and cost magnitude, and typically is the product of an estimation of forecasted traffic or travel, the identification of resultant shortfalls in transportation capacity or services, the generation of alternate scenarios to meet these needs, and the selection of a recommended plan according to an established set of evaluation criteria. The document may be based upon a statement of some desired future condition (vision), and typically is linked with other community attributes and goals (e.g., sustainability, affordability, quality of life or economic development). The document may serve as a guideline, or it may become a legally-binding policy if it is adopted by the relevant authority.

  In the context of this survey, **long-term transportation plans** also can comprise capital programming documents, budgets or policy studies (e.g., for long-term growth plans, or to establish funding policies). They also can include area structure plans, secondary plans, transportation corridor studies, needs assessment studies, environmental assessment studies, etc.

- **Transportation Planning Tool** – Any software, spreadsheets, manuals, or other material that is used to support the transportation planning process

- **Travel Demand Forecasting Model** – A spreadsheet or commercial software that allows for the calculation of the estimated future traffic or travel demand.

- **Sustainable Transportation** – Transportation that reduces resource use, including energy, while still meeting the transportation needs of the current population.

- **Performance Indicators** – describes an attribute of a transportation system's performance – an example might be planning level of service of the transportation system. The indicator is not the same as, but rather should correspond to, an objective or goal (e.g., maintain level of service "C"). It must describe clearly and precisely a desired output or outcome (e.g., 'roadways operating at volume to capacity ratio of 0.85' as opposed to 'acceptable level of service'), and must be usable for documenting and monitoring progress towards the goal. The indicator is intended to enable a common, systematic ranking and comparison among competing projects; therefore, it must be usable for all potential projects or locations to be measured.

- **Evaluation Measure** – is the means used to quantify or qualify the indicator and provides an assessment of that attribute. For example, the variations in volume to capacity ratio during an evaluation period across the network, or the percentage change in the transit modal share during a typical peak hour. The measure can be expressed quantitatively as a percentage, index, rate or some other metric or as a threshold, standard, benchmark or logical value; or it could be a qualitative assessment (e.g. high, medium, low). It should be monitored at regular intervals.

# 2. TRANSPORTATION PLANNING CONTEXT

Canadian municipalities face a variety of transportation planning challenges and operate in many different circumstances, with a wide range of challenges and opportunities. All of these communities must deliver, in some way, a form of long-term planning. The breadth of long-term transportation activities undertaken across Canada is as broad as the range of communities themselves.

As discussed, this report addresses best practices in long-term transportation planning for small- and medium-sized communities by focussing on some key objectives. Before directly examining these objectives, however, it is important to gain an understanding of key topics: a definition of 'best practice' (**Section 2.1**) and the current context of transportation planning in Canada (**Section 2.2**). **Section 2.3** completes the discussion of context with a profile of the communities that responded to the survey.

## 2.1 Principles of Best Practice

"Best Practice" is a term with many possible connotations and implications across a wide variety of fields. In order to ensure that this guide is as useful as possible, it is necessary to provide a definition of the term for the purposes of this report. To accomplish this, the following sections present three topics: the concept of "Best Practice", how the authors determined what to include as best practice, and an outline of how readers should use this best practice guide.

### 2.1.1 Concept of "Best Practice"

The intention of this project, as reflected in the title, is to identify "Best Practices" in long-term transportation planning practices for small- and medium-sized communities. In order to create a document that is valuable and useful to the target audience, first it is necessary to define "Best Practice." This is a necessary but challenging task, as common definitions are wide ranging.

Researchers and writers have used the idea of best practice, and the term itself, across many specializations. An internet search of the term "best practice", led to almost 60,000,000 hits, hinting at its prevalence in the modern lexicon. With a little research, one can find references to best practices across a variety of industries, including sports, health care, project management, and education. The intended meaning, however, is neither obvious nor consistent, and so the authors of this report have included this section in order to define it and ensure the usefulness of the term for the purpose of this report.

Several organizations have attempted to define best practices. The National Guide to Sustainable Municipal Infrastructure, Transport Canada, and the Canadian Urban Transit Association in (Committee for Determination of the State of the Practice in Metropolitan Area Travel Forecasting, 2007) also addressed the concept of Best Practices. This document states that "Best Practices are the best proven methods and technologies for municipal infrastructure planning, design… taking into account economic, environmental and social factors." Michigan State University's Outreach Partnerships Groups defined best practices as "models of service deliveries that have shown some effectiveness in accomplishing desired outcomes." (University Outreach, M. U., 2002)

Using these guidelines and other common understandings of best practices, the authors present two facets of best practices as themes throughout the report. These are:

1. "Applied innovation" – meaning those best practices that the authors considered new and innovative. Anything in this category must have been successfully applied to small- or medium-sized communities. Further to this, some innovative practices that have been applied in larger communities, but with clear potential for application by the intended audience of this paper may also be included.

2. "Practices proven successful" – many small- and medium-sized communities already engage in long-term transportation planning practices. This report presents these practices, providing examples and strategies that have proven track records of success.

Although this definition of best practice may not apply in all cases, it provides the most appropriate strategy for proceeding with these guidelines.

In addition to the best practices described above, the report includes certain applicable methods and applied research from the academic community as well as from the current state of the practices in Canada. The long-term transportation planning needs identified by Canadian small- and medium-sized communities also have been included in the appropriate subject areas.

### 2.1.2 "Best Practice" Evaluation Criteria

With the plethora of information currently available concerning long-term transportation planning, it was necessary to develop criteria that outline which items are essential for inclusion in this best practices document. The authors intended to provide innovative examples of long-term transportation planning methods, tools, and data gathering processing that may be applied, with success, by small- and medium-sized communities in Canada. According to these intentions, the resulting list of criteria is:

1. The practice must be applicable for communities that have populations between 10,000 and 250,000, whether they are part of a region or larger municipality, or independent organizations charged with their own planning.

2. They must fall into one of the two categories described above. That is, the practice must be either an "applied innovation" or evidence must exist that it is a proven and successful practice.

### 2.1.3 How to Use "Best Practice" Guidelines

These guidelines outline practices that municipalities, regions, or other organizations are currently implementing with success. As the authors intended this guide for small- and medium-sized communities in Canada, the majority of the information has come from these communities. Additional practices and information that are applicable for Canadian small- and medium-sized communities from larger and/or international organizations supplement this information.

## 2.2 Context for Transportation Planning in Canada

Long-term transportation planning is driven in large part by legislation and planning requirements. However, each province and territory has different legislation governing these planning activities, as well as different nomenclature for similar groups of activities. Accordingly, in order to understand transportation planning practices in communities across Canada, it is necessary first to examine the types of land use planning activities, as well as the different terms that are used across the country.

Gordon and Elliot outline nine categories of planning terms (Gordon, D. L. & Elliot, T, 2007). Their review focuses largely on land use planning, but understanding these terms is essential to transportation planning. For the most part, no specific legislation governs municipal transportation planning and so it typically falls under the umbrella of land use planning legislation. It is, therefore, necessary to understand the land use planning context in order to understand transportation planning. In addition, their categories and corresponding table of nomenclature exemplify the types of differences that exist between provinces and territories. The nine categories of planning terms, according to Gordon and Elliot are (Gordon, D. L. & Elliot, T, 2007):

1. Provincial [Territorial] Planning Legislation: The provincial [territorial] act that governs the majority of land use planning activities.

2. Plan/Zoning Appeal Body: The administrative body charged with reviewing municipal planning decisions.

3. Regional Plan: A plan that addresses a large area, typically including more than one municipality. These plans may be advisory in nature or may not be required.

4. Municipal Land Use Plan: A comprehensive land use plan specific to one municipality. Plan naming may vary by municipality, but an approximate outline of the contents is normally defined in enabling legislation, with additional guidance in supporting provincial or territorial policies, in some cases.

5. District Plans: Detailed land use guidance for sub-areas within the municipality. These types of plans respond to the fact that some municipalities may be too large to provide

detailed guidance in their municipal plan. The content, status, and approval process for district plans varies across municipalities.

6. Street and Block Layout: These plans often have no legislative authority, but provide a layout of streets and blocks. They can provide a range of levels of detail, from general policies to a detailed plan of subdivision, for every parcel of land.

7. Land Subdivision: Plans for control and approval of subdividing land. These are required by all jurisdictions.

8. Zoning Bylaws: Regulate the use of property and the form of buildings.

9. Site Plan Review: A process for the review and approval of detailed site plans. The content of these plans may vary, but all jurisdictions allow municipalities to process these plans in some form.

**Exhibit 2-1**Error! Reference source not found. below is taken from (Gordon, D. L. & Elliot, T, 2007) and presents the naming systems in each province and territory for the land use planning categories described above. It should be noted that conventions and legislation continue to evolve: since the source article was published in spring 2007, regulations in British Columbia and Saskatchewan have been updated. (**Exhibit 2-1**Error! Reference source not found. incorporates these updates.[4])

## 2.3 Profile of Survey Respondents

As noted, the 59 respondents to the practitioner survey comprised municipalities from 10 provinces and territories, plus local governments, regional governments, and transit authorities, and provincial / territorial governments. The results presented in this report reflect the organizations' self-definition of organizational type. Statistics Canada's 2006 *Census of Canada* and other organizations may identify government entities in different ways, and so it is important to understand how the jurisdiction is perceived internally – i.e., functionally from the perspective of transportation planning as opposed to a legal, political or statistical definition. For this reason, the authors have chosen to present the survey respondents based on their self-defined organization types.

The respondents also included communities of many sizes, with the smallest having a self-reported population of just under 9,000 residents and the largest local government respondent reporting a population of approximately 800,000 residents. For the purposes of reporting, it is advantageous to consider the responding organizations based on both their organization type as well as their size.

4 The authors of the original article will update the chart regularly. The latest version of the chart, which is incorporated in Error! Reference source not found., may be found in the Planning Legislation section at www.PlanningCanadianCommunities.ca. Error! Reference source not found. is current as of April 2008.

**Exhibit 2-1: Provincial and Territorial Planning Nomenclature (Gordon, D. L. & Elliot, T, 2007)**

| Level of Detail | British Columbia | Alberta | Saskatchewan | Manitoba | Ontario | Quebec | New Brunswick | Prince Edward Island | Nova Scotia | Newfoundland & Labrador | Yukon | Northwest Territories | Nunavut |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Provincial planning legislation | *Local Government Act / Vancouver Charter* | *Municipal Government Act* | *Planning and Development Act* | *Planning Act* | *Planning Act* | *Land Use Planning and Development Act (Loi sur l'aménagement et l'urbanisme)* | *Community Planning Act* | *Planning Act* | *Municipal Government Act* | *Urban and Rural Planning Act* | *Municipal Act and Area Development Act* | *Planning Act* | *Planning Act* |
| Plan/Zoning Appeal body | No plan appeal tribunal | Subdivision and Development Appeal Boards (local) | Development Appeals Board (local) and Saskatchewan Municipal Board | Manitoba Municipal Board | Ontario Municipal Board | Commission municipale du Québec | Assessment and Planning Appeal Board | Island Regulatory and Appeals Commission | Nova Scotia Utility and Review Board | Four district appeal boards | Yukon Municipal Board | Development Appeal Boards (local) | Development Appeal Boards (local) |
| Regional Plan | Regional Growth Strategy | Intermunicipal Development Plan | District Development Plan | Regional Strategy | Upper Tier Plan / Joint Planning Areas | Land Use Planning and Development Plan (Schéma d'aménagement et de développement) | Regional Development Plan | Regional Plan | Regional Municipal Land Use Strategy | Regional Plan/ Joint Municipal Plan | Regional Land Use Plan | Regional Land Use Plan | Regional Land Use Plan |
| Municipal land use plan | Official Community Plan | Municipal Development Plan | Official Community Plan | Development Plan | Official Plan | Planning Programme (Plan d'urbanisme) | Municipal Plans | Official Plan | Municipal Planning Strategy | Municipal Plan | Official Community Plan/ Local Area Plans | General Plan | Community Plan/ General Plan |
| District plan | Area Development Plan/ Comprehensive Development District (e.g. Vancouver) | Area Structure Plan/Area Redevelopment Plan | Local Area Plan | Secondary Plan/ Re-development Plan (e.g. Winnipeg) | Secondary Plan | Special Planning Programme (Programme particulier d'urbanisme) | Development Scheme/ Area Plan | No data | Secondary Planning Strategy | Development Scheme/ Comprehensive Development Area Plan | Area Development Scheme | Development Scheme | Development Scheme |
| Street and block layout | Neighbourhood Plan | Outline Plan | Plans of Survey | Secondary Plan | Tertiary Plan | Special Planning Programme (Programme particulier d'urbanisme) | Tentative/ Subdivision Plan | Proposed Subdivision | Subdivision Regulations | No data | Proposed Subdivision | Proposed Subdivision | Plan of Subdivision |
| Land subdivision | Preliminary Proposal/Plan of Subdivision | Proposed Plan/Plan of Subdivision | Proposed Plan/Plan of Subdivision/ Plans of Survey | Proposed / Registered Plan of Subdivision | Draft/ Registered Plan of Subdivision | Subdivision By-Law (Règlement de lotissement) | Tentative/ Final Plan of Subdivision | Preliminary/ Final Subdivision Plan | Tentative/ Final Subdivision Plan | Subdivision Regulations | Preliminary Plan/ Proposed Subdivision | Proposed Subdivision/ Plan of Subdivision | Plan of Subdivision/ Plan of Survey |
| Zoning | Zoning By-Law | Land Use By-Law | Zoning By-Law | Zoning By-Law/ | Zoning By-Law | Zoning By-Law (Règlement de zonage) | Zoning By-Law | Zoning and Development By-Law | Land Use/ Zoning Bylaw | Land Use Zoning Regulations | Zoning By-Law and Area Development Regulations | Zoning By-Law | Zoning By-Law |
| Site plan review | Development Permit | Development Permit | Development Standards Site Plan Control Architectural Controls | Development Permit | Site Plan Control | Site Planning and Architectural Integration Programme (Plan d'implantation et d'intégration architecturale) | Development Permit/ Final Subdivision Plan | Development Permit | Site Plan Approval/ Development Permit | Development Permit | Development Permit | Development Permit | Development Permit |

iTRANS divided communities that described themselves as local governments into four groups based on population, as follows:

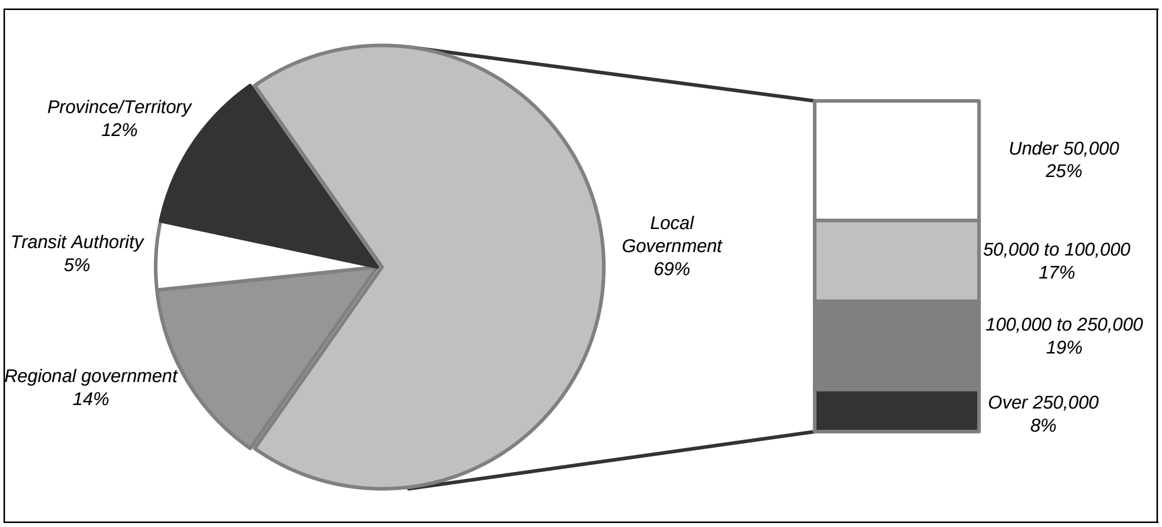
- Under 50,000
- 50,000 to 100,000
- 100,0000 to 250,000
- Over 250,000

Like the organization type, these values are survey response values; the authors of this report have not derived them from Statistics Canada or other legal or statistical categorizations. The first three groups represent the target audience of this study; they are small- and medium-sized communities. Ten percent of this target audience responded to the survey. The fourth group includes larger communities. Although these communities are not the major focus of this study; as noted, their best practices and lessons learned can provide valuable, transferable information for small- and medium-sized communities.

**Exhibit 2-2** shows the distribution of respondents by organization type. It can be seen that local governments comprised over 2/3 (69%) of the respondents. Of these, the side bar shows a reasonable representation among the four population categories; with the 'under 50,000' group representing 25% and the 'over 250,000' representing 8%. It should be noted that these divisions are used throughout this report, although in some cases it is advantageous to group two or more categories of respondents.

The remaining 31% of respondents are distributed among provincial / territorial governments (12%), regional governments (14%) and transit authorities (5%).

**Exhibit 2-2: Respondents by Organization Type and Population**




The community profile portion of the survey resulted in valuable information about the types of communities that responded to the survey and about the range of community structures, budgets, and activity types across the country. **Exhibit 2-3** demonstrates the range of capital works budgets per capita, with reported high values of over $1,500 per capita for one province or territory and over $1,100 for one local government.

**Exhibit 2-3** also demonstrates the relationship between population and capital budget per capita. Although there is a great deal of variation within every respondent group, the greatest range exists within the local government with less than 50,000 residents. In fact, some of the smallest communities show the highest capital budgets per capita. This observation suggests that factors other than tax base influence capital works budgets and that some small communities have a greater portion of their revenue available for capital investment than other types of communities. The observation also may suggest a fixed capital works burden that is independent of community size: two data points in the figure that reflect null budgets are for regional authorities that may not invest directly in physical capital.

**Exhibit 2-3: Capital Works Budget per Capita**

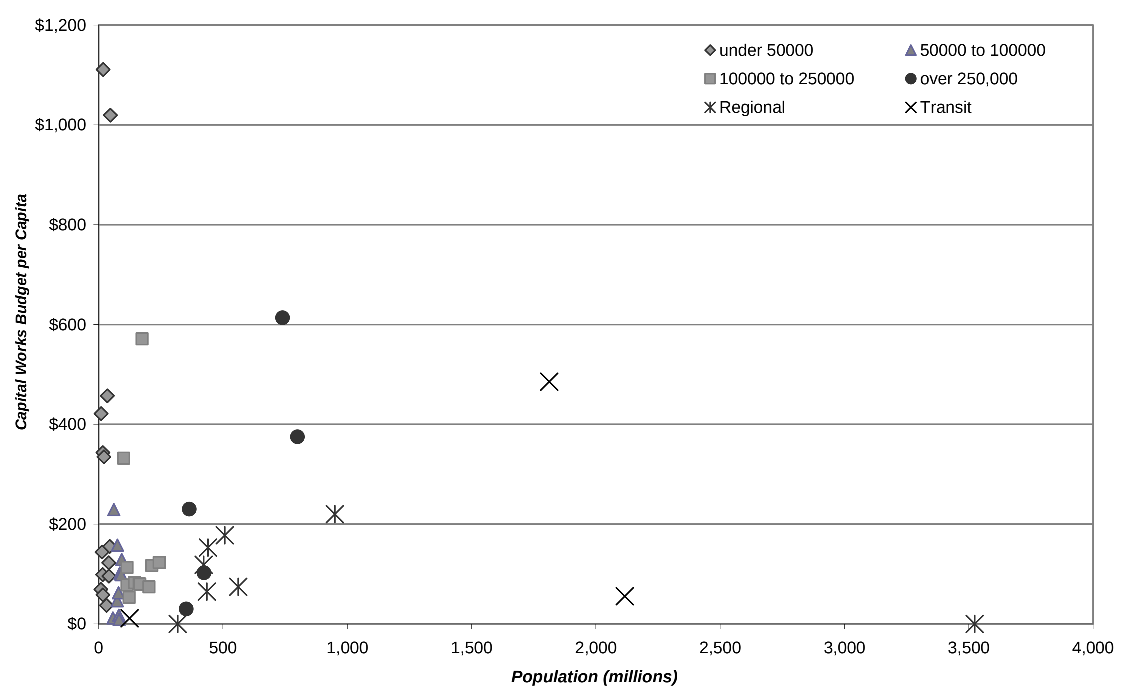
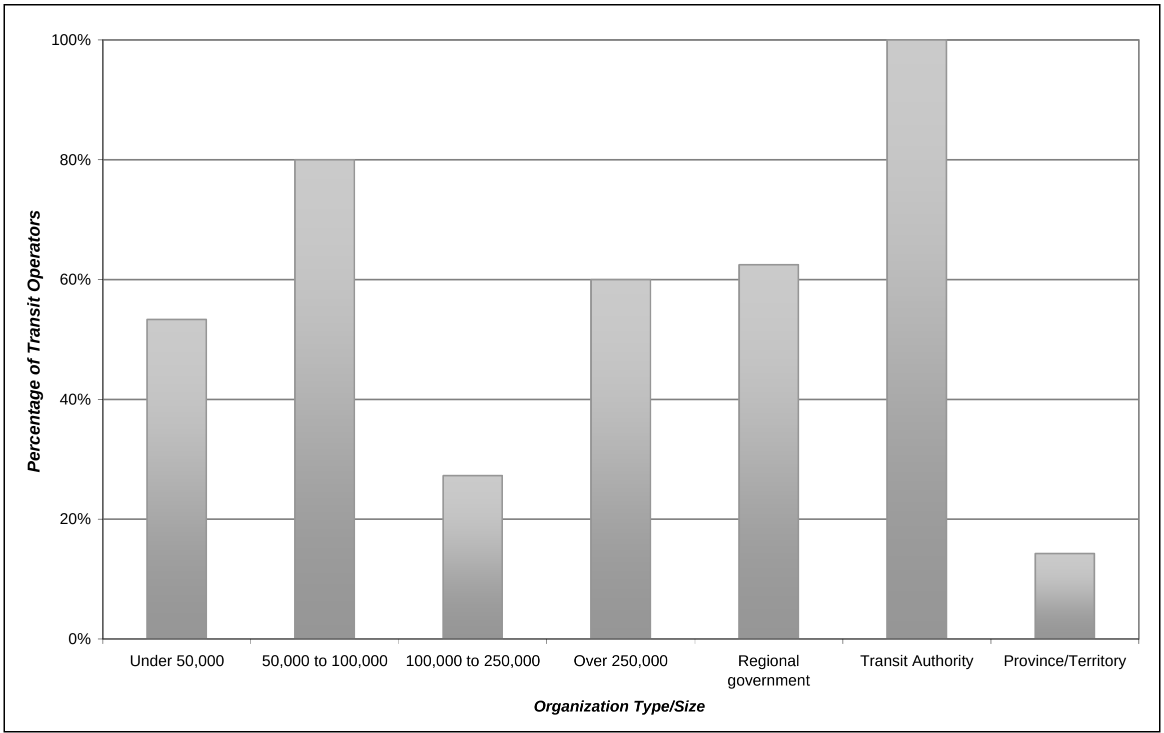



**Exhibit 2-4** describes the proportion of respondents that operate transit, by type of organization. Just over half (53%) of all respondents operated a transit system: of interest, communities of all sizes - including small communities - were recorded as operators, albeit to different degrees (and there was no consistency by size). On the other hand, this finding is somewhat skewed, since all respondents in the transit authorities category operate transit systems by definition; and transit service in some medium-sized communities is operated by other authorities at a regional scale. Very few provincial / territorial organizations operate transit directly, with only one in seven answering affirmatively.

**Exhibit 2-5** examines the difference in capital budget per capita between communities that operate transit and those that do not. When capital works values for each group are converted to a percentile scale, the per-capita values for organizations that do not operate transit are consistently higher than those for organizations that do operate transit; although the values may also reflect the size of community.

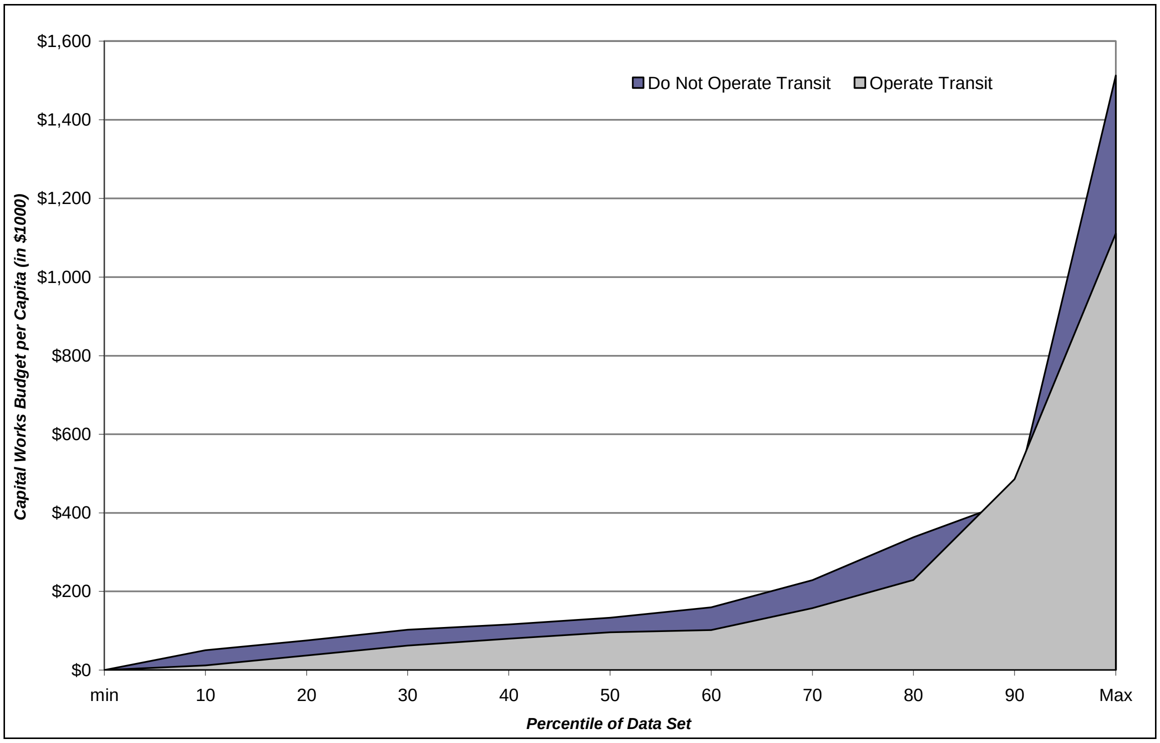
**Exhibit 2-4: Proportion of Transit Operators**



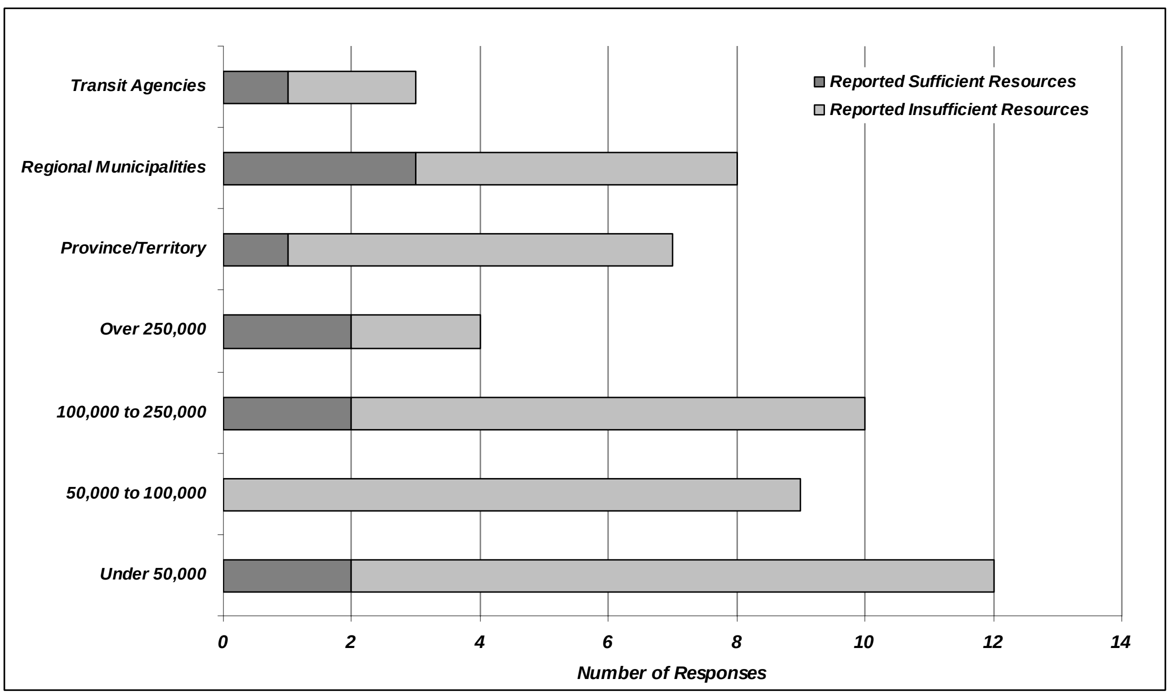

Another important aspect of this study is the investigation of the type of work that these communities are undertaking and the resources they have to complete this work and meet the needs of their communities. While **Section 3.2** discusses the types of studies conducted by the respondents and **Section 6.1.1** considers funding sources for these studies, the community profile presented here reports the number and training of planning staff in these communities.

The survey found that the large majority (79%) of respondents reported that their in-house resources are insufficient to meet their current or emerging needs.
**Exhibit** 2-6 shows the distribution of respondents reporting sufficient and insufficient in-house resources to meet their current and emerging needs by type and size. It can be seen that in any category, at best only a small number (small minority) of organizations reports a sufficiency of in-house resources.

## Exhibit 2-5: Transit and Non-Transit Operators by Capital Works Budget per Capita




## Exhibit 2-6: Report of Sufficient / Insufficient Resources by Organization Type and Size



The comments portion of the survey identified similar problems. Many respondents cited problems with limited resources. For many municipalities' staff there is a limited number of experienced staff (or none at all) dedicated to transportation planning. In some cases, growth is outpacing resources and organizations cannot find the staff or consultants required to complete the work. Many municipalities cited funding levels as an issue.

# 3. THE PROCESS OF TRANSPORTATION PLANNING

This chapter presents the types of transportation plans that are used by and are applicable to small- and medium-sized communities. **Section 3.1** provides a context for the topic. **Section 3.2** lists and describes the types of studies that comprise long-term transportation planning. **Section 3.3** organizes these studies into a functional hierarchy, and **Section 3.4** considers the process of conducting transportation plans for small- and medium-sized communities. **Section 3.5** describes indicators and evaluation measures that allow planners to assess options and monitor improvements; and **Section 3.6** illustrates these with examples. **Section 3.7** discusses prioritization strategies, followed by a discussion of challenges and opportunities faced by small- and medium-sized communities. **Section 3.8** summarizes this chapter.

The discussion of transportation planning types is important, because analytical and data requirements – the focus of this research - may vary by study type. This chapter finds that there are many types of transportation planning studies. These may or may not be linked to each other, in that a given study type may be required by law in one community and determined by need in another. A single legal or procedural hierarchy does not exist – in contrast to the United States, where federal (i.e., nation-wide) funding and air quality requirements largely, though not entirely, have dictated this need. As a result, a key outcome of this chapter is the organization of the different types into a *functional* paradigm. This allows transportation planners to understand how the different components relate to each other, regardless of the starting point (i.e., the issues that determine the need for a particular study); and also the types of studies that should be used to address a particular issue.

## 3.1 Introduction

Long-term transportation planning exercises allow communities to predict transportation needs and to respond to those needs in accordance with the vision of their community. Transportation planners have developed a variety of study types and focus areas. As noted, the primary purpose of this chapter is to identify how these different types of studies determine the analytical and data requirements.

However, a secondary outcome is the organization of these different types of studies. Long-term transportation planning study types are reasonably well established, although their use varies across the country. The problem of organizing these study types is compounded by nomenclature: As with land use planning studies, the names and specific requirements of transportation planning studies vary across Canada, even where the general content is the same. With this chapter, the authors propose to address this ambiguity by identifying the linkages among the study types (i.e., program elements) from which practitioners can identify the best ways to meet the specific needs of small- and medium-sized communities.

Finally, regardless of the process used, a transportation plan must be able to reflect the specific needs and priorities of the community. In any planning situation, a number of alternative planning outcomes may exist, and there must be a way of determining which option is the most appropriate for that community. Indicators and evaluation measures provide a community with a way to measure the expected outcome of an alternate improvement or prioritization strategy. Best practices in this category provide examples of quantifiable and accessible measurement and ranking strategies that are easy to understand and implement, and are customized for small- and medium-sized communities.

## 3.2 Study Types

As described in **Section 1.8**, for the purposes of the survey iTRANS and the PSC developed a definition of a long-term transportation plan.

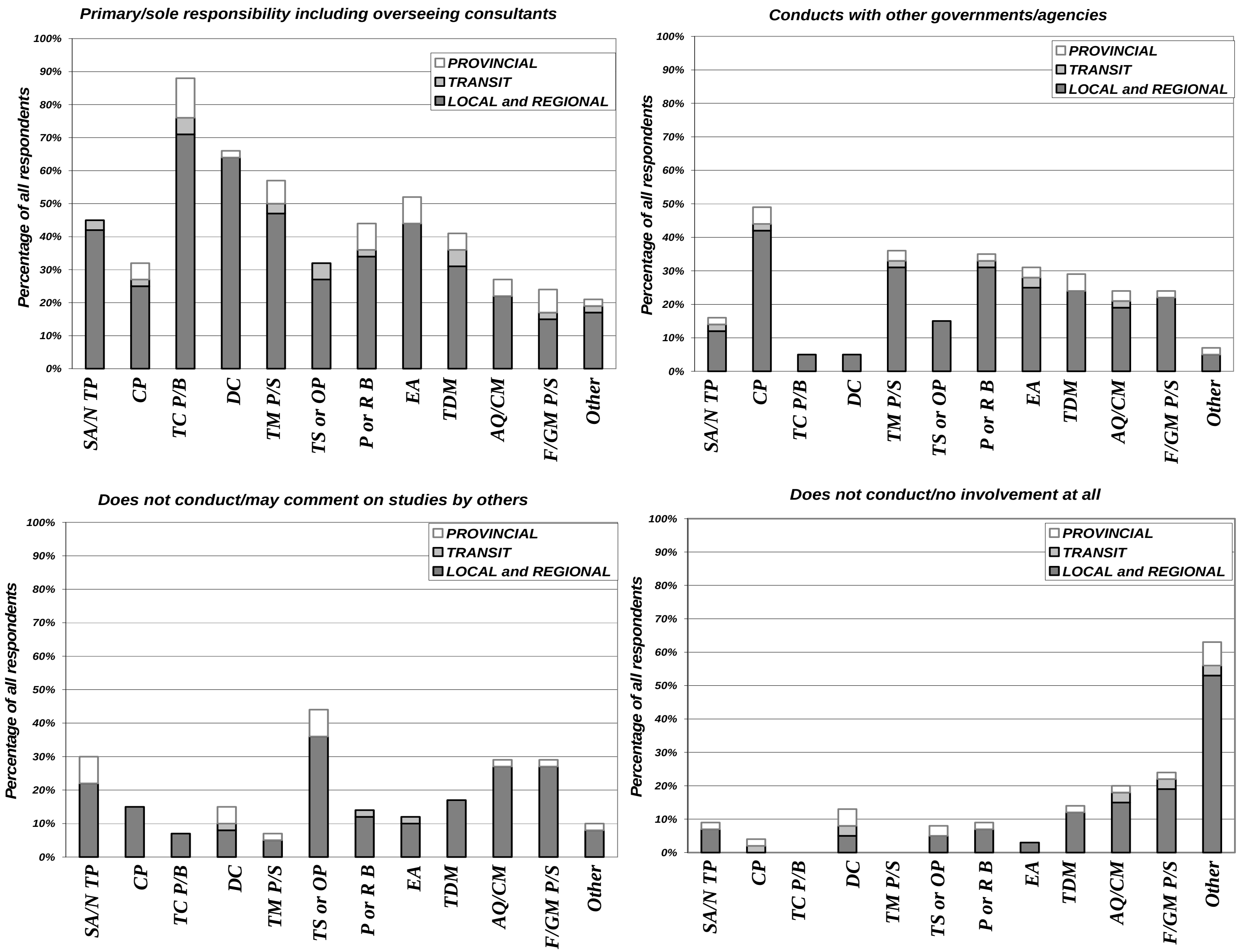
However, within this definition, there are several subject areas and transportation plan types. The primary types, as identified by the consultant and PSC and as included in the survey, are listed below:

- Transportation master plans or strategies
- Sub-area or neighbourhood transportation plans
- Corridor planning studies
- Transportation capital programmes / budgets
- Development charge studies
- Transit service or operational plans
- Policy or research / background studies (e.g. funding)
- Travel demand management studies
- Air quality / congestion management studies
- Freight / goods movement plans or strategies
- Environmental assessment studies
- Other

Each of these long-term plans fulfills specific planning needs. The plans presented here are not comprehensive of all the planning or transportation activities an organization might undertake, but provide a well rounded list of basic long-term transportation planning studies.

**Exhibit 3-1** is a summary of the survey responses concerning study type. Each of the four graphics in this exhibit represents a level of responsibility. The responses also are divided into three levels of organization, because some types of organizations were more likely to conduct certain types of studies than others. It is interesting to note that although transit authorities and provincial / territorial respondents might be expected to take a lesser role in some transportation planning study types, they still report high rates in the primary or sole responsibility category for almost every type of study.

## Exhibit 3-1: Involvement in Different Study Types by Organization Type




**TMP/S – Transportation master plans or strategies**

**SA/NTP – Sub-area or neighbourhood transportation plans**

**CP – Corridor planning studies**

**TCP/B – Transportation capital programmes / budgets**

**DC – Development charge studies**

**TS or OP – Transit service or operational plans**

**P or R B – Policy or research / background studies (e.g. funding)**

**TDM – Travel demand management studies**

**AQ/CM – Air quality / congestion management studies**

**F/GMP/S – Freight / goods movement plans or strategies**

**EA – Environmental assessment studies**

**Other – Other**

With respect to the types of studies they complete, 88% of respondents have primary or sole responsibility for transportation capital programmes/budgets, by far the highest percentage of any study type. Other areas with high results for primary or sole responsibility were development charge studies at 66% and transportation master plans or strategies at 58%. Cooperation was most common for corridor planning studies, where 46% of respondents reported conducting these studies with other governments and agencies.[5]

The least common study types were freight / goods movement plans or strategies, with which 24% of agencies did not conduct or had no involvement, while another 29% reported that they did not conduct but may comment on studies by others. Other studies with relatively high combined scores in the ‘does not conduct / may comment on studies by others’ and ‘does not conduct / no involvement at all’ categories were transit service and operational plans (44% and 8%) and air quality/congestion management studies (29% and 20%).

Overall, the survey shows that the respondent organizations, in general, are very involved in the planning process, with all planning types utilized by at least 14 organizations. Further, twelve respondents replied that they have primary responsibility for another type of study not listed.

Each of the plan types listed above is described below.

- **Transportation master plans or strategies** (identified as ‘TMP/S’ in **Exhibit 3-1**) were cited by 93% of local and regional agencies as a study type they conduct or in which they are involved. The remaining 7% of these agencies comment on TMPs completed by others.

  TMPs or strategies are the guiding documents that address the long-term transportation needs and programs of a municipality or region as a whole. A TMP identifies the transportation goals of the community: it should correspond to the community’s comprehensive development plan (see **Section 2.2**), and may be developed as part of that plan. Normally, a roadway TMP uses some form of traffic forecasting and network analysis along with stakeholder consultation to determine the deficiencies in the network and to plan for future needs. In addition to addressing these kinds of traffic capacity issues, master plans should consider a wide range of concerns, at least at a broad perspective; allowing municipalities to identify goals and challenges that may lead to other types of studies. These studies should identify challenges around major growth nodes, freight movement, active transportation, transit service, policy changes, safety, and transportation sustainability initiatives. The results of the TMP should lend themselves to capital planning and development charge studies. Sometimes, these studies may be included as part of the TMP. Triggers for other types of studies can also come out of preliminary investigations done as part of the TMP.

[5] Twelve respondents indicated that they have primary responsibility for some other kind of study. However, only two respondents identified these studies: “microscopic modelling for planning intersection needs on corridors” and “road drainage plans.”

The preceding paradigm generally describes multi-modal, motorized transportation. Distinct and separate TMPs can be completed for active transportation; that is, for a municipality's bicycle and pedestrian network. These studies follow the same basic format as the general TMP. However, they place less emphasis on demand and they have a wider variety of considerations. The needs assessment for bicycle and pedestrian master plans is based more on building and achieving the community's strategic vision for active transportation, with less emphasis on demand (trip generation) or capacity analysis. These plans also must consider the variety of user groups that will eventually benefit from the facilities. Bicycle and pedestrian TMPs include strategies and plans for route selection and connectivity, implementation and construction, supporting plans and facilities such as bicycle parking and shower facilities, and education and marketing campaigns. The active transportation network must be integrated with other modes and must provide inter-modal connectivity.

- **Sub-area or neighbourhood transportation plans (SA/NTP)** identify challenges and goals specific to a certain study area or defined neighbourhood within a municipality. These sub-areas typically fall under the larger umbrella of the municipality. Sub-area or neighbourhood transportation plans accomplish the same broad goals as TMPs but in a more detailed way. NTPs may be motivated by a specific change in the area, such as growth, land-use changes, or by changes to the transportation network such as the opening or closing of roads. The study area for NTPs should encompass the neighbourhood or area of concern as well as the surrounding transportation network that may be impacted by the change. These plans consider options for improvement and provide recommendations that lead to more detailed studies for specific improvements.

- **Corridor planning studies (CP)** respond to changes in the use of a corridor, due to changing land use, increased traffic volume, poor road operation, opening or closing of links to the corridor, or other changes to the function or operation of a roadway facility. Similar to sub-area or neighbourhood transportation plans, the study area for corridor planning studies should extend beyond the boundaries of the corridor itself to the surrounding road network that may be impacted by any changes. Corridor plans identify needed improvements and lead to more detailed environmental assessment studies or functional plans.

- **Transportation capital programmes / budgets (TCP/B)** were the most commonly-cited study type. As noted in **Section 3.2**, 88% of respondents have primary or sole responsibility for transportation capital programmes and budgets. This is the study type with the highest number of organizations with primary or sole responsibility. Respondents are also completing these studies relatively frequently, with 15% of respondents having completed more than 10 capital programmes or budgets in the last three years. This study type had the highest percentage of respondents in the 10 or more category of any studies.

  Transportation capital program and budget studies estimate the needs of the community for infrastructure improvements, as well as their staging, timing and costs. The frequency of studies depends greatly on the community's level of growth and on the associated need for upgrading road and transit infrastructure. The results of a network-wide need assessment carried out at the Master Plan level are subsequently applied, with some modification to timing and staging, to the annual capital budget.

It is also important to understand the impact of asset management planning on long-range transportation planning. Asset management programmes manage the life-cycle of the hard assets of an organization to ensure best value. These programmes are not listed here as types of long-range transportation plans because their purpose and scope differ from that of the long-range transportation plans described here. However, the information collected and analyzed as part of an organization's asset management program can have significant impact on long-range transportation plans. **Section 3.3** provides more information on the relationship of asset management programs and other types of studies to long-term transportation plans.

- **Development charge studies (DC)** were the second-most common study type for which respondents had primary or sole responsibility, at 66% of responses. The frequency for this study type is somewhat lower than for transportation capital programmes and budgets, with 5% completing more than 10 development charge studies in the last three years and 64% completing between one and five studies in the past 3 years.

  The method of assessing financial responsibility for infrastructure investments undertaken under capital budgets varies across Canada. However, all methods use a more or less systematic process in which all or a proportion of the investment cost is allocated to the party triggering the need. These studies can be done as part of the overall TMP or as independent studies.

- **Transit service or operational plans (TS or OP**) investigate the feasibility of initiating or expanding transit service or review the operation of existing service. Transit plans assess the transit needs of the community and determine the best way to provide for those needs.

  In many cases, conventional transit is under the jurisdiction of regional bodies, with municipalities providing input but having limited direct control. Because of this, the responsibility of transit planning often falls on the regional body. Other municipalities that are stand alone and without regional governance have stand-alone transit operations or cooperate with other municipal governments.

  In addition to planning for conventional transit, transit service and operation plans must consider the needs of limited mobility clients and many organizations provide alternative service, such as handi-buses for these riders.

- **Policy or research / background studies (PS)** can address a wide variety of subjects. They are used to provide policy guidance to other studies, such as TMPs, or they can be used to build a knowledge base in a specific focus area. These studies can include changes to overriding policy, research into funding mechanisms, or background and research studies to fill specific knowledge gaps.

- **Travel demand management studies (TDM)** investigate initiatives and techniques to reduce demand on the transportation network by reducing the number of trips or shifting them between modes, corridors or time-of-day periods. TDM plans may identify methods of reducing the total number of person-trips, such as telework or flex-time initiatives, or to reduce the number of vehicle-trips, such as increased use of alternative modes. These programs may come as a response to public demand for sustainability, or as a measure to reduce congestion and decrease the infrastructure investment that accompanies increased volume. TDM strategies are often included with other kinds of studies as an alternative to a singular type of transportation improvement.

- **Air quality / congestion management studies (AQ/CM)** quantify the environmental cost of congestion and/or high traffic volume in an area or corridor and provide recommendations to improve air quality and decrease congestion. An air quality or congestion management study may be completed in conjunction with a neighbourhood transportation plan or corridor plan, or as a stand-alone study.

- **Freight / goods movement plans or strategies (F/GMP/S)** had the lowest response rate, as noted; with 24% of agencies reporting that they did not conduct or had no involvement in freight/goods movement plans or strategies at all, while another 29% reported that they did not conduct these types of studies but may comment on studies by others. Recently, the amount of literature concerning freight and goods movement has increased, signalling its increasing importance as an urban transportation issue and a transportation planning practice area.

  Freight / goods movement plans identify many of the same issues as TMPs but focus specifically on goods movement. These plans should encompass goods movement by all available modes and identify network deficiencies and future needs.

- **Environmental Assessment studies / Functional Planning studies (EA)**, define "major improvement" studies. An **Environmental Assessment** or **Functional Plan** is a process by which the planning body assesses a number of options for their social, environmental and transportation impacts, among other things. In some provinces, these types of plans are legislated and are required to address specific subjects; this is the case for EAs in Ontario, for example. These studies should not be confused with Environmental Impact Studies or Environmental Impact Assessments and related plans, which fall under different legislation and address the specific environmental and/or social impacts of a proposed development. These environmental plans are normally regulated by provincial legislation and also could be subject to review by the Canadian Environmental Assessment Agency. The result of an Environmental Assessment or Functional Planning study is a complete functional design of a road that provides the best solution considering all impacts.

## 3.3 Organization of Studies

Two important points may be drawn from the preceding sections: First, the variation among these study types is considerable, in terms of scope, duration, frequency, magnitude and, it follows, analytical and data requirements. Second, many of these study types are related to each other; and to some degree, their scope and analytical requirement overlap. However, it is important to note that while some of these types are triggered by regulatory requirements, others are initiated to meet a specific identified need. As a result, a formal legal or procedural relationship or hierarchy does not exist.

However, the different study types are functionally related. Moreover, some communities may link their planning studies via a top-down process, while others may use a bottom-up procedure. For example, in a top-down process, a transportation master plan might identify the need for sub-area and corridor studies; and the master plan might provide guidance into policy formulation regarding funding options. In this case, the planning process starts with the 'big picture' and continues down with increasing detail. On the other hand, transportation planning in small- or medium-sized communities often is driven by a problem to be addressed in a specific corridor, which in turn leads to the need to consider the implications across the community as a whole (bottom-up approach). The point is that there is neither a single starting point nor a single end point, although the functional relationships suggest subsequent steps.

**Exhibit 3-2** illustrates these functional relationships. Transportation master plans or strategies feed into community plans or official plans – together they provide the 'big picture' for a community's transportation and development. The remainder of the studies are categorized into three groups that, in turn, feed into the TMPs:

1. Budgeting studies - that is, studies that focus on the financial implementation of a plan.[6]

2. Area / facility focused studies, which address a specific corridor or area. As noted, environmental assessment studies flow from these.

3. Special / support studies usually are not mandatory and may be completed to respond to the specific circumstances, goals, and priorities of each community.

A top-down approach might start with a community plan and TMP, then proceed to implementation studies and, according to priorities agreed through the TMP process, to specific area or facility studies. Special studies, such as a pricing policy, might be developed to support the TMP.

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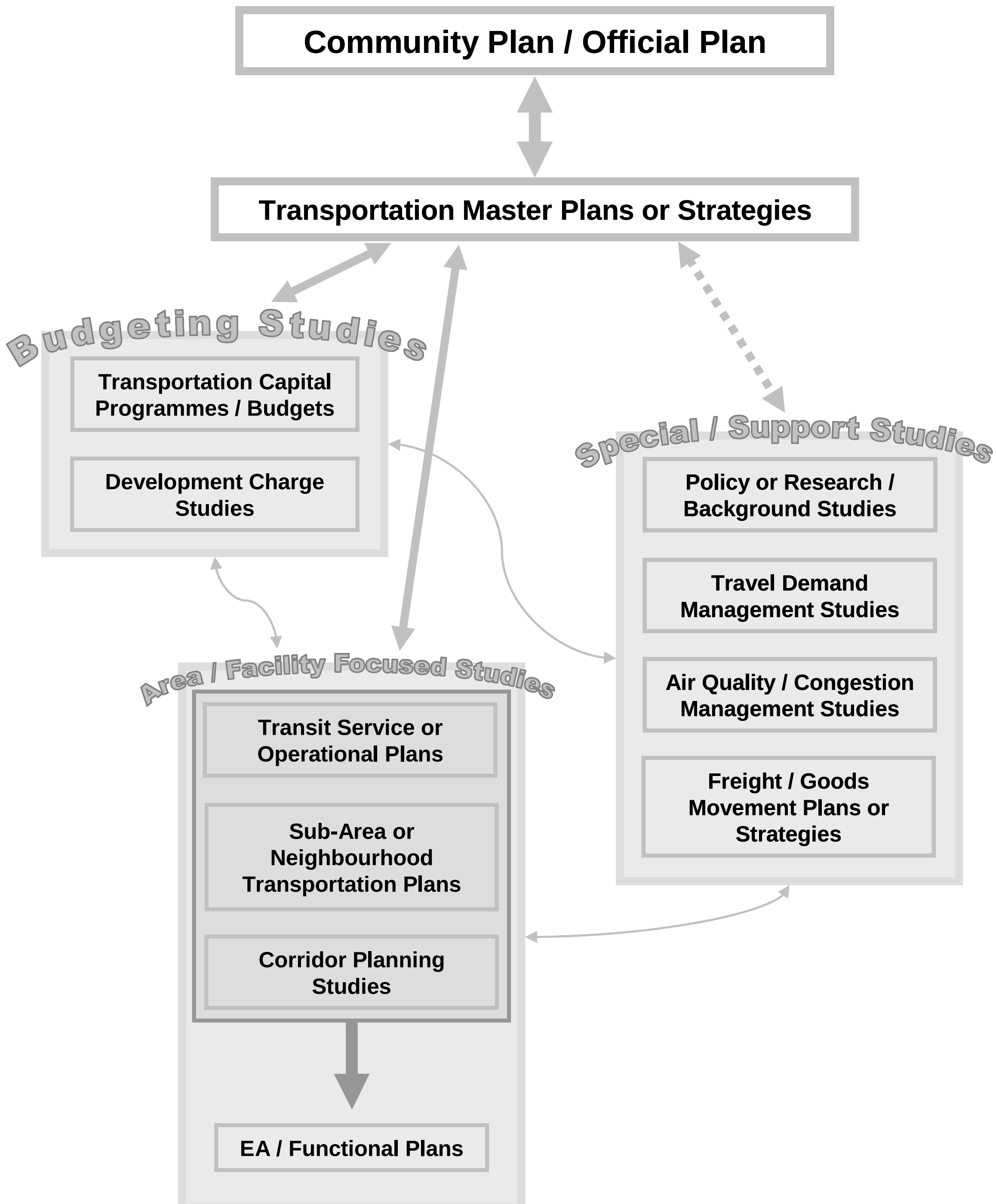
6 We distinguish between these types of implementation studies, which still are planning studies, and traffic operational and design studies, which are oriented toward the actual construction or introduction of the facility or service. The former must precede the latter.

**Exhibit 3-2: Long-term Transportation Plan Types**



A bottom-up approach might start with a corridor planning study. That study might result in an environmental assessment. However, under this organizational scheme, the likely resultant need to address capital budgeting in turn would identify the need for a coordinating, big-picture statement; that is, for a TMP.

The preceding approaches are applicable to communities of different sizes; and to communities that are part of a larger urban region or which stand-alone. Because small- and medium-sized communities may not have the staff resources to conduct specific work in each of these important areas, integration is extremely important. In addition, a complete transportation planning program incorporates many study types or focus areas (Cambridge Systematics, Inc., TransManagement, Inc., TransTech Management, Inc., & Heanue, K, 2007).

The studies included here are not the only ones that affect long-term transportation planning. Two other categories of transportation studies should be noted: These are asset management programs and planning studies with a different focus than the long-term transportation plans discussed above.

Asset management programs allow government organizations to understand what assets they have, the life cycle of those assets, and how the assets are performing. Hard assets (i.e. roads, bridges, etc.) can have life cycles much longer than the common horizon of a long-range transportation plan. After a hard asset has been constructed it may be physically difficult, expensive, or politically unpopular to remove it. As a result, long-range transportation plans must consider the impacts of proposed network improvements on the organization's hard assets beyond the final horizon year of the study.

Good asset management programs also provide important data to the long-range transportation planning process. Transportation planners should consider life cycle when timing infrastructural improvements. For example, if a bridge has 15 years remaining in its life cycle, and capacity analysis indicates that the connection will require an additional lane in 20 years, it may reduce life cycle cost to build the additional width when the bridge is replaced in 15 years. This type of knowledge can provide great value to the long-range transportation planning process.[7]

The second category qualifies as a type of transportation planning study. However, studies in this category differ from the types discussed above, in two ways: they have a smaller spatial scale and/or they have a short-range orientation. They include parking studies, safety assessments and traffic impact studies (i.e., traffic studies to support the approval of individual site development plans). These studies can identify issues and concerns that must be addressed on a larger scale through one or more of the long-term transportation planning studies discussed above. They also may be triggered by findings of a long-term transportation plan.

7 Personal telephone communication with Dr. Lynne Cowe Falls, University of Calgary, April 17, 2008..

General approaches to transportation planning have been documented in a number of sources. This report does not detail the specifics of the planning process. However, to understand the applications of long-range transportation planning in small communities, it is important to understand the principles of transportation planning. An excellent reference of basic transportation planning concepts and practices is the Institute of Transportation Engineers (ITE) ***Transportation Planning Handbook*** (1999). Readers are encouraged to refer to this handbook, with special attention to Chapter 12: Urban Transportation Studies for a broad background into the application of transportation planning. (ITE, 1999)

An emerging best practice, as discussed later in the report, is planning for sustainability. In Canada, municipalities increasingly have incorporated sustainable transportation planning into their studies and plans. However, sustainable transportation does not have a widely accepted definition and although many municipalities have integrated sustainable concepts into their long-term plans, few have seen tangible results. Transport Canada and TAC have developed guidelines to help municipalities better incorporate sustainable transportation into their planning activities. These guidelines address twelve principles divided into two categories: sustainable communities and transportation systems and sustainable and effective transportation planning (Transport Canada & TAC, 2007). These principles are listed in Error! Reference source not found..

**Table 3-1: Key Principles for Sustainable Transportation Planning**

| Sustainable communities & transportation systems | | | Sustainable & effective transportation planning | |
|---|---|---|---|---|
| Principle 1: | Integration with land use planning | | Principle 7: | Strategic approach |
| Principle 2: | Environmental health | | Principle 8: | Implementation guidance |
| Principle 3: | Economic and social objectives | | Principle 9: | Financial guidance |
| Principle 4: | Modal sustainability | | Principle 10: | Performance measurement |
| Principle 5: | Transportation demand management | | Principle 11: | Public involvement |
| Principle 6: | Transportation supply management | | Principle 12: | Plan maintenance |

Source: (Transport Canada & TAC, 2007)

This guide has applied the key principles for sustainable transportation planning listed above along with guidance provided by the PSC and formulated five “Key Elements of Transportation Planning.” The Key Elements take the transportation principles and apply them to the process of choosing and specifying long-range transportation planning studies described below. These Elements are used to choose what type of plan to complete and what considerations to integrate into those plans. They also are used in the discussion of Evaluation Measures and Performance indicators, which is introduced in Section 3.5. The Key Elements of Transportation provide a guideline to planners attempting to address all the needs of the community.

**Key Elements of Transportation Planning**

1. Acknowledge that transportation is tied to other areas of planning and work with groups in these other subject areas to integrate different planning strategies

   a) Integrate transportation planning and land use planning
   b) Integrate transportation planning and economic planning

2. Consider the "Triple bottom line:" Evaluate based on Economic, Social, and Environmental Indicators

   a) Plan a transportation network for all modes – auto, active (pedestrian, bicycle, and other), transit, goods movement.
   b) Balance modal split to provide the greatest benefit to the community
   c) Consider the needs of all socio-economic groups
   d) Consider environmental impacts
   e) Limit environmental impacts, and resource and energy use by make the best use of existing infrastructure
   f) Consider safety and security provisions integral to the transportation network

3. Consider the spatial focus
   a) Identify the immediate study area
   b) Consider the impacts on the larger  network

4. Utilize supply-side and demand-side solutions
   a) Consider the impacts of changes to supply
   b) Integrate Transportation Demand Management into all planning practices

5. Plan and carry out a measurement strategy
   a) Choose best practices performance indicators and evaluation measures
   b) Set goals consistent with the needs of the community's vision
   c) Collect data and measure progress
   d) Reassess

As discussed above, transportation planning in small- or medium-sized communities may be driven by a specific problem or challenge. Addressing this challenge may motivate other larger plans and study types. The flowchart in **Exhibit 3-3** is intended to show communities how specific triggers can lead to different plan types. It also provides some guidance to help communities determine the types of plans they may need to address a particular issue. The flowchart is not intended as a comprehensive glossary of all trigger-plan type relationships, but as a sample: It is impossible to show graphically every combination of circumstances that may be encountered by an organization when considering long-range transportation planning.

Although the flowchart does not represent every trigger and path to long-range transportation planning studies, it does reflect a thought process that is consistent with the best practice guiding principals of long-range transportation planning. The flowchart addresses the following steps. Note that step 2 and step 3 may be inversed in some cases:

1. Identify triggers – Triggers may result from a number of sources. Some examples are:

    a) Another long-range transportation plan (i.e. recent TMP identified a recent decrease in Air Quality = Air Quality Concerns)
    b) Public feedback (i.e. complaints about a particular location of traffic congestion = Traffic Congestion)
    c) A more localized transportation plan (i.e. TIS identified impacts on the larger transportation network from a large development = Large Development)
    d) Staff knowledge (i.e. staff identify parking shortage along a commercial corridor = Parking shortage / parking management)

2. Determine the spatial realm of the project – Transportation planning projects should have a defined study area in which the majority of the analysis will focus. For example, a study can be spatially limited to a corridor or a neighbourhood, although the actual impacts of the project may extend outside the determined study area. It is important to define the spatial scope of a study, but then to consider the impacts to other parts of the transportation network. This concept of spatial scope is reflected in the exhibit. These considerations may play a small role in the study itself, but should be considered for further study through other study types or for integration into the next TMP. Not all examples in the flow chart have this step quantified.

3. Determine the study focus – all studies should adhere to the guiding principles of transportation planning and take a balanced approach; however, meaningful study must have a clear focus. A freight study, for example, is focussed on the freight transportation network, but also must consider the impacts of the freight transportation network on other modes. In the same way, a Corridor Planning Study should consider all modes of transportation in a corridor, as well as supply and demand management when responding to a trigger such as 'Traffic Congestion'.

When using **Exhibit 3-3** it is very important to understand that the rectangles represent possible study types, not the considerations for individual studies. For example, the Traffic Congestion trigger leads first to a spatial question – is the congestion localized to a route – to determine whether further study should be limited to a route, to a neighbourhood, or whether a city-wide study should be done. Once the spatial realm has been identified, a corridor plan, neighbourhood plan or TMP may be warranted to study the problem in more detail. The study, whatever form it takes, should address the key elements of transportation planning described above and consider all potential solutions to the congestion, including multi-modal solutions and demand management. At this point, the study may find that sufficient capacity cannot be provided, and that a larger scale TDM plan may be required. This is not the only possible outcome of the study – for example, it may find that transit system as a whole needs to be reassessed, leading to a Transit Study. Alternatively, a Corridor study may find that changes to this corridor are going to have wider implications and lead to a revision of the Transportation Master Plan.

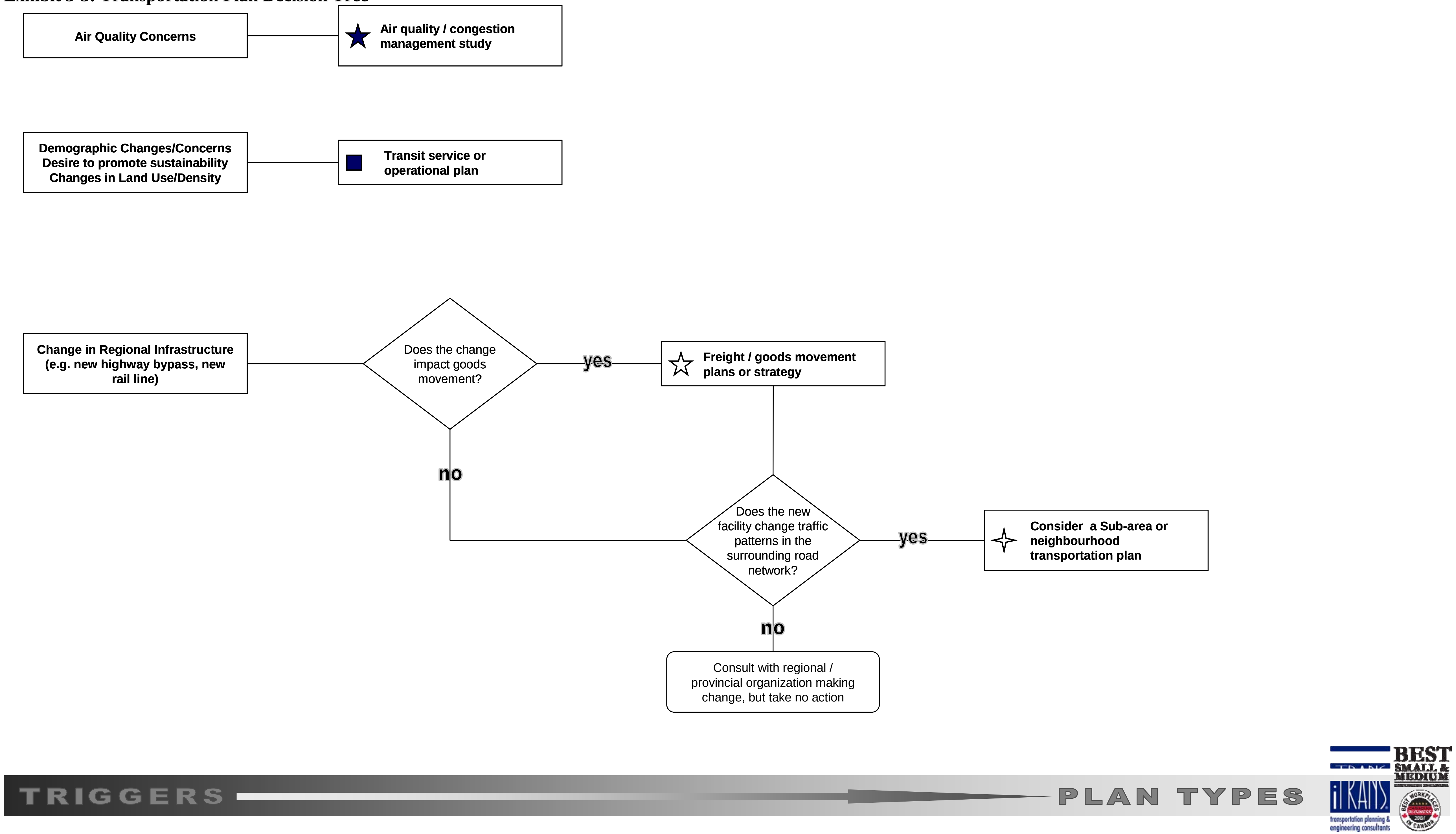
**Exhibit 3-3** also acknowledges that studies have set scopes and limitations. A Corridor or Neighbourhood Transportation plan should consider TDM within the scope of the plan; however, it is not feasible to do a large scale TDM plan within the smaller scope of a localized study. Because of this, the exhibit shows the option of a full TDM study if there are capacity constraints that cannot be addressed within the Corridor or Neighbourhood Plan. This is not the only route that may lead from a Corridor or Neighbourhood plan to a TDM study. A full TDM study may also be needed if public consultation showed that the community supports demand management measures that cannot be fully explored within the context of the original Corridor or Neighbourhood plan.

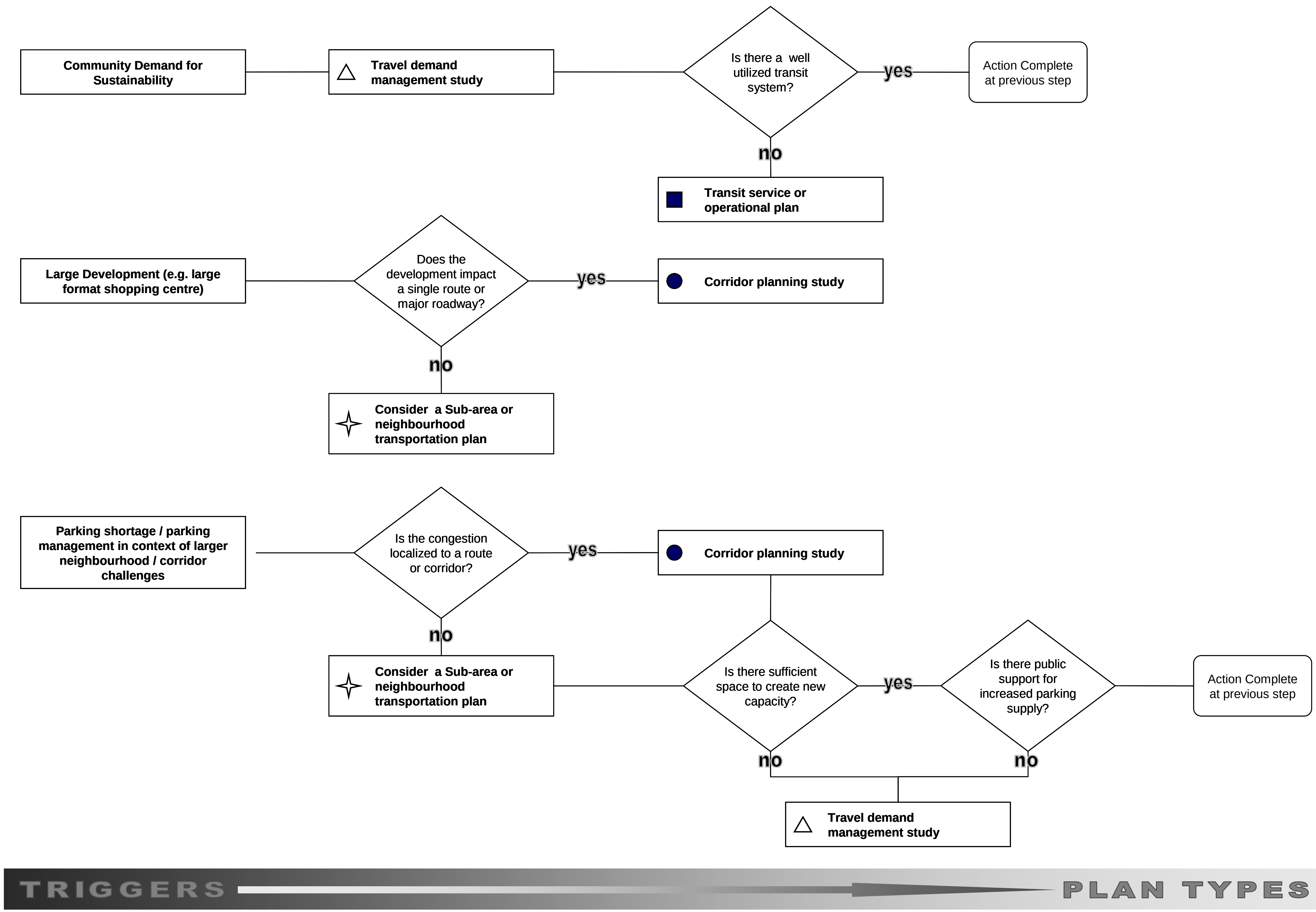
The trigger and resulting study address a specific problem (the trigger problem), but also act as a starting point to enter the transportation planning strategy process shown in **Exhibit 3-2.** Ultimately, however, the findings of the individual studies should provide input to, or inform, the development of a new TMP or update. All communities should complete regular updates to a TMP. The findings of individual studies allow communities to refocus goals, adjust data collection needs and/or incorporate land use and transportation network changes.

In every case where a corridor plan or neighbourhood transportation plan recommends a new project (i.e., a new facility or improvements to existing facility), the next step is an environmental assessment or functional plan. **Exhibit 3-3** does not include this relationship, which is shown in **Exhibit 3-2**. Capital plans were not included in **Exhibit 3-3** because they are a budgeting function and are not triggered by specific community planning issues. In many cases, the studies listed, such as Corridor Planning Studies and Neighbourhood Studies may identify the need for a more specific type of study, such as a parking study.

As discussed above, **Exhibit 3-3** does not represent every possible path. Also, it does not show how plans are interconnected.
**Exhibit 3-4** shows an example of how the flowchart might be expanded. The sample flow chart expansion is based on a TDM plan.

**Exhibit 3-3: Transportation Plan Decision Tree**




Community Demand for Sustainability
Travel demand management study
Is there a well utilized transit system?
yes
Action Complete at previous step
no
Transit service or operational plan
Large Development (e.g. large format shopping centre)
Does the development impact a single route or major roadway?
yes
Corridor planning study
no
Consider a Sub-area or neighbourhood transportation plan
Parking shortage / parking management in context of larger neighbourhood / corridor challenges
Is the congestion localized to a route or corridor?
yes
Corridor planning study
no
Consider a Sub-area or neighbourhood transportation plan
Is there sufficient space to create new capacity?
yes
Is there public support for increased parking supply?
Action Complete at previous step
no
no
Travel demand management study
TRIGGERS
PLAN TYPES

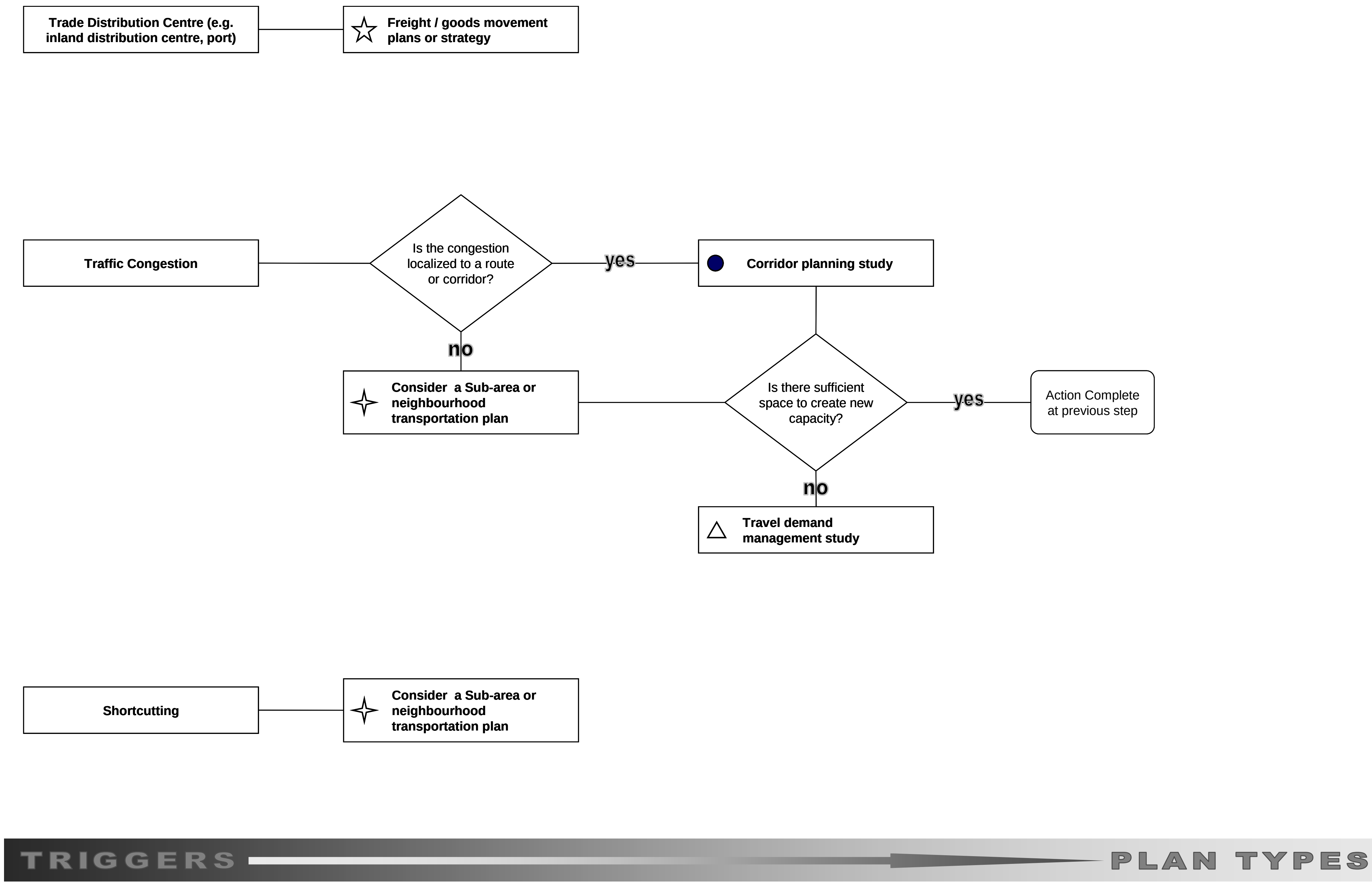
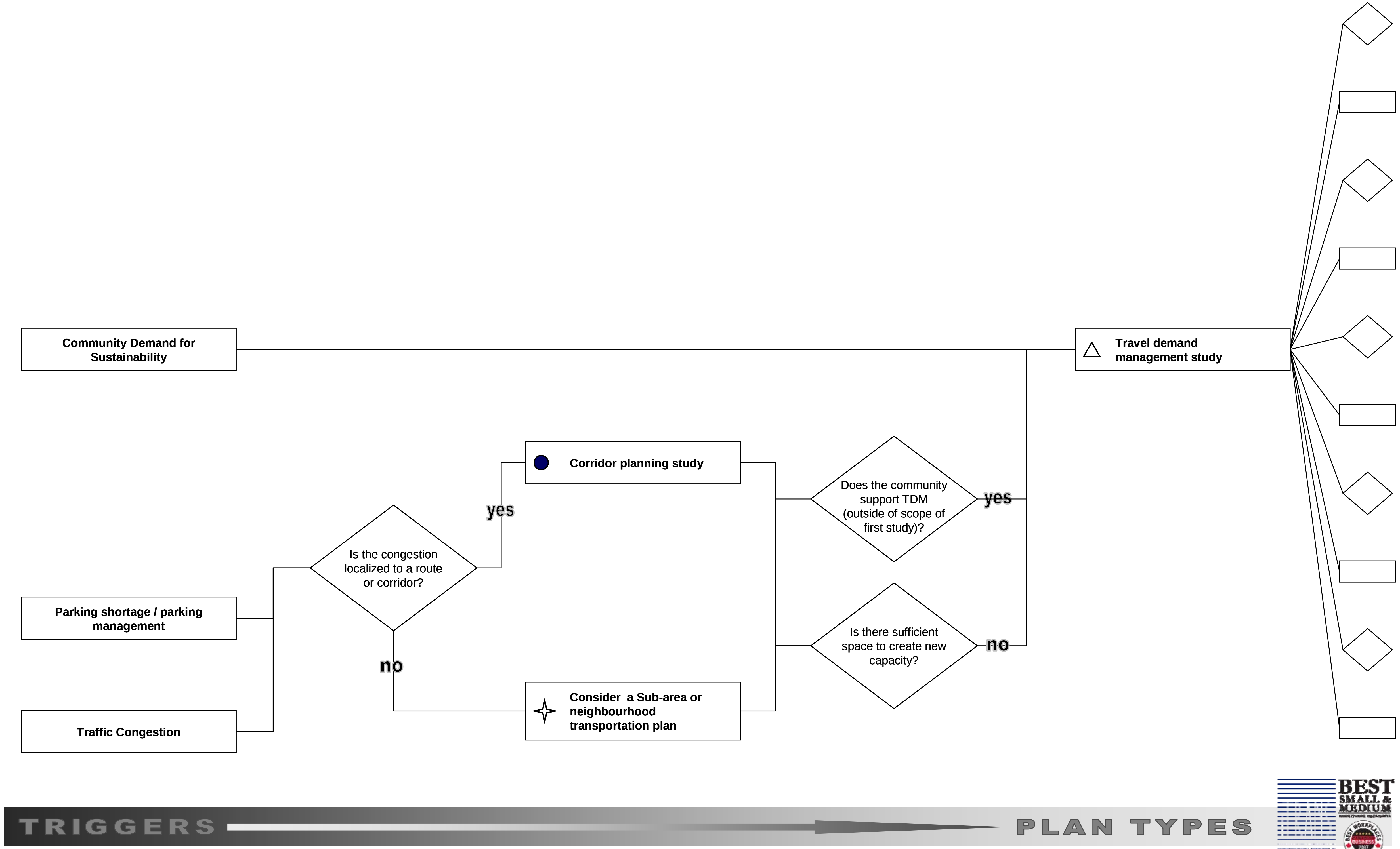



**Exhibit 3-4: Sample Flowchart Expansion – TDM**


Community Demand for Sustainability
Parking shortage / parking management
Traffic Congestion
Is the congestion localized to a route or corridor?
yes
no
Corridor planning study
Consider a Sub-area or neighbourhood transportation plan
Does the community support TDM (outside of scope of first study)?
yes
Is there sufficient space to create new capacity?
no
Travel demand management study
TRIGGERS
PLAN TYPES

## 3.4 Study Process

Although many of these study areas have similar areas of consideration and follow similar steps, the actual *application* of these studies to small- and medium-sized communities may have specific perspectives. There is little literature on these specific applications. However, a 2007 NCHRP study illustrates the specific application of long-term transportation planning methods to small- and medium-sized communities. The NCHRP *Guidebook for Freight Policy, Planning, and Programming in Small- and Medium-Sized Metropolitan Areas* is a comprehensive and recent source of best practices in freight planning.[8]

Although this discussion addresses freight planning specifically, the information and strategies described here are transferable to planning for passenger transportation, and thus they provide an excellent referent for long-term transportation planning practices in a more general sense.

Freight transportation planning is a relatively new practice area for the staff of many small- and medium-sized communities. The first step in developing a freight planning program is for the acting authority to assess what freight issues are already being addressed within the community's existing planning program, and then to identify which additional measures are most appropriate in the context of that community. It is important to identify freight stakeholders as well as the expertise within the local authority (Cambridge Systematics, Inc., TransManagement, Inc., TransTech Management, Inc., & Heanue, K, 2007).

A complete freight planning program is made up of a variety of activities. The number and type of these activities vary from community to community, and the acting authority must integrate these activities to form a complete program. It is important to remember that freight planning includes all modes available to a community, including truck, rail, intermodal, air, water, and pipeline. In addition, it is key that freight planning, like other disciplines, be integrated into an overall transportation planning program. The three main components of a long term plan for freight transportation are described below (Cambridge Systematics, Inc., TransManagement, Inc., TransTech Management, Inc., & Heanue, K, 2007):

1. **Regional freight profile**. Developing the profile allows a community to understand the freight transportation system in the surrounding region. The profile should summarize the geographic area and provide a high level overview of transportation infrastructure. In addition, it may be advantageous to identify the natural resources and industries that generate transportation demands. The discussion on data, presented later in the report, includes comments on freight data needs relative to developing a freight profile, as well as for other elements listed above. The development of the profile can be complex or simple, depending on the needs of the community and resources available. The most basic approach is to contact key regional freight partners, in order to develop a freight system infrastructure map, review aggregate commodity flow data, summarize key socioeconomic data and, finally, develop a summary of this information. A more

[8] The terms freight and goods movement are used interchangeably here.

expansive program may examine regional logistics patterns, consider international trade, or model truck trips for the region, among other initiatives.

2. **Freight needs and deficiencies**. After the development of the regional freight profile, planners should identify freight needs and deficiencies. Understanding freight needs, and therefore deficiencies in the existing network, is dependent on data collection and analysis, as well as stakeholder input. At its most basic level, this element involves reviewing the previously developed regional freight profile in order to identify points of congestion, high accident locations, geometric constraints, and inadequate loading/unloading zones. Planners should then use this information to identify bottlenecks, and then transform this bottleneck information into a summary of high priority needs. A more advanced approach may involve the collection of additional data and application of this information.

3. **Long-term plan for freight**. All the information and analysis completed in the previous steps should be integrated into the community's long-term plan. This may pose challenges, as staff may be dealing with processes that are specific to freight and new to the planning repertoire of the local community. Communities may face a variety of other challenges when completing these types of plans, including data availability, freight expertise, partner participation, and political opposition.

The applicability of these three components to passenger transportation plans in small- and medium-sized communities is evident. The freight 'best practice' plan focuses on what is achievable, given the available resources, data and tools. It addresses the practical and emphasizes a broad stakeholder consultation. It leaves open the types of analytical processes and underlying data that are required, although it also allows planners to expand or extend the development of analytical tools or collection of new data according to need.

## 3.5 Indicators and Evaluation Measures

In every transportation planning exercise, it is necessary to define indicators and evaluation measures that indicate the performance of the system, or identify which option or action is most appropriate given a specific set of goals. Performance measures allow agencies to report to the public, but also to communicate with the public about the transportation system (Transportation Association of Canada, 2006). In addition, performance measures and indicators specify the status of a project and provide guidance in the next steps (Tate-Glass, M. J., Bostrum, R, & Witt, G, 2007). This section and **Section 3.6** describe a comprehensive list of measures of indicators, while **Section 3.8.2** provides direction regarding their application.

Performance indicators and evaluation measures work together to give municipalities tools to evaluate the system and identify preferred options, as well as to communicate progress and choices to the public. As defined in **Section 1.8**, performance indicators describe an attribute of a transportation system's performance. Evaluation measures are the means used to quantify or qualify the indicator and provide an assessment of that attribute. Communities must develop a system of indicators and evaluation measures that are consistent with their goals, while being measurable and understandable by the public and politicians.

In California, the state and municipalities have a relationship of split authority that requires a consistent method for comparing projects and programs. Because of this relationship, transportation policy makers in California have worked to develop performance indicators and measures. Based on this process, the three key components of a performance measurement framework are (Tate-Glass, M. J., Bostrum, R, & Witt, G, 2007):

1. A clear direction or purpose, often enunciated as a vision.

2. A simple set of metrics, based on readily obtainable data.

3. Routine, readable reports.

A transportation agency potentially could develop an unlimited number of performance indicators and evaluation measures. However, a usable list of performance indicators and evaluation measures must meet some key criteria: One must consider the availability of data, the cost and time to collect data, and the quality of data. Indicators and measures must not be difficult to develop, and should utilize the technology and resources already available to the agency. The indicators and measures should be ‘forecastable’, clear to professionals, policy makers and the public, useful and applicable to the agency’s goals, provide a direct way to diagnose problems, be comparable across time, and relevant to the agency’s planning and budgeting processes (Transportation Association of Canada, 2006; Tate-Glass, M. J., Bostrum, R, & Witt, G, 2007).

Freight planning provides an excellent example of best practices in long-term transportation planning that is relevant to other applications. A comprehensive list of possible performance indicators and evaluation methods is presented below: however, measuring some of the criteria listed can be resource- or labour-intensive. Small- and medium-sized communities might not have the resources to use these criteria and need to choose performance indicators and evaluation measures that are appropriate for their community. The NCHRP’s ***Guidebook for Freight Policy Planning*** is instructive in providing recommendations that allow planners to choose specific performance indicators and evaluation measures that work for their community or project from the large number of possible criteria (i.e., for passenger plans as well as freight plans).

The most effective way to guarantee that planning practices for a specific program area are incorporated into a community’s long-term planning process is to “modify and enhance” the existing system of evaluating and ranking transportation improvement projects (Cambridge Systematics, Inc., TransManagement, Inc., TransTech Management, Inc., & Heanue, K, 2007). To ensure that the indicators and measures are usable, they should be measurable. Common performance indicators that communities can incorporate or adjust to account for freight planning include improvements in mobility, reduction in congestion, improved access, economic impacts, and safety and security enhancements (Cambridge Systematics, Inc., TransManagement, Inc., TransTech Management, Inc., & Heanue, K, 2007). These indicators also are applicable to planning for passenger movement.

Two sources of inputs to developing the indicators are observed data, such as traffic counts or surveys, and/or model outputs. Both provide quantifiable values Models also can forecast the expected impacts of improvements to the system. For example, when using existing travel demand models, analysts can calculate the impact of improvements on truck operations. It is possible to quantify these improvements in some of the categories described above, such as improvements in mobility and economic impacts.

Stakeholder consultation can complement these 'hard data' by providing anecdotal and qualitative insights on current conditions or on the expected impacts of enhancements to the freight transportation system. This information also provides a context for data on observed existing conditions and for interpreting model forecasts.

A 2006 TAC survey of provincial and territorial transportation authorities offered a series of possible evaluation measures for road networks, in five performance indicator categories: safety, transportation system preservation, sustainability and environmental quality, cost effectiveness, reliability, and mobility / accessibility (Transportation Association of Canada, 2006).

Although that survey targeted provincial and territorial bodies, small- and medium-sized communities may be able to apply many of the evaluation measures cited. From the aforementioned list, sustainability and environmental quality, cost effectiveness, and reliability are most obviously applicable to long-term planning; however, the historically operationally-oriented categories of safety and mobility / accessibility increasingly also may be considered as germane to long-term planning. Potential measures for each of these categories that (Transportation Association of Canada, 2006) were reported as being used by one or more provinces / territories are listed in **Table 3-2** below.

**Table 3-2: Performance Measures Used by Provinces and Territories**

| Performance Indicator Category | Possible Evaluation Measures |
|---|---|
| Safety | Accident rates per million vehicle kilometres |
| Sustainability and Environmental Quality | Noise |
| Cost Effectiveness | Net present value<br>Net benefit/cost ratio<br>Internal rate of return |
| Reliability | Level of service<br>Percent delay |
| Mobility / Accessibility | Average speed<br>Traffic volumes |

Source: (Transportation Association of Canada, 2006)

The TAC report also accounted for other indicators and evaluation measures that have been used or developed by practitioners in the United States and elsewhere. As well, some performance indicators that are currently covered in a more limited way in Canada are being addressed to a greater degree by governments elsewhere. For example, although ‘noise’ was the only measure cited by provincial and territorial organizations for the “Sustainability and Environmental Quality” performance indictors, applicable measures used elsewhere appear in the new performance indicators of “Economic Development” and “Environmental and Resource Conservation.” All of these are listed below (adapted from (Transportation Association of Canada, 2006)):

- Accessibility / Mobility
  - Average travel time from facility to destination (by mode) or to major highway network
  - Average trip length
  - Overall mode spit
  - Mode split by facility or route
  - Origin-destination travel times
  - Total travel time
  - VMT [VKT] by congestion level
  - Lost time due to congestion
  - Delay per VMT [VKT]

- Level of Service
  - Intersection level of service
  - Volume/capacity ratio
  - Travel Speed
  - Variability of Travel Time

- Economic Development
  - Direct jobs supported or created
  - Economic costs of accidents
  - Economic costs of lost time
  - Indirect jobs supported or created
  - User Cost Distance

- Environmental and Resource Conservation
  - Overall mode split
  - Tons of pollution (or vehicle pollution generated)
  - Fuel usage
  - Greenhouse Gas Emissions
  - Traffic Noise Exposure

- Safety
  - Number of accidents per VMT [VKT]
  - Number of accidents per year

- Number of accidents per trip
- Number of accidents per capita
- Number of accidents per ton-mile traveled
- Average response time for emergency services
- Railroad/highway-at-grade crossings

## 3.6 Indicators and Measures Exemplified

Performance indicators and evaluation measures can be described in different ways. This section presents examples from two perspectives. The first perspective is at the TMP level, and is intended to provide a broad, all-encompassing multi-modal perspective. The second perspective considers the emerging area of sustainability and the environment.

As with the preceding sections, these perspectives illustrate the range and breadth of the requirements for performance indicators and measures. Guidelines for applying the indicators and measures are discussed in **Section 3.8.2**.

### 3.6.1 Master Plan Performance Indicators and Measures

The 2003 City of Ottawa Transportation Master Plan, also called *Ottawa 20/20*, is a recent example of a comprehensive performance measurement system designed and employed to monitor the implementation, effectiveness and efficiency of transportation system goals and objectives verbalized in the plan. The list of performance objectives, indicators, methods of measurement (evaluation measures), targets and the influence the City has over the successful meeting of the target has been reproduced in **Exhibit 3-5** from the City of Ottawa website dedicated to the *Ottawa 20/20* document. The 11 categories of performance objectives listed in the table address a variety of community needs and transportation planning indicators considering all three aspects of a sustainable society; that is, the objectives integrate the triple bottom line of economy, society and environment. (City of Ottawa, 2003)

Each objective is measured through one or more performance indicators, which are measurable values in units such as 'vkm' (vehicle-kilometres [travelled]) per capita, modal split or emissions. The *Ottawa 20/20* plan also includes other important components that, together, create a holistic plan of evaluation measures. These include the period of measurement, location, source, and frequency of measurement, and target values. Further, the City of Ottawa has identified its ability to influence that objective.

Other cities have developed similar approaches. The Ottawa example is useful because it demonstrates how to tie the indicators and evaluation measures into a plan: identify an objective, decide on indicators, set a target and measure it. A plan's objectives may be identified as legislative requirements, or as determined through public or political consultation. To some extent, the indicators similarly may be determined through consultation, although they also may be functions of the available data and of how reliably they can be forecasted. Targets can be legislated standards or requirements or, as with the objectives, determined through consultation. Finally, the measure provides a tangible element to the indicator.

**Exhibit 3-5: Ottawa 20/20 Performance Indicators and Measures**

| Performance Objectives | Performance Indicators | Period of Measurement | Location, Source and Frequency of Measurement | Target | City Influence |
|---|---|---|---|---|---|
| **1. Limit motor vehicle traffic growth** | | | | | |
| (a) Reduce motor vehicle use per capita | Individual automobile use (vehicle-km per capita) | Year | To be determined | *TBD* | Medium |
| | Relative growth in traffic volumes (% change in volumes / % change in population) | Afternoon peak period | Aggregated key screenlines (counts, annual) | Less than 1.0 | Medium |
| (b) Increase motor vehicle occupancy rates | Auto occupancy (persons per vehicle) | Afternoon peak period | a) Aggregated key screenlines (counts, annual)<br>b) City-wide (origin-destination survey, every 10 years) | Not less than 1.3 (both screenline and city-wide | Low |
| **2. Increase transit use** | | | | | |
| (a) Increase transit ridership per capita | Transit passenger volumes (rides per capita) | Year | City-wide (counts, counts) | 200 | High |
| | Transit modal split (% of motorized trips) | Afternoon peak period | a) Key screenlines (counts, annual)<br>b) City-wide (origin-destination survey, every 10 years) | a) 30% | High |
| (b) Increase service availability | Proximity to employment (% of jobs within 400 m walk of 10-minute headway service in peak periods) | Morning peak period | City-wide (employment survey, every 5 years) | *TBD* | High |

**Exhibit 3-5: Ottawa 20/20 Performance Indicators and Measures**

| Performance Objectives | Performance Indicators | Period of Measurement | Location, Source and Frequency of Measurement | Target | City Influence |
|---|---|---|---|---|---|
| | Service level (vehicle-km per capita) | Year | City-wide (service statistics, annual) | *TBD* | High |
| (c) Increase service speed and reliability | Intersection approaches with transit signal priority (number) | *N/A* | City-wide (inventory, annual) | *TBD* | High |
| | Completion of transit priority network (%) | *N/A* | City-wide (inventory, annual) | 100% | High |
| | Average vehicle speed (vehicle-km per vehicle-hr) | Year | City-wide (service statistics, annual) | *TBD* | Medium |
| | On-time performance *(to be determined)* | *TBD* | *TBD* | *TBD* | Medium |
| | Cancelled trips (% of scheduled trips) | Year | City-wide (service statistics, annual) | *TBD* | High |
| | Completion of rapid transit network (%) | *N/A* | City-wide (inventory, annual) | 100% | High |
| (d) Increase user comfort and convenience | Shelter provision (% of stops) | *N/A* | City-wide (inventory, annual) | *TBD* | High |
| **3. Increase cycling** | | | | | |
| (a) Increase cycling modal share | Cycling modal share (% of all trips) | Afternoon peak period | a) Inner Area cordon (counts, annual)<br>b) City-wide (origin-destination survey, every 10 years) | *TBD* (cordon)<br>a) 3% (city-wide) | Medium |

**Exhibit 3-5: Ottawa 20/20 Performance Indicators and Measures**

| Performance Objectives | Performance Indicators | Period of Measurement | Location, Source and Frequency of Measurement | Target | City Influence |
|---|---|---|---|---|---|
| | Cycling activity index (bicycles per 100 motorized vehicles) | 8 hours (morning, midday & afternoon peak periods) | Urban area (counts, biannual) | *TBD* | Medium |
| (b) Increase availability of cycling facilities | Completion of Urban Cycling Transportation Network (%) | *N/A* | City-wide (annual) | 100% | High |
| **4. Increase walking** | | | | | |
| (a) Increase walking modal share | Walking modal share (% of all trips) | Afternoon peak period | a) Central Area cordon (counts, annual)<br>b) City-wide (OD survey, every 10 years) | b) TBD (cordon)<br>c) 10% (city-wide) | Medium |
| (b) Increase availability of walking facilities | Sidewalk coverage (% of arterial and collector roads with sidewalks or pathways on both sides) | *N/A* | Urban + villages (annual) | *TBD* | High |
| **5. Reduce unwanted social and environmental effects** | | | | | |
| (a) Reduce air emissions from transportation | Greenhouse gas emissions from passenger travel (kg per capita) | Year | City-wide (annual) | *TBD* | Medium |
| | NOx emissions from passenger travel (kg per capita) | Year | City-wide (annual) | TBD | Low to medium |
| (b) Reduce road salt use | Road salt usage (tonnes) | Year | City-wide (annual) | N/A | High |

| | | | | | |
|---|---|---|---|---|---|
| (c) Reduce road surface per capita | Road surface area (square metres per capita) | N/A | City-wide (annual) | N/A | Medium to high |
| **6. Optimize use of existing system** | | | | | |
| (a) Increase capacity | Transportation system management coverage (% of arterial road traffic signals with real-time optimization measures) | N/A | City-wide (annual) | TBD | High |
| (b) Increase transit efficiency | Transit efficiency (passenger-km per vehicle-km) | Year | City-wide (annual) | *N/A* | Medium to high |
| (c) Spread peak travel demands - roads | Peak period factor for roads (% of daily person-trips in a.m. + p.m. peak periods) | *N/A* | Aggregated key screenlines (counts, annual) | *N/A* | Low to medium |
| (d) Spread peak travel demands - transit | Peak period factor for transit (% of daily person-trips in a.m. + p.m. peak periods) | *N/A* | Aggregated key screenlines (counts, annual) | *N/A* | Low to medium |
| **7. Manage transportation assets** | | | | | |
| (a) Maintain adequate condition of road, Transitway and structures | Major infrastructure condition (% of road, Transitway and structure lane-km meeting or exceeding Performance Indicator Acceptability Benchmarks) | N/A | City-wide (annual) | 100% | High |
| (b) Maintain adequate condition of walking and cycling infrastructure | Walking and cycling infrastructure condition (% of sidewalk and cycling network meeting or exceeding Performance Indicator Acceptability Benchmarks) | N/A | City-wide (annual) | 100% | High |

| | | | | | |
|---|---|---|---|---|---|
| (c) Maintain adequate condition of transit fleet | Average vehicle age (years) | *N/A* | City-wide (annual) | 9 yr | High |
| **8. Improve transportation safety** | | | | | |
| (a) Reduce death and injury from collisions | Road injuries (number) | Year | City-wide (annual) | 30% reduction by 2010 | Medium |
| | Road fatalities (number) | Year | City-wide (annual) | 30% reduction by 2010 | Medium |
| (b) Increase walking safety | Reported pedestrian collisions (number) | Year | City-wide (annual) | 30% reduction by 2010 | Medium |
| (c) Increase cycling safety | Reported cyclist collisions (number) | Year | City-wide (annual) | 30% reduction by 2010 | Medium |
| **9. Enable efficient goods movement** | | | | | |
| (a) Minimize delay for trucks | Off-peak road congestion (volume/capacity) | Mid-day period | At aggregated key screenlines (annual, counts) | *TBD* | Medium |
| **10. Meet mobility needs of persons with disabilities** | | | | | |
| (a) Increase accessibility of conventional transit service | Bus accessibility (% of low floor buses in fleet) | *N/A* | City-wide (annual) | 100% by 2015 | High |
| | Access to information (% of transit schedule information that is accessible on Web site) | *N/A* | Annual | *TBD* | High |
| (b) Maintain adequate specialized transit service | Usage (eligible passenger trips per capita) | Year | City-wide (annual) | *TBD* | High |
| (c) Increase accessibility of public rights-of- | Pedestrian crossing accessibility (% with depressed curbs) | *N/A* | City-wide (annual) | *TBD* | High |

| | | | | | |
|---|---|---|---|---|---|
| way | Traffic signal accessibility (% with accessibility features) | *N/A* | City-wide (annual) | *TBD* | High |
| | Traffic signage accessibility *(to be determined)* | *TBD* | *TBD* | *TBD* | High |
| **11. Meet public expectations** | | | | | |
| (a) Increase satisfaction with transportation system | Public satisfaction with transportation system (% people rating as good or better)<br>Overall<br>Walking<br>Cycling<br>Transit<br>General traffic | *N/A* | City-wide (annual) | 100% | Medium |
| (b) Ensure transportation funding that is adequate and equitable | Capital investment (dollars per capita in municipal transportation projects)<br>Roads (multimodal)<br>Transit facilities and fleet<br>Walking facilities<br>Cycling facilities | Year | City-wide (annual) | *N/A* | High |
| | Operating investment (dollars per capita in municipal transportation projects)<br>Roads (multimodal, including walking and cycling)<br>Transit | | | | |
| | Reliance on property tax (% of capital investment derived from property tax rather than more equitable sources)<br>Roads (multimodal)<br>Transit facilities and fleet<br>Walking facilities<br>Cycling facilities | Year | City-wide (annual) | *TBD* | Low |

### 3.6.2 Indicators and Measures of Sustainability and Environmental Quality

Sustainable transportation has increasingly come to the forefront of public perception in recent years. As such, an important category of indicators and evaluation measures comes under the heading of sustainable transportation. Generally, sustainability speaks to generational equity; **the ability of the current generation to meet its needs without compromising the ability of future generations to meet their needs**. A common understanding is the concept of the triple bottom line: sustainable practice must balance the economy, the environment and societal issues. Transport Canada and TAC state that sustainable transportation is "**a concept that promotes a balance of the economic and social benefits of transportation with the need to protect the environment**"(Transport Canada & TAC, 2007). In order to utilize sustainability as criteria in the development of long-term transportation plans, communities must be able to use existing data as much as possible when quantifying indicators and evaluation measures.

As discussed **in Section 3.3**, TAC / Transport Canada developed guidelines to aid municipalities in creating sustainable transportation plans (Transport Canada & TAC, 2007). The guidelines also include a number of options that can be used to integrate these principles into transportation plans. It is equally important to develop indicators and measures that allow communities to determine their level of success and to adapt their plans to better meet the community's goals for sustainability. One of the twelve sustainability principles listed in the guidelines speaks to the need to incorporate a performance measurement strategy in any sustainable transportation plan (Principle 10 - see **Table 3-1**). The strategy recognizes that external factors continuously change and thus impact the ability to implement the plan. The strategy also allows decision makers to identify "changes in analytical assumptions, shifts in social or economic circumstances, and updated financial positions." The strategy could account for both qualitative and quantitative measures. A "thorough" strategy could identify "key targets and the relevant indicators to be tracked; data collection activities, resources and schedules; and reporting parameters and frequencies." (IBI & et.al., 2005)

The TAC / Transport Canada guidelines cited two "notable" Canadian examples (IBI & et.al., 2005):

- The Capital Regional District's (Victoria, BC) Regional Growth Strategy (long-range development plan) incorporates a monitoring programme that measures transportation outcomes against sustainability and other objectives and specific targets. The measures include annual transit ridership (total and per capita); number of insured passenger vehicles (total and per capita); work trip modal shares for the region and sub-regions; modal shares (daily and p.m. peak period) for various modes; p.m. peak period non-auto modal shares to/from/within the metropolitan core or CBD; weekday VKT per capita; length of cycling facilities by types in various areas; and, percent of homes within 400 metres of minimum-frequency transit service. The programme requires for data to be collected at 1-, 2- or 5-year intervals (depending on the indicator) and to be compared against 2001 baseline data. Benchmark comparisons also are to be made against other communities every 5 years, along with periodic status and progress reports.

- The City of London's 2004 Transportation Master Plan identified the need for annual "state of the system" reports and for any plan amendments that arise from new traffic data, trends, TDM initiatives, etc. Performance measures include the reduction in the use of single-occupant vehicles, the increase in overall average road capacity and the transit modal share.

(The TAC / Transport Canada guidelines also cited the aforementioned 2003 Ottawa Transportation Master Plan as a third "notable" Canadian example.)

Non-Canadian examples also were cited. Of interest is the City of Boulder, Colorado 2003 Transportation Master Plan. Relevant indicators included congestion levels and their duration; emissions of Criteria Air Contaminants; corridor service levels; quality of facility performance (pedestrian, bicycle and transit); and a city-wide mobility index for all modes (using a weighted index).

Of relevance to this study, the Boulder example is of interest for two reasons: it is a fast-growing, medium-sized city of approximately 100,000 residents, in the metropolitan Denver region; and, it speaks to terms that more commonly are associated with road improvements - *congestion*, *mobility* and *corridor* (i.e., as opposed to *road*) *service levels* – but broadening the approach to account for non-auto alternatives. (In other words, it goes back to basics: whereas transit and alternatives to the single-occupant vehicle trip are well established in many Canadian cities, the lack of transit and other alternatives in smaller communities *may* require a similar reference point in order to help stakeholders understand the concept.)

Another approach is provided by Hellinga and McNally. They developed a preliminary set of evaluation measures in three performance indicator categories: integrity of living systems; efficiency; and sufficiency, opportunity and equity (Hellinga, B & McNally, R, 2003). From an initial list, they chose five evaluation measures to be used in the model. The five measures were selected because they could produce a quantitative result using data that are readily available or are easy to collect, and because they are applicable at the project or local policy level. The authors acknowledged that communities can, and should, expand their final list as a greater variety of indicators become available. By category, the five factors are:

- Integrity of Living Systems
    - Total emissions
    - Emissions per trip unit
- Efficiency
    - Total energy use
    - Energy use per trip unit
- Sufficiency, Opportunity, and Equity
    - Quality of service

### 3.6.3 Applicability to Small- and Medium-Sized Communities

The indicators and performance measures described in the preceding sections could be applied to communities of any size. Generally, then, the applicability of these measures to small- or medium-sized communities depends upon the specific issues that are of interest, coupled with the availability of relevant data and information (which, in turn, can be limited by resources).

Three American studies provide further guidance. Schutz describes the development of performance measures based upon planning goals for a long-range transportation plan in Island County, Washington. (Schultz, J., 2002) The county comprises two residential, retirement and recreational island communities just north of Seattle. Its sub-regional transportation master plan was based upon the plan for the larger region, under the direction of a "Sub-Regional Technical Advisory Committee." In order to develop performance measures, the Committee members were asked to rank the importance of the sub-regional plan's 26 goals. The ranking identified several recurring themes among the goals, aimed mainly at maximizing the utility of the transportation system by encouraging the use of transit and other efficient means of travel. In turn, the 26 goals were reduced to 4 key goals, which then were restated as performance measures. The 'usability and relevance' of each measure was then evaluated against a set of criteria. In the author's words, the measure:

- "Is accepted by and meaningful to the customer.
- Tells how well goals and objectives are being met.
- Is simple, understandable, logical and repeatable.
- Shows a trend.
- Is unambiguously defined.
- Allows for economical data collection.
- Is time.
- Is sensitive."

Two other measures also were adopted, to measure the utility of the planning process itself, as required by the state Department of Transportation.

Next, an approach was developed to prepare the actual measurements. The approach had four guiding elements:

- "Keep it focused.
- Keep it flexible.
- Keep it meaningful.
- Keep it consistent."

**Table 3-3** summarizes the six measures. The first column describes the measures, as translated by the Committee from the plan's goal statements. The table also states the "what" and the "how" to measure. The measures and their development are noteworthy for several reasons. They:

- Were derived by stakeholders according to that group's interpretation of the plan's goals.
- Were developed according to a clearly defined set of practical and simply yet comprehensive criteria.
- Are expressed in practical, straightforward terms.
- Stress measurements based upon observed, actual conditions over time, which can be easily developed locally.
- Relate specifically to the local goals of Island County, regardless of whatever else the regional goals might say.
- Use available information, which includes a travel demand forecasting model.
- Speak directly to financing, affordability and the need to maintain infrastructure (i.e., issues that typically drive transportation planning processes in small- and medium-sized communities).
- Account for the planning process, in addition to the plan itself.

**Table 3-3: Measurement System – Island County, Washington TMP**

| Measure | What to Measure | How to Measure |
|---|---|---|
| Emphasize the movement of people and goods rather than vehicles in order to obtain the most efficient use of transportation facilities. | Mode split | Count vehicle occupancy at points where concurrency will be monitored, in the p.m. peak hour. |
| Increase the efficiency of the sub-regional road and highway system by maximizing use of existing facilities. | Travel time | Drive Whidbey Island from Clinton to Deception Pass each year on the same day of the year and compare travel times. |
| Protect the capital investment in the transportation system through adequate maintenance of facilities. | Pavement management | Evaluate the degree to which the pavement management system of each jurisdiction is keeping up with its goals. |
| Actively promote transit service throughout the Island sub-region. | Identify a promotional plan | Degree to which the plan is implemented annually. |
| Travel forecasting from the State DOT model.* | Compare concurrency counts with forecasts annually | Take peak hour count from the 24-hour count for concurrency annually. Project forecasts linearly. |
| Implementation of the plan.* | Dollars spent on projects identified in the financially constrained plan | Compare expenditures annually against inflation-adjusted portion (5%) of the 20-year plan. |

Source: (Schultz, J., 2002)

* These two measures were added, in accordance with the state DOT procedures, in order to assess the planning process.

A second study describes the quantification of mobility levels in small cities. (Schrank, D., 2002) The study applies the Texas Transportation Institute's (TTI's) well-known *Urban*

*Mobility Study* congestion and mobility indicators to Grand Junction, Colorado, a city of 50,000 residents. The study is important for several reasons:

- It demonstrates how 'big-city' methods can be applied to small- and medium-sized communities.
- It acknowledges that small- and medium-sized communities also have congestion and mobility problems, and that their travellers also desire faster travel, improved trip-time reliability and reduced delay.
- It focuses on measurements for arterials, as opposed to the expressway / major arterial orientation of the larger-city application.
- It demonstrates how data can be collected in small- and medium-sized communities. (The issue here is that much of the data used in the *Urban Mobility Studies* is developed according to nation-wide data collection standards and criteria, which may not necessarily apply to smaller communities.)

Finally, TTI researchers also developed guidebook to quantify congestion in communities having a population less than 250,000.(Eisele, W. & Crawford, J., 2008) They note that congestion exists in these communities, and that it "is often highest along state highways that also serve major local travel functions." There is much literature available on measuring, monitoring and improving large urban area congestion, but resources are scarce for these smaller communities. Hence, this guide was developed to address these gaps: "potential solutions and performance measure targets necessarily are much different for smaller communities than those identified in the literature for urban areas." The research developed a six-step mobility monitoring framework and tested it in two communities in Texas.

The six steps are:

1. Identify the needs and opportunities.
2. Create a monitoring plan.
3. Monitor the system.
4. Analyze the data.
5. Package and distribute the results.
6. Continue the monitoring.

The technical analyses and data collection build upon existing TTI / *Urban Mobility Study* indicators and techniques. However, much emphasis is placed on "making the framework easily understood and implemented" through graphics and user-friendly techniques.

## 3.7 Prioritization Strategies

Several decision models are available for prioritizing improvements. These require quantitative or economic values, while others rely on a qualitative assessment of the economic and social impacts of an alternative improvement, or some combination of the two. The authors of (Cambridge Systematics, Inc., TransManagement, Inc., TransTech Management, Inc., & Heanue, K, 2007) developed four decision methods for freight, which also can be applied to all types of projects (Cambridge Systematics, Inc., TransManagement, Inc., TransTech Management, Inc., & Heanue, K, 2007): benefit-cost analysis, cost-effectiveness analysis, equity impact analysis, and multi-criteria weighting analysis.

Hellinga and McNally also provided an example of a method to use their aforementioned indicators in choosing the most sustainable alternative for a transportation project. The authors weighted each performance indicator within its own category. This weighting reflected the place of the indicator within the larger goals of the community, or its strength relative to the other indicators in the same category. Similarly, the authors assigned each category of performance indicators a weight against the other categories.

The authors then analyzed each of the transportation improvement alternatives according to the sustainability indicators, and determined an indicator value for each alternative – for example, the total emissions for each alternative. They compared the calculated performance indicator values in every category to a baseline value. This resulted in each alternative having a score for each indicator.

Finally, the authors calculated a total score for each alternative. First, they multiplied the weight for each indicator by the score for the alternative. By summing the values, they determined an overall score for each alternative. The alternative with the best total weighted score was determined to be the most sustainable (Hellinga, B & McNally, R, 2003).

The method provides a multi-criteria comparison is a transparent method of selecting an appropriate alternative based on the performance indicators chosen by a community. Weights can be developed to reflect the community's specific goals.

## 3.8 Summary

This chapter has addressed two major considerations:

- Choosing study types that are appropriate for a community's size, goals, and resources and integrating those studies into an appropriate long-term transportation planning framework.
- Selecting and applying performance indicators and evaluation measures and using these indicators and measures in a prioritization strategy that ensures that a community's transportation network and plans are in line with its goals.

### 3.8.1 Building a Long-Term Transportation Planning Study Framework

There are a number of long-term transportation plan types that a community should consider in building a transportation planning framework. The major plans cited in this report are:

- Transportation master plans or strategies, including bicycle and pedestrian transportation master plans
- Sub-area or neighbourhood transportation plans

- Corridor planning studies
- Transportation capital programmes / budgets
- Development charge studies
- Transit service or operational plans
- Policy or research / background studies (e.g. funding)
- Travel demand management studies
- Air quality / congestion management studies
- Freight / goods movement plans or strategies
- Environmental assessment / functional planning studies

Some of these types are triggered by regulatory requirements, while others are initiated to meet a specific identified need. Functionally the different study types are related. Moreover, some communities may link their planning studies via a top-down process, while others may use a bottom-up procedure.

A top-down approach might start with a community plan and TMP, then proceed to implementation studies and, according to priorities agreed through the TMP process, to specific area or facility studies. Special studies, such as a pricing policy, might be developed to support the TMP.

A bottom-up approach might start with a corridor planning study. That study might result in an environmental assessment but under this organizational scheme, the likely need also to address capital budgeting in turn would identify the need for a coordinating, big-picture statement; that is, for a TMP.

### 3.8.2 Suggested Evaluation Measures and Performance Indicators

The sections above describe a wide range of evaluation measures and performance indicators. Small- and medium-sized communities may not have the resources to consider all of these measures. This section outlines some of the most applicable performance measures for small- and medium-sized communities; however, each community must develop its own list of measures and indicators. Planners should apply the following criteria when selecting performance indicators and evaluation measures.

1. Measurable, quantifiable, and easy to obtain.
2. Reflect the goals of the community
3. Applicable to that project/policy
4. Clear to policy makers and the public

The evaluation measures and performance indicators discussed here can be used to monitor actual performance, tracking a community’s progress over time against stated goals. Using many evaluation measures and indicators to track progress does not require a complex model as many measures can be obtained directly from historical data or surveys.

Measures and indicators also can be used to prioritize improvements, or choose from a number of alternate solutions. **Section 3.7** describes these types of strategies. When measures and indicators are used in this context, that is, to prioritize projects or choose the most appropriate alternative, they require some predictive capability. The planner must understand the implications of proposed changes on the measures and indicators, through either calculations or the use of a model.

This report includes a large number of overlapping performance indicator categories. Below is a list of five major categories:

- Accessibility / mobility
- Reliability
- Economic development
- Safety
- Social and environmental sustainability

Together, these five performance indicator categories present a balanced view of transportation planning projects. Communities should assess their goals and decide which combination of specific performance indicators and evaluation measures are most appropriate for their needs. The exact list of evaluation measures used in each category will change from community to community and from project to project within a community. It is important to express measures in terms that are meaningful to the community: for example, the notions of congestion, mobility and corridor service levels largely speak to road needs and auto travel; but these also often are the issues that predicate transportation planning in small- and medium-sized communities. However, these can be broadened to account for non-auto alternatives, thus allowing sustainability concepts (for example) to be introduced meaningfully into the discussion.

There are different methods of assessing the level of achievement in each evaluation measure or performance indicator. These methods range in the type of resources required.

- Statistics Canada has Census data available, including population, employment, and economic data

- Land use data from internal sources

- Stakeholder consultation can be a source of more qualitative information which can still be used to assign values to some evaluation measures

- Some data can be collected through surveys

- Model output can provide data on the existing (calibrated) or future transportation system

- Additional information, such as accident data or transit ridership may be available from another agency or internally within the municipality

As discussed, every community must choose its own performance indicators and evaluation measures. Some measures are more applicable for small- and medium-sized communities. **Table 3-4** presents a number of measures and indicators that can be gathered from a variety of data sources. Communities may wish to add measures that are not on this list.

## Table 3-4: Suggested Indicators and Measures

| Performance Indicator / Category | Evaluation Measure | Measurement Unit | Possible Data Sources | Applications / Comments |
|---|---|---|---|---|
| Accessibility / Mobility | Bicycle Facilities | Km | Survey | |
| | HOV Lanes | Km | Survey | |
| | Average Travel Time | Minutes | Model Output | |
| | Average Trip Length | Minutes | Model Output | |
| | Overall mode split | % of trips by each mode | Survey, Model Output | |
| | Total Travel Time | Minutes | Model Output | |
| | Delay per VKT | Seconds per km | Model Output | |
| | Lost time due to congestion | VHT under congestion | Model Output | |
| Reliability | Level of Service (Intersection, movement) | Letter grade based on seconds of delay | Micro-simulation Output, Survey | Intersection level or movement by movement |
| | Volume/capacity ratio | (no unit) | Model Output, Micro-simulation Output, Survey | Intersection level or movement by movement |
| | Travel Speed | km/h | Model Output, Micro-simulation Output, Survey | Average speed on a corridor, average speed on given road classification on a network, average speed (including stop time) for transit |
| Economic Development | Economic cost of accidents | Costs | Research, accident data | Benefit cost ratios for possible improvements |
| | User Cost Distance | Vehicle operating costs ( per km) | Model Output | |
| Safety | Number of accidents per year | Number of accidents (given type) / year | Accident database | |
| | Number of accidents per capita | Number of accidents (given type) / person | Accident database, Statistics Canada | |
| | Number of accidents per VKT | Number of accidents (given type) / km | Accident database, model output | |
| | Average response time for emergency services | Minutes | Stakeholder Consultation | |
| Social and Environmental Sustainability | Sidewalk coverage | % of given roadway classification (one side or two sides) | Survey | |
| | Overall mode split | % trips by each mode | Survey, Model Output | |
| | Fuel usage | Litres | Model Output | |
| | GHG or Air Contaminant Emissions | Tons or tons/person | Model Output | |
| | Traffic noise exposure | Traffic volume | Model Output | |
| | Relative growth in traffic volumes | % change in volumes / % change in population | Survey, Model Output | |

# 4. BEST PRACTICES IN APPLICATION OF TRANSPORTATION PLANNING TOOLS

The tools of transportation planning give communities the capacity to complete the long-term transportation planning studies discussed in the previous section. Tools for different levels and intensities of planning exist and communities must choose those that are appropriate for their size, budget, and planning needs.

The following discussion has five parts. First, **Section 4.1** outlines the concept of transportation planning tools and introduces the types of topics that are addressed in the remainder of the chapter. **Section 4.2** discusses travel demand forecasting models and trend analysis, with specific consideration of best practices for small- and medium-sized communities. **Section 4.3** amplifies this discussion with a review of current Canadian practices. **Section 4.4** presents the challenges and opportunities faced by small- and medium-sized communities in Canada regarding the acquisition and application of these methods and tools. This discussion is followed by a review of forecasting and micro-simulation tools in **Section 4.5**. **Section 4.6** presents a decision-tree for identifying specific modelling approaches and tools. **Section 4.7** summarizes the chapter.

## 4.1 Introduction

Planning authorities have a wide variety of travel estimation methods and tools available to them. These tools require varying levels of effort and types and intensities of data and result in different levels of analysis. The authors of this guide intend this section to provide practitioners and representatives serving small- and medium-sized communities with the knowledge they need to choose and use travel demand estimation methods and tools. The chapter provides knowledge about standard travel demand forecasting methods, including a brief overview of the techniques utilized to complete travel demand forecasting. It also explores alternative methods. Finally, the chapter provides information to help municipalities make informed decisions about the best tools available.

## 4.2 Travel Demand Estimation Methods and Tools

The demand for travel is a derived demand; that is, people travel in order to partake in some land-based activity. Travel demand forecasting predicts the volume, type, start and end points (e.g. origin and destination), and distribution of “trips” on a transportation network as a function of land use. Travel demand can be expressed in terms of the movement of individuals (person-trips), goods (commodity flows) or vehicles (vehicle-trips). A “trip” always refers to travel between two points for one purpose, such as between home and work, or work and shopping. This definition allows for the use of multiple modes of travel for the same trip (e.g., walk or dropped off at a bus stop). Travel demand forecasting tools allow practitioners to estimate the impact of changes to the transportation network and surrounding land uses on the volume, route, and mode of travel. By estimating travel demand for different situations, communities can plan and make informed decisions regarding growth and improvements to the transportation network, which is the goal of long-term transportation planning.

### 4.2.1 Primer on Travel Demand Forecasting Methods

Forecasting travel demand (see definition above) can employ manual methods, computer software or a combination of the two. Computer-based travel demand forecasting models require extensive details for land use, travel demand and the transportation network before modelling can proceed. Smaller communities may therefore prefer to use alternatives to a computer-based model for this task (TMIP & Texas Transportation Institute, 1999). In a draft report for NCDOT, Stone et al. note that communities with populations over 10,000 normally require computer-based travel demand models, but that a quick response method can provide sufficient results using default parameters, where appropriate parameters are available (14).[9]

Most often, travel demand forecasting models feature four distinct steps, namely:

- Trip generation
- Trip distribution
- Mode choice
- Trip assignment

Depending on the complexity of the model, the mode choice step can come before or after trip distribution; or it may be omitted entirely. Some models may only implement the trip assignment step.

Before starting the four-step process, the analyst must assemble some type of transportation database. This database must contain information about the highway and/or transit network(s), depending on the type of analysis required, as well as land use data such as population and employment figures, broken down into small regions as available (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998). In a transportation network, links (or sections of roads or transit infrastructure) represent facilities that make up the transportation system, such as roads or transit routes that operate on the roads, and nodes represent locations where the links connect, such as at intersections or transit stops. The analyst may be able to create networks based on a number of data sources, including GIS networks or other digitized maps, depending on the travel demand software used and the analyst's level of familiarity with it.

The type of analysis required dictates the required complexity of the network. Analysts should build networks at different levels of complexity according to the specific situation. Regional networks may only require freeways and major arterials (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998).

[9] 'Quick response' describes simplified rates, parameters and factors that are derived from observations elsewhere, and which can be applied to spreadsheet analyses: their primary benefit lies in their simplicity; however, they are not necessarily transferable or applicable to the specific community at hand.

Networks often feature graded levels of detail, where the complexity of the road system decreases away from the specific municipality or area of interest.

Transportation Analysis Zones ("TAZs" or "zones") divide the municipality into relatively homogeneous areas of land use and activity. These areas have, as far as possible, clear boundaries, commonly denoted by changes in land use, natural dividers (such as rivers) or major transportation infrastructure (such as railways). Each TAZ aggregates land use data (e.g. population, jobs and household characteristics such as household size), for all households and employment centres within its boundaries. All trips within the municipal area will start or end at a TAZ. A zone centroid, located at the demographic centre of each TAZ, represents the origin or destination point for all trips from or to that zone. Centroids must connect to the network at points where traffic would typically enter the traffic system (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998).

The number and size of TAZs affect the complexity of the model. In a draft NCDOT report by Stone et al., the authors recommend that communities with populations between 10,000 and 50,000 use between 10 and 15 zones. In the same report, the authors outline the following recommendations for defining TAZ:

- "The size of the zones should reflect the level of analysis desired.
- Zones should bound homogeneous activities as much as possible (residential, commercial, industrial, mixed use, etc.).
- Zones should consider natural boundaries and census designations.
- Zones should follow geographic boundaries where possible ([major] roads, railroads, streams, etc.).
- The density of development across the zone should be relatively even.
- The number of trips generated by each zone should be relatively equal and the total trips generated by any one zone should be less than 10 – 15 thousand.
- The size of the traffic analysis zones should reflect the purpose of the intended analysis.
- It is important when establishing zones to consider their compatibilities with the transportation network to be used. Consideration should be given [as] to how the zone will load to the network.
- [As a general rule,] the [superior] network should form the boundaries of the zones (Stone, J. R., Huntsinger, L. F., & Khattak, A. J., 2007)."

#### 4.2.1.1 Trip Generation

Trip generation is the first formal step in the four-step forecasting process. On a typical day, people travel from one place, e.g. their home, to another, e.g. their workplace. This travel, starting at one place and ending at another, is a trip. A trip can be made by an individual or by a vehicle, but normally trip generation is completed for individuals; that is, person-trips. The trip generation step of the four step process estimates the number of trips created within the boundaries of a TAZ. The total trips generated by a zone are either produced by the zone (i.e. the trip starts in that zone) or attracted by the zone (i.e. the trip ends in the zone).

To understand the relationship among generation, production, and attraction, consider the example of a residential neighbourhood. In the morning peak hour when people leave to go to work, school, or some other activity, they create trips out of the area (production). In the same time period, people returning home, perhaps from dropping their children at school or from a night shift, create trips to the area (attraction). Similarly, trips destined to an employment area are attracted to the area. Together, trips that are attracted and produced represent the total trips generated by the area. Some of these trips may start and end in the same zone. Different land uses (e.g. residences, schools, hospitals, office buildings, shopping centres) have different trip generation characteristics.

Trips are governed by their trip purpose. The most common ones are home-based work, home-based non-work, and non-home based, but it is possible to include other trips (e.g. school, shopping) depending on the accuracy required. Trips that start and end within the study area are called internal trips. External trips start or end outside of the study area. In addition to these two classifications, through trips include vehicles that use the transportation network without starting or stopping within the municipal area. For stand-alone small- or medium-sized communities, where a significant portion of the population finds employment outside of the community (or the community serves as a source of jobs and commerce for the surrounding area), external and through trips can comprise up to 30% or more of all trips (14) As a result, a separate treatment may be needed to address these trips: this is described in **Section 4.2.1.2** below.

Information about land use enables the amount of travel generated within the municipality to be estimated. Factors such as vehicle availability, household type and size, density, and employment type can influence the number of trips that will be generated by a given zone (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998). The ideal method to customize the travel demand model for local conditions is to utilize locally developed travel data based on home and/or workplace travel (origin-destination) surveys, which provide the most comprehensive source of data. However, many stand-alone small- and medium-sized communities do not have the resources to complete these types of surveys, although communities that are part of a larger region often have access to a regional travel survey. There are two alternatives to using local data. These are (TMIP & Texas Transportation Institute, 1999):

- Using borrowed trip rates

- Updating trip rates from previous survey data

The first option, using borrowed trip rates, comes with several caveats. Different geographic locations can have distinctly different local conditions and produce different trip rates. It is possible to use rates from areas with similar characteristics with reasonable accuracy, but the results will depend on the similarity of the area to the local situation (TMIP & Texas Transportation Institute, 1999). Published trip generation rates, such as those by ITE, for example, provide site-specific vehicle trip rates. Planners can use household information and model trip rates to determine the trip generation for a zone. Various organizations, including the NCHRP (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998), have created this type of trip generation data. Alternatively, trip generation data can be established from workplace and home travel surveys (TMIP & Texas Transportation Institute, 1999).

For the municipality as a whole, it is necessary to balance the total of all trips produced and attracted within all zones. Each trip must have a beginning (origin) and an end (destination); therefore productions and attractions should be equal. These total values may not initially be equal because of inaccurate trip generation rates and inaccuracies in the number and types of households, and particularly available employment information. By applying one or more factors to either the trip production data or the trip attraction data, the trip productions and attractions can be balanced.

External trips require special attention. In order to understand external trips, practitioners often depend on cordon counts and origin-destination surveys of external trips. Vehicle traffic entering and leaving a municipality usually does not balance out (i.e. more will enter than leave or vice-versa). The difference should be scaled across all zonal trips to achieve system balance. Note that in most cases household data is more accurate than employment data. Because of this, Martin and McGukin recommend that forecasters use trip productions by purpose as the control for scaling the trip attractions. Special generators such as airports are the exception to this recommendation (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998).

#### 4.2.1.2 Trip Distribution

The second step in the forecasting process, trip distribution, links each trip production to a trip attraction, either in the same zone, another zone, or external to the network. Similar to the case for trip generation, trip distribution tables are required for each trip purpose. There are two principal types of distribution methods: the gravity distribution model and growth factor (Fratar) updating.

Newton’s theory of gravity inspired the gravity distribution model. Like Newton’s theory, the gravity model in trip distribution relies on the fact that the attraction between two zones is proportional to the product of their mass (the quantity of produced and attracted trips) and inversely proportional to the separation between them (represented by distance, travel time, travel cost, or some combination of these).

The gravity model includes two steps; the estimation of “friction factors” and the distribution of trips (i.e. productions and attractions) between zones.

The friction factor reflects the impedance, or cost of travel, between two zones. Each pair of zones will have a different friction factor that is calculated based on the trip time and cost between them. (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998).

In order to estimate the number of trips that will take place between two zones, the forecaster must understand how relatively difficult it is to travel between the two zones compared with trips between other zones. The first step in this process is to compile, in the form of a matrix, ‘generalized costs’ (that is, accounting for travel time and costs, or distance) between each pair of zones. These times enable the forecaster to define the difficulty (impedance) for travel between zones (i.e. friction factors) by using lookup tables. A more complex, but more accurate option is to calibrate friction factors iteratively, as described below.

As an initial estimate, the travel time matrix can use free flow travel times based on the shortest or fastest distance paths between zone pairs. ‘Free flow’ means that travel time is not influenced by congestion - thus it is generally the posted (or greater) speed limit on each link. Travel times are calculated, using distance and free-flow (posted) speed and include the amount of time required to walk to and from transit stops, to park or to access a parked car. When they exist, tolling facilities must be taken into account in the travel time impedances; normally through conversion via value-of-time equivalents. It is also necessary to include average intra-zonal travel times in the matrix for trips made within a zone, even though the intra-zonal trips will be removed are not assigned since they do not cross the zone boundary or use the transportation network. However, it is important not to delete these intra-zonal trips from the matrix, because they identify the extent of internalization (which can be an important indicator of the potential for walking or cycling) and, as a result, they must be included in calculations of energy use, greenhouse gas emissions, travel activity, etc.

Sometimes, time and cost are not enough to explain what may deter people from choosing a certain path. Rivers and bridges, for example, are barriers. In cases such as this, additional adjustments in travel time allow the model to reduce the number of trips across a barrier. Where local data about trip lengths, travel times, and trip patterns are available, the model should be run iteratively and compared at each step with the local data so that the model coincides as closely as possible with actual trip patterns (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998).

Distributing trips using the friction factors described above in a gravity model determines the number of trips between each zonal pair (for each trip purpose). Gravity models utilize the characteristics of the zones, the number of trip attractions and productions of each zone, and the impedance to travel between the zones to estimate the number of trips between zone pairings. The output is a trip table (a matrix) for each trip purpose (home-work, home-school, and so on) that displays where each trip is coming from and going to (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998).

The Fratar or growth factor distribution method involves multiplying known trip patterns (such as for a present or past year) by adjustment factors applied to the total number of trips (trip productions and attractions for each origin and destination). What these adjustments are depends on changes in land use such as population and employment growth. This method can be used as a standalone trip distribution or it can be combined with a gravity model. For the gravity model example given above, the resulting trip table requires adjustment to the trip ends so that the row and column totals match the total productions and attractions in each zone. Martin and McGuckin used the Fratar method to adjust trip ends iteratively for their trip distribution case study. They also used average trip lengths from US census data to check the reasonableness of the average trip length (for each trip purpose) from the model. This check allowed the authors to determine that the free flow trip times were appropriate when compared to actual road network data (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998).

Finally, it may also be necessary to create trip tables that are based upon congested travel times. Whereas free flow trip tables represent the state of the model given no congestion, congested trip tables consider the effects of excess demand causing traffic congestion, and consequently increased travel time between origin-destination pairs. As a result, the impedances between pairs will change and, it follows, the distribution also will change.

The process of creating congested trip tables is similar to the basic process of creating free flow trip tables, but requires some preparatory steps. First, the analyst must convert the person trips from the free flow trip distribution to vehicle trips and run a trip assignment (as described later in this section). After completing the assignment, it is possible to calculate congested trip times for the loaded or congested trip matrix. Applying the same process discussed for free flow trip distribution tables, using the gravity model, the new trip times are then used to estimate the new trip table. The analyst can complete iterations of this process until appropriate average trip travel times are reached (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998). When transit constitutes a significant share of all trips, transit travel times can be incorporated into the process, in combination with the vehicle (auto) trip times, in order to account for trip tables for all modes.

#### 4.2.1.3 Mode Choice

Travellers may decide to travel by different modes; many forecasting models, in areas where there is a viable alternative to driving, reflect this choice to some degree. Mode choice analysis is the splitting of total trips between two zones by each of the possible methods available to make the trip. This division is typically into private vehicle and transit alternatives; however, it can include stratification by auto occupancy (such as treating high-occupancy vehicles as a separate mode) or between auto drivers and passengers. It can also include breaking transit into sub-modes (bus, high speed rail, etc.), and multi-modal trips with access modes (such as a park-and-ride trip, with both an auto and a transit component). The process may also account for non-motorized modes, such as walking and cycling, or for other specific modes, such as school buses. Forecasters can implement mode choice either, as in the order given here, after distribution (a trip-interchange model) or before distribution (a trip-end model). A trip-end model assumes that there is a preferred mode (generally auto drive) and the decision to take an alternate mode does not depend on convenience but rather demographic properties such as age or income. The split between auto and transit usually is done with established trip percentages between zonal pairs. A trip-interchange model, in contrast, allows different modes to "compete" for users.

A trip-interchange mode-choice model type is the most complex component of a four-step process, as it usually requires a calculation to estimate the probability of choosing a specific mode over some other mode(s), i.e. the relative attractiveness of each mode. This depends on the availability and convenience of the competing modes in relation to each origin and destination point, combining travel time (including any waiting or access times) and travel cost, along with a random factor. The higher the time and cost, the less probable it is that the mode will be chosen. A high-speed rail service located within walking distance from a traveller's home will be attractive compared with an auto, while a local bus service requiring a 400 m walk to a stop would be less attractive. In allocating the trips according to the estimated probabilities, the trip table is split by mode into several components before assignment of these trips to the transportation network.

#### 4.2.1.4 Trip Assignment

The final stage of the four-step modelling process is trip assignment, the step that determines the optimal routing for each trip through the auto (and transit if applicable) network(s). Auto and transit trips have different types of assignments, and heavy vehicles are also often assigned separately from personal vehicles.

There may be several possible types of road network assignments available depending on the assignment software used. These fall into two categories—**static,** where the traffic flow remains uniform during the study period (i.e. there is a fixed number of vehicles to travel on the network all of which are assumed to be travelling simultaneously during the study period), and **dynamic**, where the demand varies by small time slices during the study period. Travel time on the road network is usually the key element used to determine route choice although road costs (e.g. tolls, parking charges) also must be taken into account. This is achieved through the expression of impedances in terms of generalized costs, in which monetary cost commonly are translated to travel times via value-of-time equivalents. The values of time may be derived from local surveys or may be taken from sources elsewhere.

Traffic assignment results should always be validated through comparison with observed traffic count volumes at key points such as bridges or municipal boundaries, and by using speed and travel-time surveys to control the model results.

**Static auto assignments:**
Common static traffic assignment types include the all-or-nothing (free flow), user equilibrium, incremental and stochastic approaches.

The simplest of these tools is the all-or-nothing, which calculates the uncongested (free-flow) travel time on each route between two traffic zones, and then assigns all the traffic between those zones to the route with the lowest travel time. The drawback with this method is that it does not account for traffic congestion, which increases the travel time on a route.

The user equilibrium method functions according to Wardrop's first principle, namely: "Each individual road user chooses a route such that the journey would take the same time on each alternate route [between a given origin and destination pair], and switching routes would only increase personal journey time." Where there is no congestion, this is the same as the all-or-nothing assignment, but in other cases, the algorithm shifts vehicles between alternate paths until no individual vehicle can make its trip faster by switching routes. As congestion (volume) increases, speed on each link of the network decreases according to a series of delay functions, which relate the original (uncongested) speed and the assigned volume to the actual speed. The actual speed typically decreases precipitately (with travel time increasing in proportion) as saturation conditions (capacity) are neared. The number of iterations needed to reach this "equilibrium" state, or an approximation of it, varies depending on how congested the network is and how precise the approximation needs to be.

The incremental assignment is based on splitting the trip table into various subcomponents and then assigning them to the network in turn, using for each new assignment the travel times that were set and re-estimated by the previous one, which can be expected to increase as congestion increases with successive assignments.

The stochastic method is similar to the user equilibrium, but takes into account the fact that users may not have complete information on how long each potential route will take to travel, and thus may choose a less than optimal route. There is some random variability allowed in travel times to attain this.

**Dynamic auto assignments:**

Dynamic assignments[10] break up the trip table into individual "slices" of time, with different volumes and travel times for each, and trips are assigned to a slice based on their time of departure. Within each slice, a static assignment distributes the trips on the network. With this method, route choices vary depending on departure time, and even the departure time itself may shift in order to take advantage of less-congested conditions at a different time.

**Transit assignments:**

Transit assignments differ from auto assignments in that they model people instead of vehicles (consequently requiring no occupancy conversion) and the important factor in determining travel times is transit route information and frequency of service (headways), instead of congestion (transit assignments may or may not set a capacity, but the number of travellers will not usually impact overall travel time). Assigning transit to the same network used for the auto assignments can enable the effects of auto congestion to be modelled on

[10] Not to be mistaken for "Dynamic Traffic Assignment (DTA)" algorithms used in traffic micro-simulation procedures.

transit lines as well, and also facilitate the modelling of multimodal trips (such as those involving park-and-ride).

These descriptions of the components of the four-step process illustrate that it is iterative - each component potentially receives input from the other steps of the process. While the distribution step determines the volumes for assignment, the assignment step determines the inter-zonal travel times that the distribution step takes back as input for loaded or congested network assignments. In addition, accessibility between transportation zones can have an impact on land use development and, consequently, trip assignment results can provide input to trip generation as well as distribution. The practice with these models is to continue iterating through the steps until the results of two successive assignments are not significantly different. One feedback loop is likely to be enough to achieve this, in small- and medium-sized standalone communities (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998); although larger regions or sub-areas of larger regions likely will require several more iterations (for example, the regional models in the Lower Mainland have used six cycles for a number of years).

#### 4.2.1.5 Emerging Developments: Micro-simulation Demand Modelling

The four-step forecasting paradigm remains widely used in transportation planning practice around the world. However, several critiques of the process have arisen:

- The ability of the process to address current planning needs. These needs have evolved from the planning of new highways to meet forecasted demand (the originally intended application of the four-step process), to the local optimization of network components or to managing that demand through TDM or use of alternate modes.

- Inconsistencies among the four steps have been identified, with respect to their formulation, parameter values, costs and their variables (Boyce, D. E. & Zhang, Y. F., 1997). As well, the four-step process treats travel choices as independent choices, whereas in reality they are not mutually exclusive. Some models have addressed this by combining steps (e.g., trip distribution and modal split (Boyce, D. E. & Zhang, Y. F., 1997) or the trip generation, distribution and modal split (Kriger, D, Baker, M., Joubert, F., & Joubert, G., 2005)).

- The lack of feedback has been identified as a problem. Some models have incorporated feedback loops, as described above, to allow congested assigned travel times to be fed back to trip distribution. However, there may also be a need to allow for a reallocation of future population and employment which are impacted by a congested network (that is, as opposed to treating land use as a static input).

Forecasting methods can be categorized into two broad groups: macro-analytical methods that are based on zonal averages and micro-analytical methods that are based on individuals and households. The four-step process falls under the first group. Because of their low cost and technical simplicity, macro level forecasts remain popular. However, it is precisely these two reasons that leads to questionable and inaccurate results (Chung, J. H. & Goulias, K. G., 1997). In contrast, micro level forecasts can predict impacts with more detail and accuracy.

More generally, the development of micro-level forecasting capabilities also addresses the behavioural inconsistencies identified above, through the use of activity-based models. This approach treats travel as derived from the demand for personal activities, so that travel decisions become part of an individual's broader activity-scheduling process. In turn, activities are modelled, rather than only trips. The basic travel 'unit' is a tour, which is defined as "the sequence of trip segments that start at home and end at home" (Shiftan, Y et al., 2003). This allows a more consistent and inclusive treatment of the individual's decisions (when, where, why and how to travel); links these decisions for all of the individual's trips over the day; allows the decisions to be analyzed in the context of the decisions of other members of the households; and, allows for consideration of lifestyles (e.g., 'commuting' by internet) (Meyer, M & Miller, E, 2001). The resultant 'chain' of decisions means that higher-level decisions are fully informed about lower-level decisions (that is, decisions are nested) (Urban Analytics Inc.and URS Corporation, 2004). Emerging methods also allow the simulation of individual's activities dynamically, meaning that this micro-level treatment eliminates the need for zonal aggregations; allows the heterogeneous [travel] characteristics of the population to be analyzed; and, has the potential to generate "emergent behaviour" (that is, behaviour is not explicitly "hard-wired" into the model, based upon its calibration to conditions at a particular point in time) (Meyer, M & Miller, E, 2001).

Activity-based models thus have a considerable advantage in terms of accuracy and attention to detail over the traditional aggregated approach. However, the scope of data collection and model design resources required for their implementation remains a major obstacle to their broader use (at least in the short term). None of the survey respondents reported their use currently.

#### 4.2.1.6 Best Practices for Small- and Medium-Sized Communities

In the literature, the specific needs of travel demand forecasting models for small- and medium-sized communities tend to reflect two things:

1. How well they represent the specific travel, demographic, socio-economic and urban form conditions of these communities.

2. The lack of data and the corresponding need to use default rates, or values from other urban areas.

To this end, three alternate approaches are presented below. The first addresses the development of transferable 'quick response' parameters for small communities. The second develops a prototypical small-community model based upon a common set of data that can be calibrated to local conditions, and employing several advancements from large-city models. The third approach considers the development of a sub-area model for a small community that is located within a large metropolitan region.

1. **Transferable 'quick response' parameters for small communities**. Sarasua et al. developed transferable travel demand forecasting parameters for models of urban areas having populations less than 50,000. The object was to provide more specific parameter values than those that are provided in sources such as NCHRP 365, while accounting for diverse demographic and socio-economic characteristics that differ from the national averages that are the basis of NCHRP 365 (in this case, for South Carolina). The research recognizes that the data upon which NCHRP 365 is based – the 1995 Nationwide Personal Travel Survey – tend to reflect rates and values for larger communities (reflecting where the population lives).

   The parameters were based upon local travel surveys conducted specifically for the research. Models were developed for two small cities in South Carolina (populations of 12,00 and 10,000). Each model was calibrated against local ground counts, and then validated by applying the parameters from the second city's model. Key features of the models:

   - Networks were digitized using an AutoCAD base (i.e., using commonly-available software).

   - Trip generation rates were developed from the survey data, and were linked to groups of block-level demographic and socio-economic data that were available from the U.S. Census. Three trip purposes were modelled - home-based-work, home-based-other and non-home-based - along with internal-external trips.

   - The gravity formulation was used to calibrate internal-internal and internal-external trip distributions, based upon travel time frequency distributions. The researchers found that the time distributions were similar for the three purposes, in contrast to those of larger cities, which vary (i.e., with work trips being longest). This was explained in three ways: for smaller cities, limited shopping destinations may increase average travel times for home-based-other trips; fewer local schools similarly increased home-based-other trips; and, long work commutes that skew travel time distributions in larger models are not reflected in a small city's home-based-work trips – instead they become internal-external or external-internal trips. To account for externally-based trips, the researchers developed separate models, based upon a license-plate survey at 16 external stations.

   - Neither community has transit service, so modal split was not considered.

   - Trip assignment was conducted with both the all-or-nothing and equilibrium assignment methods, with little difference in the results (reflecting the networks of the communities).

   The researchers found that there was considerable deviation in the NCRHP 365 rates for many model parameters. For example, the NCHRP 365 trip production rates were 25% lower than those of the two models; and NCHRP 365 trip attraction rates significantly underestimated CBD traffic when compared against ground counts. There were also significant differences in travel time distributions, when using the NCHRP 365 friction factors (Sarasua, W., Clarke, D., & Reiff, R., 2002).

2. **Prototypical model using common sets of data**. The Oregon Small Urban Model (OSUM) was estimated from a common set of travel survey data. The survey was conducted among eight counties across the state (i.e., excluding the large cities), and comprised a two-day, household activity survey of 3,200 households. The basis of the survey was two-fold: better data could be collected from a single, large-scale survey than could be developed from several individual surveys (this was demonstrated from the subsequent models); and, the characteristics of the smaller communities were similar, so that the data could be applied universally. The uses of activities as the basis for the surveys also is noteworthy, and is discussed in **Section 5.4.2** below. Land use and travel time data also were collected. The basic elements of the models were as follows:

   - A pre-generation component estimated the number of households by size and by number of workers.
   - Trips are generated by hour-of-day for five trip purposes: home-based-work, home-based-school, home-based-shopping, home-based-recreation / -other and non-home-based. The pre-generation estimates of households by category are used as inputs.
   - Trip distribution models use a destination choice (probability) model that is based upon a multinomial logit formulation. External trips are estimated using a separate trip distribution process that links internal trips to external traffic zones, in proportion to population and distance. Through trips are estimated using a seed matrix of external-external trips, which are then factored.
   - Time-of-day factors are applied to the resultant matrices, to represent hourly trips total separately for internal and external trips and by purpose.
   - Directional factors are applied to the internal trips, to convert the hourly trips to origin-destination format. Similar, though simpler, procedures are applied to the externally-based trips.
   - Special generators are modelled separately: a shopping mall, a regional community college and a regional hospital, all of which serve the broader region beyond the immediate community and, as a result, have significant impacts on traffic. These models are applied on top of the base model.
   - Trips are assigned using a capacity-constrained equilibrium assignment. Daily and p.m. peak hours models were calibrated. The daily traffic is assigned with hourly link capacities multiplied by 24.

The researchers noted that using the combined “rich” survey data and developing a prototype model halved the model development time (Schulte, B. & Ayash, S., 2004).

The Oregon application provides a successful example of a small-area model, that is sufficiently detailed to support a synthetic household categorization model, several trip purposes, special generators and models of different times of day.

3. **Simplified sub-area model**. Manny and Dawoud developed a sub-area model from the Washington, DC regional model. The model retains the basic structure of the regional model, but accounts for specific differences in household characteristics, person- and vehicle-trip generation rates and modal share rates in smaller suburban communities. These differences otherwise are obviated by the region-wide rates that are incorporated in the large model. The model was developed for Fauquier County, Virginia, located at the urban fringe and which had a 1995 population of 55,000. The resultant model also runs more quickly than the regional model. Four trip purposes were modelled: home-based-work, home-based-shopping, home-based-other and non-home-based.

   Trip distribution models were altered from the regional formulation to account for the different local trip length distributions. The modal choice model was simplified by using and ‘fixing’ the modal split factors that result from the regional model. Trip assignment is based upon an incremental capacity restraint procedure. Finally, three categories of trips not modelled in the sub-area model were taken directly from the regional model: truck trips; ‘miscellaneous’ trips (taxi, visitor and school trips); and through trips (i.e., through the local study area) (Mann, W. & Dawoud, M., 1998).

   This approach demonstrates how a regional model can be detailed to reflect the specific travel, demographic and socio-economic characteristics of a constituent sub-area; and further demonstrates the importance of this approach. In contrast, many sub-area models have focused only on detailing the sub-area networks and zones, without accounting for these different characteristics.

Finally, two other applications that address problems that are typical of models for small- and medium-sized communities are described. The first addresses a common problem in trip generation; namely, how to develop viable rates from small-size travel surveys. The second address the treatment of external trip lengths in trip distribution models, which often are distorted for small- and medium-sized communities which can produce and attract very long-distance trips.

1. **Trip generation using limited travel survey data**. Metaxatos and Morocoima-Black address three problems that occur with any travel survey but are particularly acute with the small-sample surveys that are common to small- and medium-sized communities: outliers (whose impact is magnified in a small survey), reliability (too few observations for a given household category) and imputation (a household category might have no observations at all). The authors use a statistical procedure known as classification and regression tree (CART) analysis to develop reliable cross-categorizations of survey data

for trip generation. The CART analysis identifies how trip generation rates for some household categories for which there are problematic data can be combined in a statistically reliable manner that improves the applicability and accuracy of the resultant models (Metaxatos, P. & Morocoima-Black, R., 2008).

2. **Trip distribution for externally-based trips**. As noted, these trips constitute a significant proportion of overall trips in a small- or medium-sized community. As a result, the calibration of trip distribution models may misrepresent internal-external or external-internal trip lengths. Bei and Hershkowitz examined the applicability of relatively large travel time penalties to the trip distribution model for Parkersburg, West Virginia, a medium-sized community of 151,000 residents. The object was to improve the accuracy of how these long distance trips were simulated (i.e., given that a trip distribution model typically is dominated by the internal trip characteristics). The authors found that average travel time penalties of 15 minutes to the externally-based trips significantly improved the accuracy of the model, compared with models that used small (2-5 minutes) or no penalties – that is, the traditional approach (which again accounts for the internal trip orientation). The impact of the resultant trip matrices were evidenced in the Root Mean Square Errors of the system-wide assignments, which were significantly reduced with the larger penalties in place. The penalties were based upon a local origin-destination survey; however, where survey data do not exist, the authors proposed a simplified method for estimating external travel times based upon observed times between a specific point on adjacent highways and larger regions (Mei, B. & Hershkowitz, P., 2004).

### 4.2.2 Trend Analysis

As an alternative to travel demand forecasting, many planners use trend analysis to forecast travel. In communities where forecasts are required on a limited number of roads within an area, or where there is an extensive survey program to examine ongoing OD trends, this approach may still be applicable. Trend analysis develops quantifiable relationships from historical traffic counts, land use, demographic, economic or income trends, or combinations of these, and then uses the resultant equations to extrapolate these to a future year.

Trend analysis, or trend line forecasting, comprises four steps (Stone, J. R., Huntsinger, L. F., & Khattak, A. J., 2007):

1. Assemble historical traffic data, and historical land use, demographic, economic and/or income data.

2. Develop trend models (see below).

3. Validate and calibrate the developed models by traffic counts and “professional judgement.”

4. Apply the validated model for travel forecasting.

The growth factor and (multiple) linear regression methods are used widely. These are described below (Stone, J. R., Huntsinger, L. F., & Khattak, A. J., 2007):

- **Growth factor**. This method is a popular way to forecast trends in variables that have been increasing over time. The growth factor method works best when the variable to be forecasted is strongly influenced by other variables that inherently growth proportionally – for example, relating growth in traffic to growth in the economy. The method can be applied easily for any data series, making it readily adaptable.

  The method calculates an annual growth factor (GF) and the average annual growth factor (AGF) as a function of average daily traffic counts (ADT):

  $GF = (ADT_t – ADT_{t-1}) / ADT_{t-1}$

  $AGF = (\sum GF) / N$

  where:
  - $t$ = year
  - $t-1$ = previous year
  - $N$ = the number of ADT years[11]

- **Multiple linear regression**. This widely-used statistical method uses one or more quantitative independent variables to predict or explain variation in a quantitative dependent variable (i.e., ADT).

  $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots \beta_n x_n + \varepsilon$

  where:
  - $y$ = natural dependent variable, in this case ADT
  - $x_1, x_2, \dots x_n$ = independent variables, such as population, employment, income, etc.
  - $\beta_0, \beta_1, \beta_2, \dots \beta_n$ = regression constants
  - $\varepsilon$ = error term

  Stone et al. note the choice of independent variables is critical; and this can be done efficiently through the stepwise selection method. The final choice of independent variables should be those that have significant effects on the dependent variable and have a low co-linearity with other variables: the variables also should be meaningful (i.e., not just statistically fit). The coefficient of determination ($R^2$) is commonly used to determine the goodness of fit.

Other methods include the moving average and Box-Jenkins methods.[12]

11 Another accepted approach is to express the average annual growth factor in terms of a compound annual growth rate (CAGR). The choice depends on the circumstance: some observers argue that short-term AGFs are more appropriately defined as a linear function while CAGRs are more appropriate to the medium- or long-term. Others suggest that the CAGR should be used for all time periods, for consistency.,

Advantages of trend analysis are its simplicity; its basis in observed, readily available data; its focus on forecasts for individual facilities or corridors; and its general applicability to areas that are not growing or whose growth is slow and stable (and, as a result, may not need full long-term travel demand forecasts). A monitoring program can assess previous forecasts and determine if the current plan is adequate. This type of action is suitable to areas with populations under 200,000 that have experienced growth in the range of 1% to 2% per year. In addition, communities considering this method should not have experienced major shifts in development or employment patterns (TMIP & Texas Transportation Institute, 1999).

On the other hand, this method has limitations, as it does not fully consider roadway capacity or growth patterns. It is possible to achieve greater accuracy by analyzing past growth and decline in traffic volumes in association with growth and decline in development. One can utilize these values to estimate future growth and development and to revise the past growth rate before it is used to extrapolate into the future (TMIP & Texas Transportation Institute, 1999).

Anderson et al. describe trend analysis in a planning context; that is, as a direct demand model. This approach is consistent with the development of simultaneous travel demand forecasting models, which are more consistent with how travellers make their travel choices and circumvent the theoretical and practical limitations that are inherent to the sequential four-step modelling process (albeit a simplification of simultaneous models).[13]

To be clear, however, trend analysis typically has been applied to a single facility or corridor, as opposed to an entire urban area. However, to this end, Anderson et al. extended the facility-specific direct demand model to cover a small urban area (Anniston, Alabama; a city of 50,000 residents). They developed a multiple linear regression model that predicted ADT on road segments throughout the city (i.e., for which traffic counts existed) as a function of five independent variables:

1. Functional classification of the road segment in question

2. Number of lanes

3. Population within a 0.5-mile radius of the road (i.e., at the location of the relevant count)

4. Employment within a 0.5-mile radius

12 Stone et al. also note that trips can be allocated effectively manually, based upon judgement, experience and local knowledge. However, they further note that this method should be applied only to very small communities, with populations less than 5,000. (Stone, J. R., Huntsinger, L. F., & Khattak, A. J., 2007)

13 For example, simultaneous models account for the fact that the traveller's decision regarding whether or not to make the trip (generation), where to go (distribution), modal choice and even route choice (assignment) may all be linked. The travel demand forecasting models for Calgary and Edmonton account for these choices, among other advanced modelling features.

5. Variable designating the road as a through street or destination street, according to side friction (i.e., a mobility factor).

The research found that this method explained 82% of the variability in the traffic counts. It also calculated both the existing traffic counts and forecasted traffic as accurately as the existing travel demand model. Advantages included the direct demand model's simplicity and ability to account for alternate land use (population and employment) forecasts; although further research was needed to test the utility of other independent variables and ways to incorporate the remaining 18% of the variability into the model through the incorporation of other network or socio-economic variables (Anderson, M., Sharfi, K., & Gholston, S., 2006).

Chimba et al. advocate the use of power functions for small scale traffic forecasts: "small scale" refers to an isolated intersection or to a short corridor. The approach thus is applicable to urban areas of all sizes; however, it is designed specifically for rural and less populated areas for which counts may be limited or sporadic, or for which growth rates are uneven. The power function requires only one "accurate and reliable source of historical data like traffic counts, employment data, economic data, population data, number of registered vehicles or any kind of traffic related data which have direction relation and influence to traffic growth." The power function is based upon any one of these variables, and is validated using available traffic counts.

In addition to its simplicity, the power function follows "real world" traffic growth characteristics, whereby growth rates are highest in the initial years following the opening of a new facility, then decrease gradually as saturation is reached. As an example, a power model for predicting AADT on a highway near a small town in Puerto Rico was developed:

$$AADT_i = AADT_{base} * n^{0.022}$$

where:

- $AADT_i$ = AADT in year $i$
- $AADT_{base}$ = base year AADT
- $N$ = 1, … n years, with n = 1 for the base year

An additional advantage is that compound functions can be incorporated, to account for changes that occur when new capacity is added (e.g., on a road for which there are 20 years of counts, the impact of twinning it at year 10) (Chimba, D., Vargas, F., & Evans, W., 2008).

### 4.2.3 Treatment of External, Through and Bypass Demand

Travel demand forecasting models and trend analysis are applicable to small- and medium-sized communities that are part of a larger urban region, or which are stand-alone communities. However, an issue that is common to stand-alone communities is the consideration of externally-generated traffic. Common examples are shopping trips made by residents of a town to a nearby city (internal-external), work trips from the surrounding rural area to a regional commercial centre or recreational trips from long distances to a resort (external-internal), or through trips (external-external). Given the importance of externally-based trips to the overall travel profile of a small- or medium-sized stand-alone community, there are two related challenges: first, the need to explicitly account for these trips in the modelling process; and, second, a common lack of staff or resources to collect the necessary surveys.

Much of the available research is focused upon through-trip models (external-external) and external-internal models. (Internal-external trips typically are assumed to be incorporated within the urban model, because their characteristics are linked to community residents, similar to internal-internal trips).
The discussion below traces the evolution of these models (**Section 4.2.3.1**). Two additional topics are discussed in **Sections 4.2.3.2** and **4.2.3.3**, respectively: planning for a new bypass and the assignment of through traffic.

#### 4.2.3.1 Forecasting of External and Through Trips

Modlin's 1982 regression-based through-trip model is widely used (Modlin, D., 1982). It was based upon external survey data collected in several small North Carolina communities. It used two phases to simulate trip generation and trip distribution at external stations. Through trips were correlated with highway functional classification, average daily traffic, truck percentage, route continuity and urban area population. NCHRP 365 updated Modlin's regression equations. However, as Han and Stone point out, several key deficiencies remain: the models were calibrated for certain sizes of communities (population less than 50,000); they reflect through-trip patterns that were observed several decades ago; they depend largely on traffic characteristics; and, they do not account for unique study area economic or geographic factors. (Han, Y. & Stone, J., 2008).

With respect to the last deficiency, recent research has incorporated economic and geographic factors into the models. For example, Anderson accounted for the interaction between small communities, nearby major cities and highway facilities (Anderson, M., Sharfi, K., & Gholston, S., 2006): this is important because it recognizes "that the economic context of a study area contributes to through trip patterns and that a study area is not an isolated island."(Han, Y. & Stone, J., 2008). Horowitz and Patel (Horowitz, A. & Patel, M., 2000) improved the through trip distribution method by accounting for geographic characteristics of the study area, such as the barrier effects of natural features (lakes, etc.) and the relationships among external stations (e.g., whether the station is on a road or highway that continues to another external station, or whether it ends inside the community).

Stone et al. used these treatments as a basis for developing a new through-trip model for small and medium urban areas. The models use transportation network data, socioeconomic data, and geographic data to estimate through and external trips, replacing expensive and data intensive cordon surveys (14).

The best-fit model for through trip generation was found to be a single model for small- and medium-sized communities. The model uses a number of parameters for each external node that are relatively simple to collect. These are:

- Average daily traffic (ADT)
- Road classification
- Population in the study area
- Employment in the study area
- An indication of whether or not the road is a 'marginal route' – i.e. if it cuts across the edge of the study area
- Truck percentage
- Size of the study area (land area)

This list of data is much more accessible and less expensive to collect than large-scale cordon line data collection. ADT and truck percentage must be collected on site. All other factors should be available to municipal staff through existing documentation or observation, with the exception of population and employment. In the draft report, U.S. Census data were used for population and employment. The model results in through trip ends as a percentage of ADT.

Stone et. al also derived through trip distribution models, one for small communities and one for medium communities. These were based on similar assumptions as the through trip generation model. In this case, the model approximates the trips between external node *i* and external node *j*, using a number of parameters. These are:

- Route continuity (either 0 or 1)
- Number of lanes at destination station
- Percentage of through trips at each station, as calculated by the through trip generation model
- ADT
- Probability factor for the destination station (i.e., probability of trip being destined to a particular station)
- An indication of whether or not the road is a 'marginal route'
- Two probability factors, based on the specific characteristics of the catchment areas

Once again, the majority of this data is easy to collect or should already be available to local staff. The three probability factors must be calculated, adding slightly to the complexity of the model.

Finally, Stone et. al developed an external trip model, using North American Industry Classification System categories to represent employment types. The U.S. economic census provides employment data by NAICS categories, making the model extremely usable for small- and medium-sized communities. The models, one for small communities and one for medium-sized communities, used only NAICS data to calculate the percent of external trips in the study area. This model is very easy to use with no data collection required for U.S. communities, where employment data by NAICS category is provided. This type of model also has potential applications in Canada if employment data is more readily available in the future. The NCDOT report by Stone et. al includes the complete model and model development procedure (14). The models represent the current state of the practice (at the time of this writing), and so the resultant two-phased models are summarized below, for reference; although it should be noted that these reflect North Carolina data and conditions (Han, Y. & Stone, J., 2008):

Through-trip generation model, for both small and medium sized communities:

$$Y_i = (3.353 - 0.850Other + 1.671Small + 2.682MR + 0.000104ADT - 0.000029Pop + 0.046TRK + 0.0012Area + 0.000026Emp)^2$$

where:

- $Y_i$ = percentage of through trip ends of ADT at external station $i$ (%)
- $ADT$ = average daily traffic at external station $i$
- $Other$ = collector / local roads (0 or 1) – i.e., whether or not the station is on through or local route
- $MR$ = marginal highway route (0 or 1) – i.e., whether or not the station is on a peripheral route
- $Pop$ = population in study area
- $TRK$ = percentage of trucks at external station $i$ (%)
- $Small$ = small urban area (0 or 1) – i.e., whether or not the community has a population less than 50,000
- $Area$ = area size of study area ($mile^2$)
- $Emp$ = employment in study area

Through-trip distribution model – small communities (population < 50,000):

$$Y_{ij} = (1.42 + 1.29RTECON + 0.73D\_LANE - 0.32D\_PTT + 2.00Prob1 + 1.64D\_Zipf)^2$$

Through-trip distribution model – medium communities:

$$Y_{ij} = (0.20 + 5.04RTECON + 0.19D\_ADT\_CD + 1.13Prob3 - 0.04O\_PTT)^2$$

where:

- $Y_{ij}$ = percentage distribution of through trip ends from origin station *i* to destination station *j*
- *RTECON* = route continuity between origin and destination station (0 or 1) – i.e., whether or not the route continues
- *D_LANE* = number of highway lanes at destination station
- *O_PTT* = percentage through trip ends at origin station
- *D_PTT* = percentage through trip ends at destination station
- *D_ADT_CD* = ratio of ADT at destination station to the sum of ADT at all stations
- *D_Zipf* = Zipf's probability factor of destination station (i.e., the measure of one city's attractiveness over the summation of the attractiveness of all surrounding cities), where:

  $$Zipf_i = (P_i / D_i^2) / \sum_i (P_i / D_i^2)$$

  and where:
  - $Zipf_i$ = probability factor of external station *i*, according to Zipf's law of special interaction
  - $P_i$ = population of the nearby major city in the direction of external station *i*
  - $D_i$ = distance between external station *i* and its corresponding nearby major city

- *Prob1* = likelihood of through trip exchange between origin and destination stations when the width of catchment area equals one-quarter of the simulated study area radius (i.e., a likelihood based upon spatial considerations)
- *Prob3* = likelihood of through exchange between origin and destination stations when the width of catchment area equals three-quarters of the simulated study area radius (i.e., a likelihood based upon spatial considerations)

The choice of a single trip generation model for all community sizes and two trip distribution models by community size reflects the best fit equations.

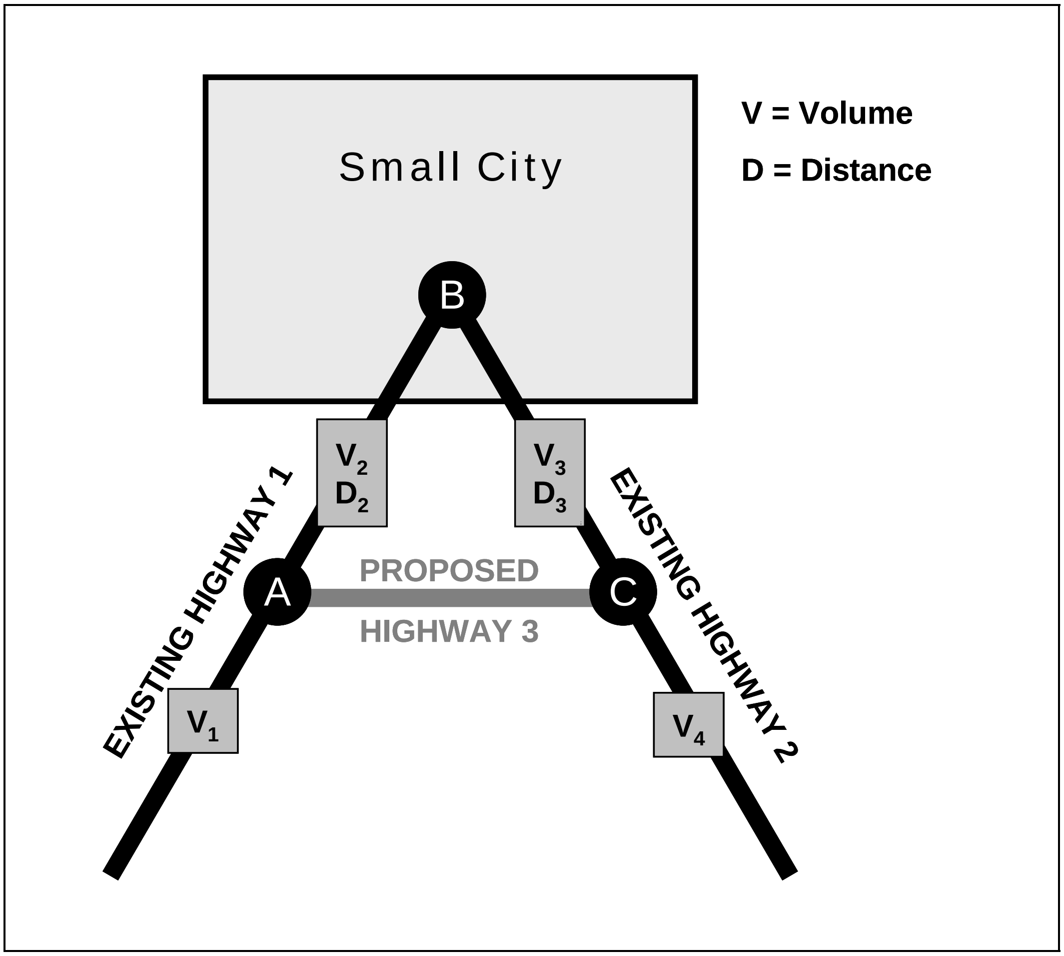
#### 4.2.3.2 Simplified Planning Procedure for New Bypass or Link

A common planning issue facing stand-alone communities is the need for a new link or bypass. A travel demand forecasting tool provides a more comprehensive perspective, and would be the desired approach for analyzing the need for new links. However, the available data or resources may preclude this approach.

A 1999 study concerning transportation planning in small cities in Texas (Schrank, D. L. & Farnsworth, S. P., 1999) presents a simplified procedure for calculating savings in mileage, fuel and travel time in a simplified manner. Although the formulas do not result in completely accurate estimations, local planners can use them to gain a basic understanding of the impacts of different alternatives.

Using **Exhibit 4-1** as an example, the following equations can be used to calculate kilometres saved, vehicle kilometres saved (VKS), fuel savings, and time savings (TS) for vehicular traffic. Note that values represented by 'V' are volumes and values represented by 'D' are distances. In the example given, Highway 3 is a proposed new connection between Highway 1 and Highway 2, and the local planner is interested in the benefits of this connection.

**Exhibit 4-1: Calculation of Impacts – Small City Transportation Improvement**




Source: (Schrank, D. L. & Farnsworth, S. P., 1999)

Kilometres saved = $(D_2+D_3) - D_{NEW}$

$V_{NEW} = [(V_1-V_2) + (V_4-V_3)] / 2$

VKS = $[V_{NEW} \text{ x } (D_2+D_3)] – (V_{NEW} \text{ x } D_{NEW})$

Vehicle-litres saved = $[V_{NEW} \text{ x } (D_2+D_3)] – V_{NEW} \text{ x } D_{NEW})$ / average kilometres per litre

Fuel cost savings per day = Vehicle-litres saved x average cost per litre of gasoline
Minutes used on old route = [($D_2$+$D_3$) / Assumed average speed on $D_2$ and $D_3$] x 60 minutes per hour
Minutes used on new route = [$D_{NEW}$ / Assumed average speed on $D_{NEW}$] x 60 minutes per hour
$TS_{OLD}$ = Vehicle minutes on old route = Minutes used on old route x $V_{NEW}$
$TS_{NEW}$ = Vehicle minutes on new route = Minutes used on new route x $V_{NEW}$
Vehicle hours saved per day = ($TS_{OLD}$ - $TS_{NEW}$) / 60 minutes per hour

It is important to remember that these formulas can be applied only in a general way and that they rely on significant assumptions. At the same time, they make use of available data and tools. By applying a range of values to these calculations, a range of savings can be calculated and applied to decision making (Schrank, D. L. & Farnsworth, S. P., 1999).

#### 4.2.3.3 Assignment of External Trips

An important consideration in modelling external or through trips is the need to ensure that they are assigned properly to the transportation network; that is, that they reflect the most likely travel patterns for externally-based trips. Specifically, it is reasonable to assume that externally-based trips will not deviate from the major road or highway network; and local travellers will make their own route choices with this understanding. However, model assignment algorithms, which usually assign all types of road traffic simultaneously, can result in the inappropriate assignment of external traffic onto the local road network as the algorithm seeks an equilibrium. In turn, this inappropriate mix can result in misleading interpretations of transportation needs, given the higher proportion of external traffic in small- and medium-sized cities (for example, in the planning of a bypass).

A common means of circumventing this problem is to pre-assign (preload) externally-based trips onto the road and highway network, prior to assigning the remaining traffic. This procedure forces the external trips onto the major road and highway network, whether or not that network represents the shortest path. That is, unlike internal trips, the distribution of externally-based trips is not necessarily influenced by interzonal travel times on the study area network. As a result, the process requires more than simply breaking up the assignment.

To this end, Anderson et al. tested the validity of using pre-assignment for Huntsville, Alabama (a medium-sized city). Through (external-external) trips were pre-assigned onto the urban network. The resultant impedances then were incorporated into the four-step (internal) trip modelling process, which proceeded separately. The analysis compared the assignment results with- and without- the pre-assignment procedures, using a license plate trace survey on the city's main urban roads to identify the proportion of external trips.[14] The study found that pre-loading the through traffic improved the assignment results on individual urban arterials by accounting more accurately for the mix of external and internal traffic. (Anderson, M., Olander, J., & Gholston, S., 2004)

14 In Alabama, the first two digits of the license plate identify the owner's county of residence.

## 4.3 Current Canadian Practices

### 4.3.1 Context

Part 2 of the Best Practices for Technical Delivery of Long-Term Transportation Planning Studies survey asked a series of questions about methods and tools used for travel demand forecasting. This section summarizes and compares key survey responses.

However, prior to that discussion, a context is provided by a 2008 state of the practice review in travel demand modelling across Canada (Hanson, T., 2008). Noting the lack of response to a 2004 Transport Canada research funding call beyond two large urban areas and the Ministry of Transportation of Ontario (for the Greater Toronto Area), "the lack of uptake by smaller urban centres and other provincial agencies suggests that provincial and municipal entities across Canada are satisfied with their modelling efforts, or do not see a need to model for purposes other than infrastructure management. Informal interviews with selected Canadian provinces and municipalities suggest the latter is true and that many are at similar modelling levels as many U.S. states, that is, regression or extrapolation-based for road traffic forecasting."

The focus of the review is on the activities of the Provincial ministries of transportation and of key municipalities. **Table 4-1** summarizes the findings of these interviews.[15] It can be seen that the involvement of the provinces ranges from data collection and facility-specific modelling to lead responsibility for the conduct of origin-destination surveys and the calibration of urban models. Resources also vary by ministry. Forecasting by most provincial ministries focused on traffic forecasting for specific infrastructure projects. No province conducted any rural forecasting or modelling, aside from projected traffic counts on major roads.(Hanson, T., 2008)[16] The availability of in-house expertise varied. Some ministries cited a lack of resources as a constraint to modelling. Two provinces apparently considered models to be tools for managing congestion and, accordingly, did not see their applicability to rural highway planning.

15 Summary prepared by the Consultant, based upon Hanson (2008).

16 It is important to note that Hanson's review was conducted for the purpose of understanding modelling capabilities in rural areas, with a focus on the rural older drivers. Hanson found that "little or no rural travel demand modelling exists in Canada."

## Table 4-1: State of the Practice in Transportation Modelling across Canada

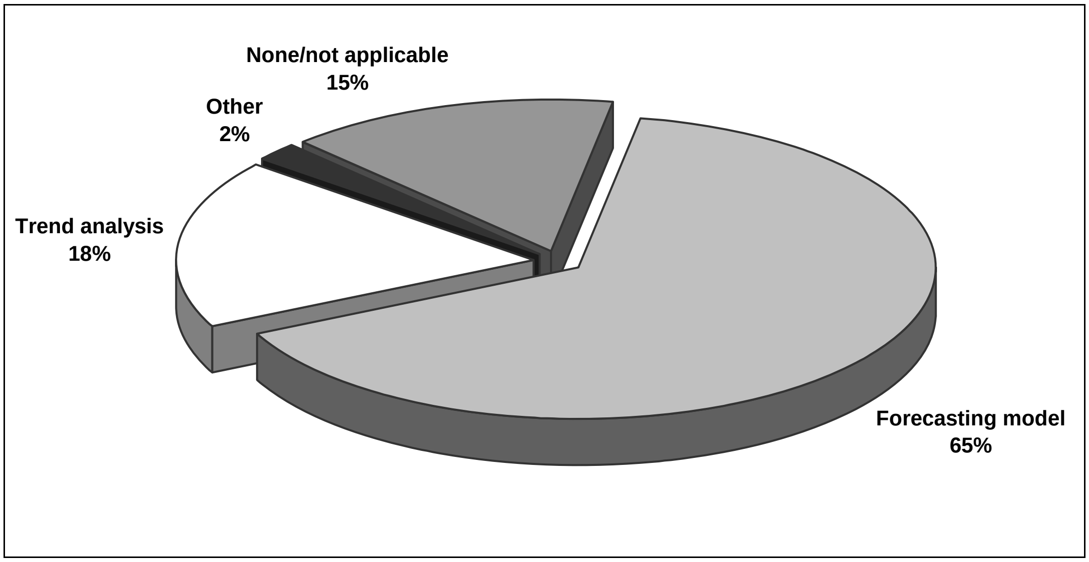
| Province | Modelling / data activities | Municipal models | Constraints / issues |
|---|---|---|---|
| Newfoundland and Labrador Department of Transportation and Works | Modelling is not conducted as part of the normal planning process. | St. John's has a model. | "Likely" reason for lack of modelling is that it "is viewed as a congestion planning tool, therefore not considered applicable for the vast majority of the network under provincial jurisdiction." |
| Nova Scotia Department of Transportation and Infrastructure Renewal | Not often, although QRS II sometimes is used for specific highway studies. Highway forecasts usually based on extrapolation of past volumes. | Halifax Regional Municipality has a QRS II model, based on Census data and traffic counts. ITE trip generation rates are used in lieu of local data or origin-destination surveys. | QRS II software model default values are used "as demographic information is not collected due to various resource constraints." Low cost of QRS II ($500) a factor in choice of software. |
| Prince Edward Island Department of Transportation and Public Works | Occasionally participates in modelling as part of specific studies. | DTPW and City of Charlottetown had consultant develop QRS II model for the city in 2001. | QRS II and Synchro "never found widespread adoption due to staffing constraints and other priorities." |
| New Brunswick Department of Transportation | No modelling. Collects classified traffic data from permanent and temporary counting stations on the highway network throughout the province | Cities of Fredericton, Saint John and Moncton all have QRS II models, based on Census data, origin-destination surveys and traffic data | |
| Ministère des Transports du Québec | In-house modelling and origin-destination surveys capabilities. Modelling in rural areas is on a case-by-case basis. MTQ assists with local corridor O-D surveys and with growth assumptions. MTQ has started to develop a province-wide model of the major road system, using Statistics Canada data to develop the trip data. | Municipalities generally do not have their own models. Accordingly, MTQ provides these models and also the underlying origin-destination surveys (in collaboration with local authorities). | |

## Table 4-1: State of the Practice in Transportation Modelling across Canada

| Province | Modelling / data activities | Municipal models | Constraints / issues |
|---|---|---|---|
| Ministry of Transportation of Ontario | In-house modelling capability. | Participates in five-year origin-destination survey centred about Greater Toronto Area (GTA). Currently developing an EMME model for the GTA/Hamilton region. Also involved in selected other models, e.g., Ottawa, Barrie. | |
| Manitoba Infrastructure and Transportation | No province-wide model. Permanent and program counts province-wide are used for traffic growth projections. TransCAD is used for site-specific modelling projects. Some joint effort with the City of Winnipeg, where provincial / municipal routes overlap. | City of Winnipeg has an EMME model, now being converted to TransCAD. | |
| Saskatchewan Ministry of Highways and Infrastructure | Modelling is not conducted as part of the normal planning process. | Saskatoon and Regina have models. | "Likely" reason for lack of modelling is that it "is viewed as a congestion planning tool, therefore not considered applicable for the vast majority of the network under provincial jurisdiction." |
| Alberta Ministry of Transportation | Highway infrastructure modelling focus, based on projection of past traffic. Origin-destination data collected in roadside surveys. | Edmonton, Calgary and selected other cities and regions have their own models and surveys. | |
| British Columbia Ministry of Transportation | No in-house expertise, in-house models, or provincial-level model. Consultants used if required.<br>Permanent count and short count program. Future demand on rural highways typically is estimated from population forecasts. | Several municipalities have their own models: Greater Vancouver, Kelowna, Kamloops and Prince George use EMME; Victoria region uses TransCAD. | |

**Exhibit 4-2** shows how the survey respondents approach travel demand estimation. Almost two-thirds use a forecasting model. A further 18% use trends analysis, and 15% do not use any method (or the question was not applicable to them).

**Exhibit 4-2: Travel Demand Estimation Methods**

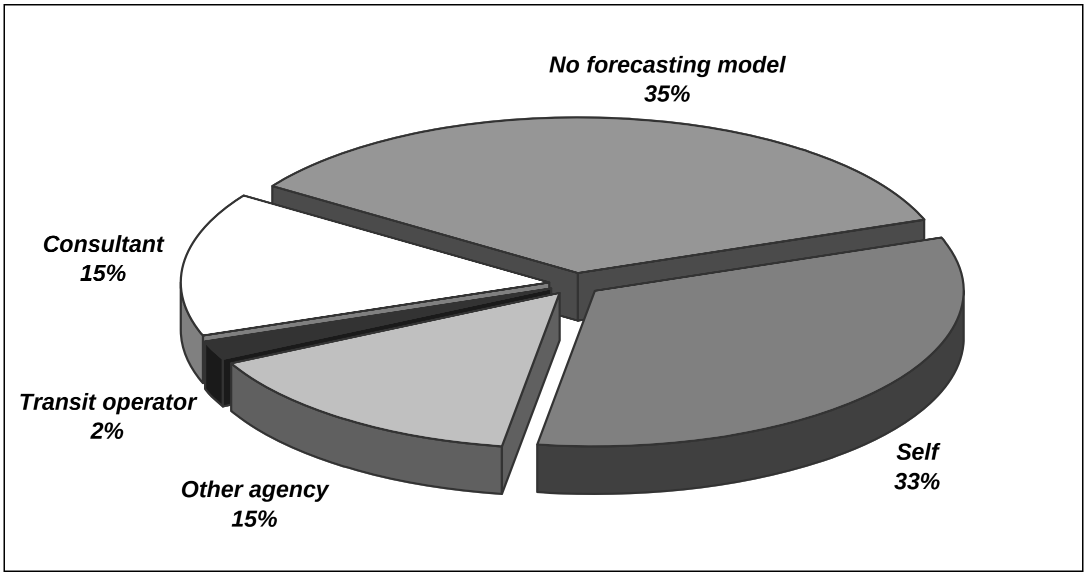



Forecasting models require significant investment and expertise. These models can be developed and operated in a variety of ways. Stone et al. recognized that the NCDOT had four possible options for the development of transportation plans. All four of these options apply to small- and medium-sized communities in Canada. They are:

1. Develop transportation models in-house
2. Sub-contract model development and plan evaluation to outside agencies and consultants
3. Develop partnerships to accomplish modelling and transportation system evaluation
4. Utilize a variety of sub-models that may be more appropriate for the size, needs, and resources of communities. (14).

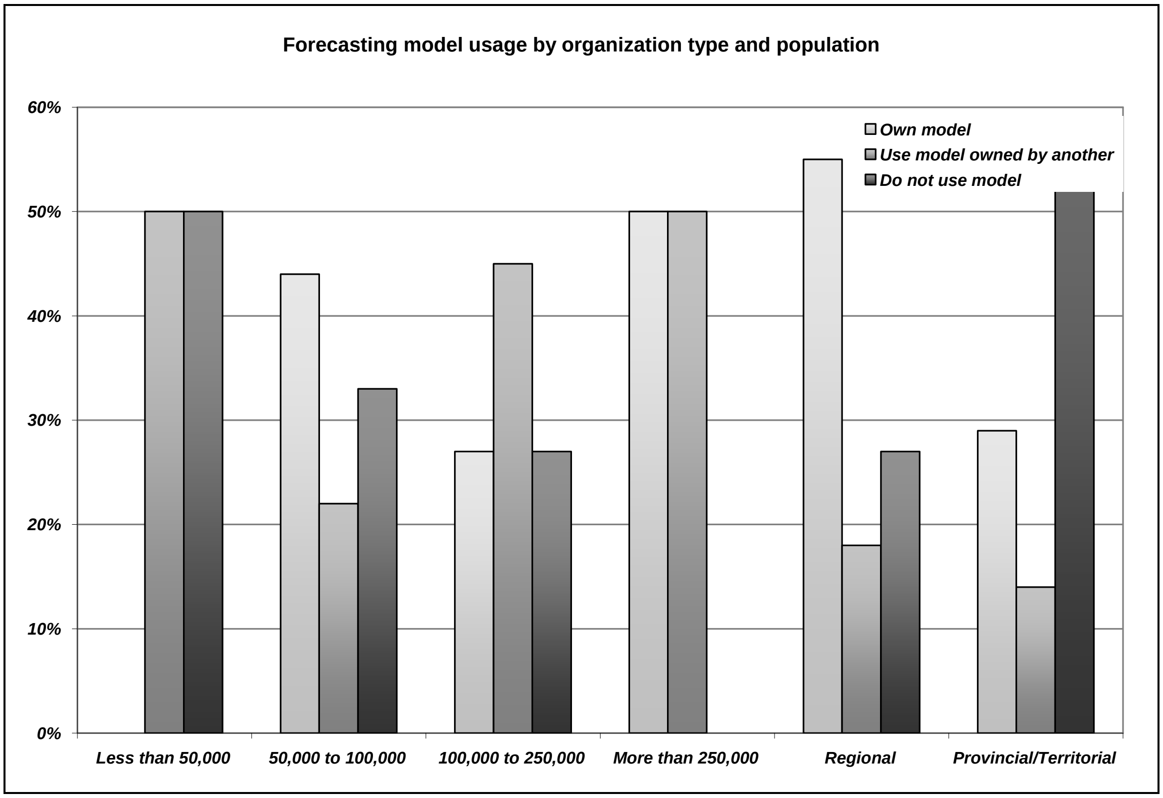
**Exhibit 4-3** describes the ownership and operation of forecasting models (i.e., as an indication of who actually does the work and where the technical resources are located, for those respondents who reported that they use a forecasting model). The respondents divide into three approximately equal groups: those who operate their own model (33%), those who depend on an externally-owned model (32%), and those who do not use a model at all (35%). Model ownership options and partnerships are discussed further in **Section 6.2**.

**Exhibit 4-3: Forecasting Model Ownership**




Model use is not restricted to large municipalities and/or regional governments, but large municipalities and regional governments (with a population over 250,000) are much more likely to have their own forecasting model, as **Exhibit 4-4** shows. Calgary and Edmonton, for example, own and control their model in-house. The model is updated continually and the cities often provide developers or consultants with model output for other studies. Where organizations do have control of their own model, their staff are much more likely to be everyday users (in 95% of cases), as opposed to consultant-owned models (38%) or other-agency-owned models (10%).

**Exhibit 4-4: Model Usage**




Among those respondents who do use models (owned externally or internally), the great majority (82%) have an established model of at least five years' use. However, many have expanded and/or enhanced their models in that time to take into account network changes, availability of new forecasting data, and the introduction of new software.

**Table 4-2** illustrates the relative popularity of several types of enhancements, all of which are being implemented or have been implemented within the last three years.

**Table 4-2: Model Updates, Types and Frequency**

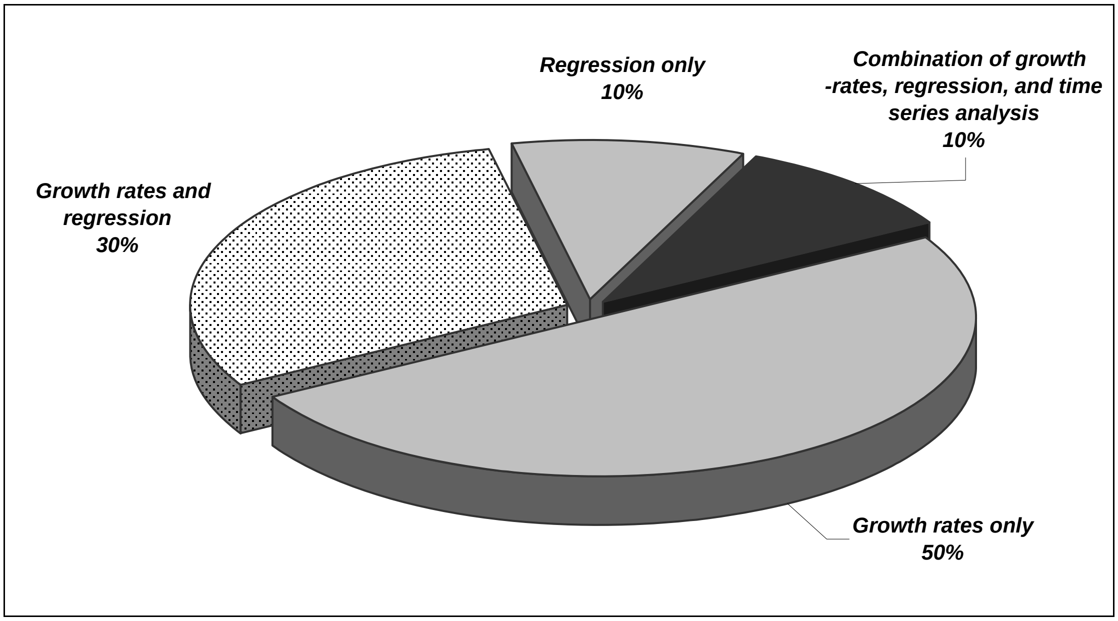
| Type of model update | Percentage | Number |
|---|---|---|
| Updates or changes in software | 8% | 3 |
| Expansion of coverage area | 6% | 2 |
| Increased zone detailing/density | 14% | 5 |
| Upgrades to auto and/or transit networks | 11% | 4 |
| Increased complexity of model | 17% | 6 |
| Recalibration/use of new land use data | 28% | 10 |
| Development of new horizon years | 6% | 2 |

The most common and straightforward upgrade is to make use of the availability of new surveys and data collection, while enhancements to the scope of the model (which includes adding enhancements such as gravity models, logit-based mode split, and commercial vehicle sub-models) are also popular. In several cases, expanded density or the need to focus on a specific corridor or study area have led to increasing the number of traffic zones. Other changes include making modifications to the network such as expanding its coverage area to deal with urban growth or adapting it to account for planned future year alterations.

Of those respondents who identified a specific type of forecasting model that they use, almost all (96%) use a variation of the standard four-step process (generation, distribution, modal split, assignment), although only 70% specifically forecast modal split and 96% specifically forecast trip assignment (all forecast generation and distribution). The only alternative type of model identified involves direct demand estimation based on expansion of origin-destination survey results and examining demographic and modal choice trends between surveys, in order to derive assignment inputs. Further details of modal splits and assignment practices are covered in **Section 4.3.3**.

Ten of the respondents selected “trend analysis” as their forecasting method—four small municipalities, two large municipalities, and four provinces or territories, which indicates that the method is not restricted to a specific type. Out of these, all but one used growth rates to estimate trends, in some cases combining this with regression analysis and/or time-series analysis. The one exception used regression only. **Exhibit 4-5** shows the division between the differing approaches.

**Exhibit 4-5: Trend Analysis Methods**




### 4.3.2 Approaches to Model Calibration and Validation

The most popularly reported calibration method was a screenline comparison, whereby the model is adjusted so that its results match, as nearly as possible, traffic counts taken at key locations on the transportation network. More than 50% of organizations with models acknowledged use of this method, which is reasonable considering that 94% of respondents have some type of traffic count collection and 78% have a formal or ongoing count program. Other methods, compared below in **Exhibit 4-6**, include statistical work to determine significant parameters, and travel time or speed comparisons, where available.

**Exhibit 4-6: Calibration Methods**

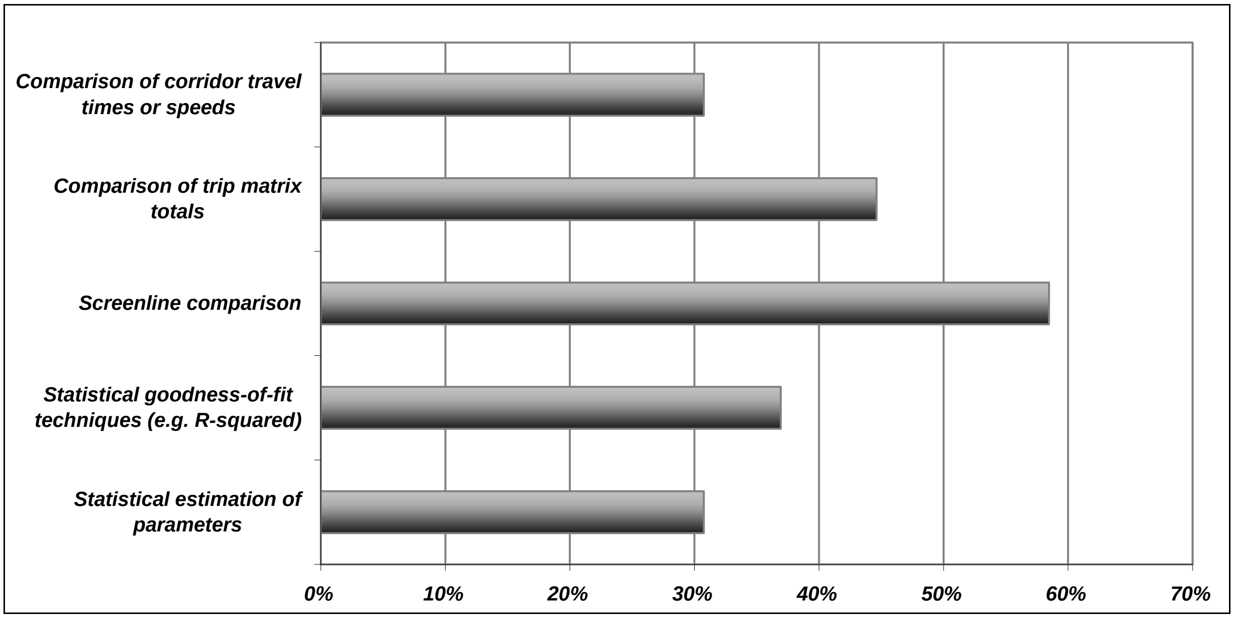
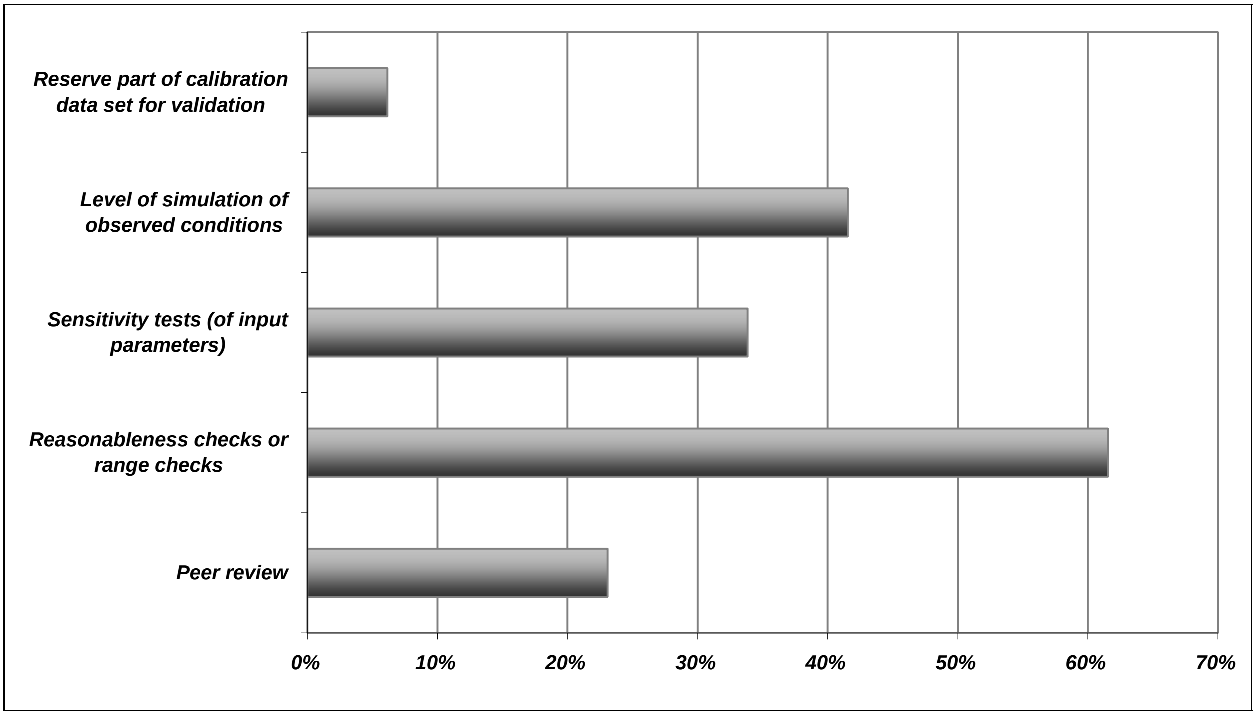


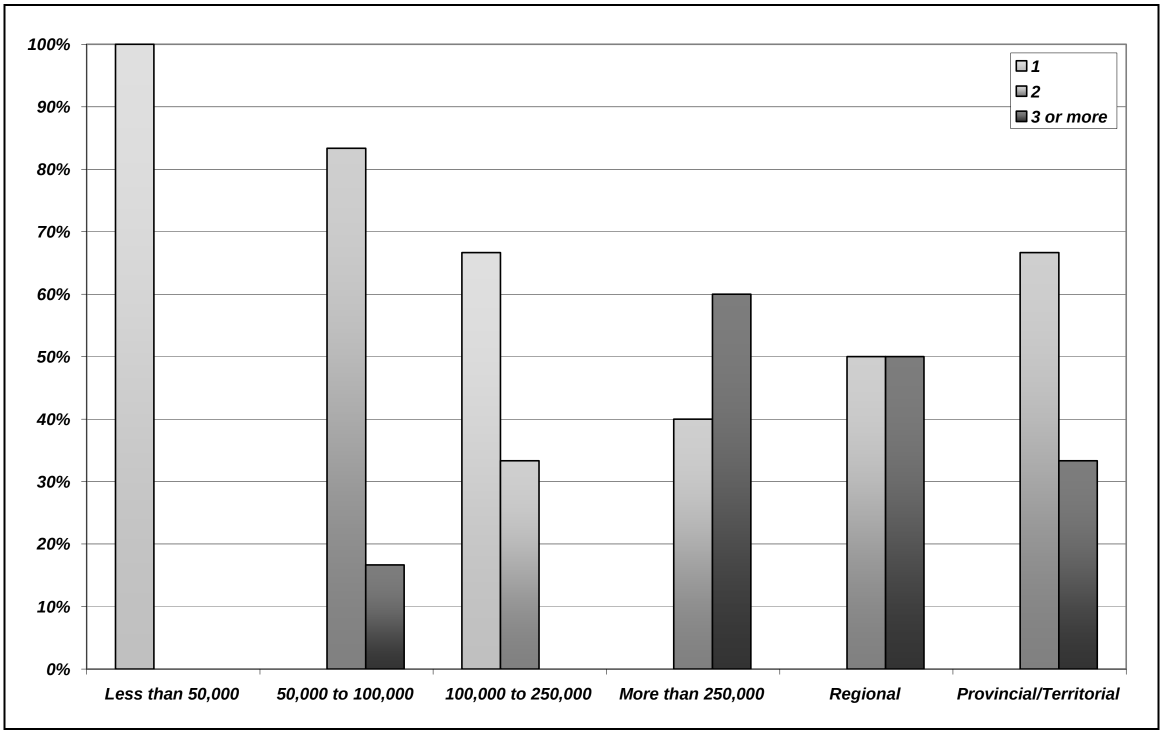

**Exhibit 4-7** illustrates the relative popularity of different methods for validating the model. As can be seen, performing reasonableness checks to test the results is the most common form of validation, used in 62% of cases.

**Exhibit 4-7: Validation Methods**




Most respondents with models use more than one validation method, and in some cases up to four methods. However, as **Exhibit 4-8** shows, the use of three or more types of model validation methods is uncommon among small and medium-sized municipalities.

**Exhibit 4-8: Validation Methods by Type and Municipality Size**




While these approaches are well established and, it follows, typical, the literature provides some examples of more comprehensive approaches:

Schulte and Ayash calibrated a small-area model in Oregon using three simulated / observed link comparisons that normally are applied to larger models. (Schulte, B. & Ayash, S., 2004) These are: link volume scatterplots (a regression of assigned link traffic volumes on the corresponding link counts); percent root mean square error (average relative difference between the assigned and observed traffic counts) and number of links by error range. The calibration was applied to the p.m. peak hour and to daily trips. The use of daily comparisons is uncommon in large models; however, its use is consistent with the available data and trip rates.

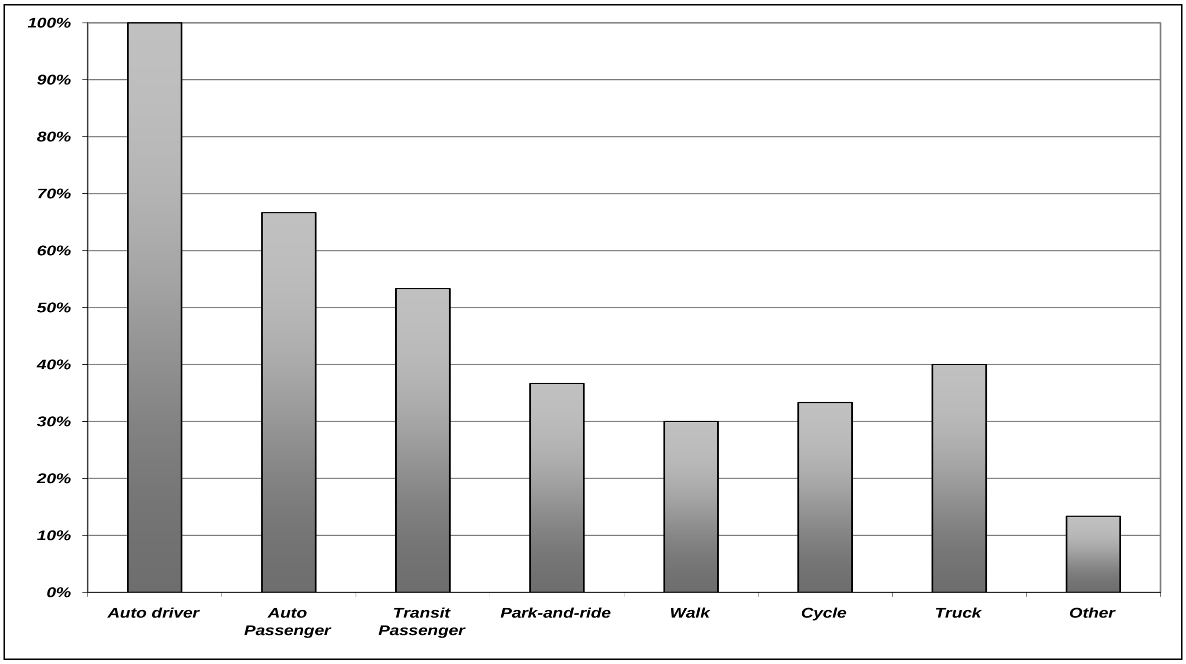
Sarasua et al. note the importance of calibrating also to the distribution of travel time, in a calibration of a small-area model in South Carolina. They (Sarasua, W., Clarke, D., & Reiff, R., 2002) also addressed disparities in trip generation rates in the Central Business District (CBD) – i.e., which were based on data from elsewhere - by assuming that there is less CBD trip chaining in smaller communities than in larger urban areas. (That is, the trip generation rates were adjusted to reflect values more appropriate to the community's characteristics.)

Walker and Reeder developed a small-area travel demand forecasting model for a corridor in Texas. (Walker, W. & Reeder, P., 2000) Given that the model had to be developed in a short timeframe and was based upon parameters from other models, four additional measures were used to confirm the model's functionality (beyond the traditional comparison simulated / observed link comparisons). These were:  comparison of vehicle trips per household by trip purpose and trip purpose percentages against travel survey data; comparison of trip length distributions; vehicle-miles travelled by facility functional classification and by area type; and the percent error by functional classification in comparison to recommended (FHWA modelling) values.

### 4.3.3 Modelling Parameters and Platforms

Depending on the level of complexity of the model in use, a variety of different modes can be considered, forecasted, and assigned. Nonetheless, by far the most common mode is auto driver, as **Exhibit 4-9** shows. All responding organizations that develop forecasts (either through their own model, or through access to another agency's model) reported modelling the auto drive mode. However, there is a substantial drop in percentage that also models auto passenger and transit. Non-motorized and heavy vehicle modes are not considered by most models.

**Exhibit 4-9: Modes Forecasted in Models**

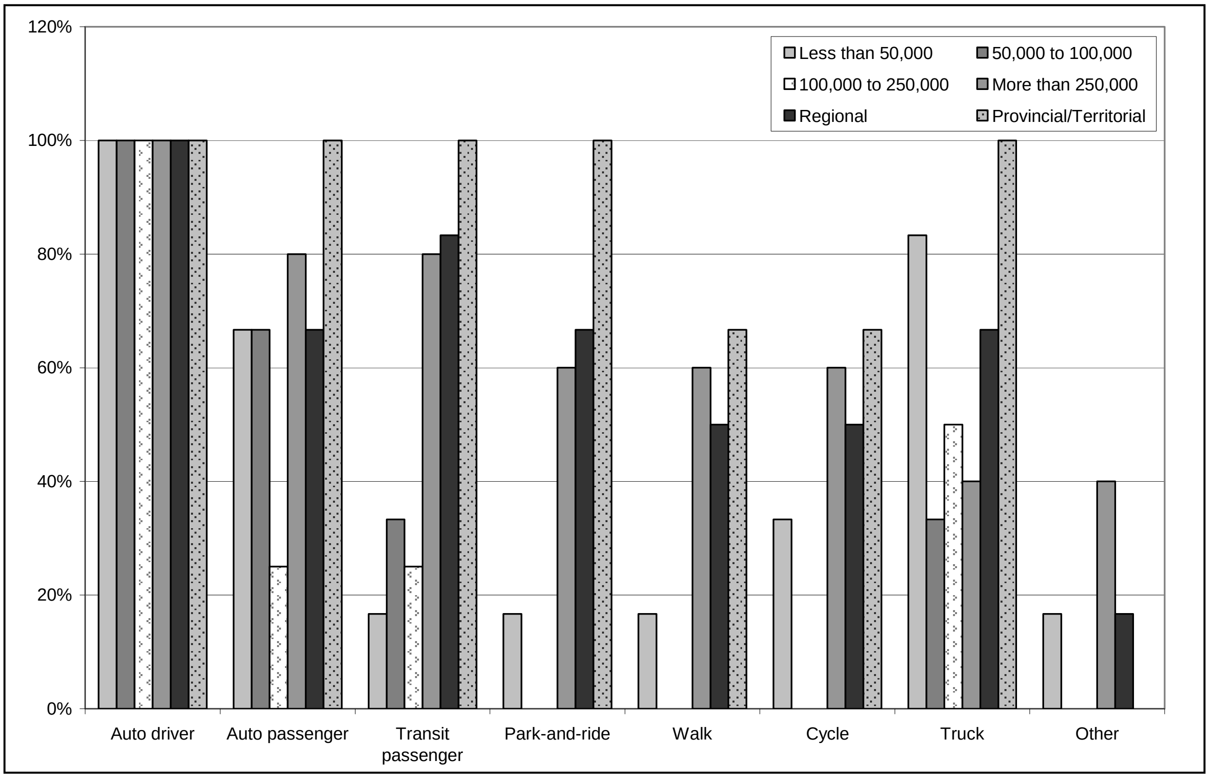



Other modes are comparably less popular; however, modelling these is not confined to large municipalities and regions—as can be seen from **Exhibit 4-10**, which breaks the modes down by organization type. At least one municipality with a population under 50,000 forecasts each mode listed. In this table, the drop-off in numbers can be seen for each mode from the leftmost auto-driver mode, which includes all the respondents. The modelling of transit and of the related park-and-ride mode are weighted towards the larger organizations. Only 25% of small- and medium-sized municipalities that model auto trips also model transit: this might reflect the relative insignificance of transit as a choice mode in many of these communities (i.e., if only 'policy' service is provided). By comparison, 86% of municipalities and regional governments over 250,000, and provinces and territories model transit.

One mode which does not appear dependent on organization size is truck; although many of the municipalities and agencies that forecast trucks do so via accessing another agency's model.

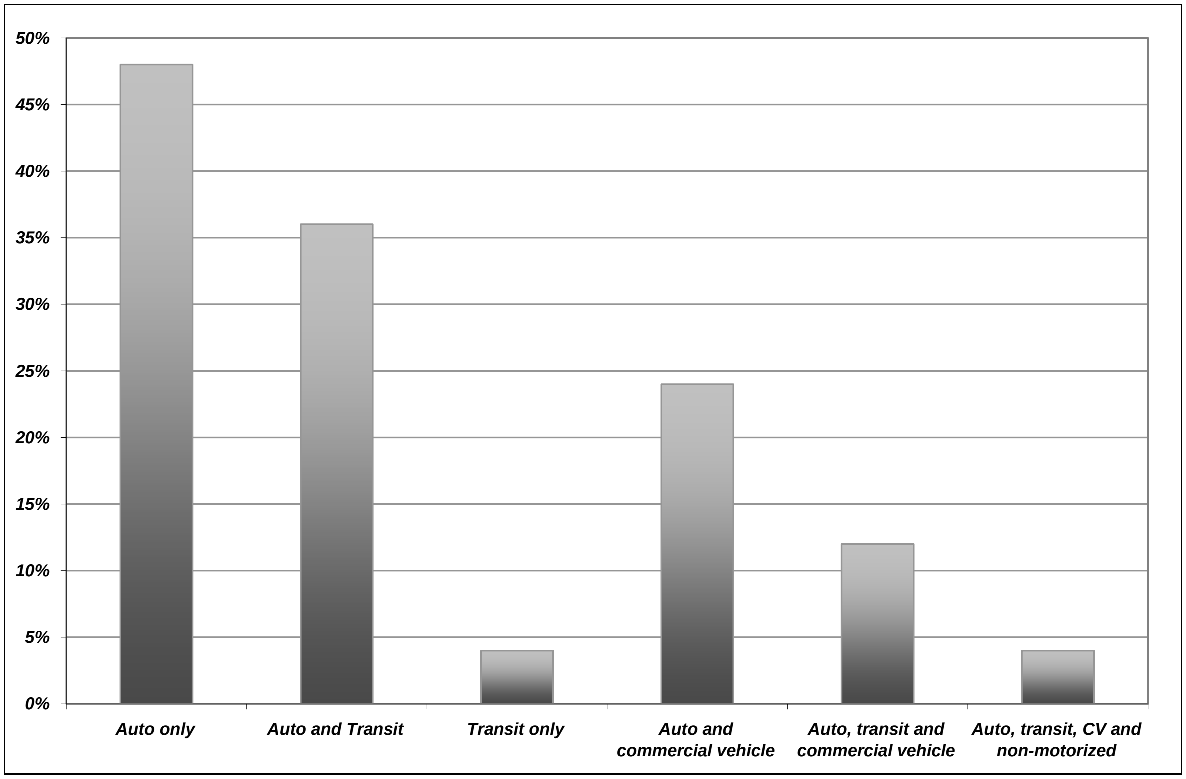
Finally, the "other" category refers to an assortment of modes, each of which was mentioned by a single respondent. These include school bus, motorcycle, adapted transport and taxi, as well as some aggregations of non-motorized and non-auto modes.

**Exhibit 4-10: Modes by Population and Respondent Category**




As expected, there is a relation between the modes forecasted and the types of network assignment performed. Ninety-six percent of those respondents who use a forecasting model do trip assignment, and 92% perform some type of auto assignment. **Exhibit 4-11** indicates fully the types and combinations of assignment performed.

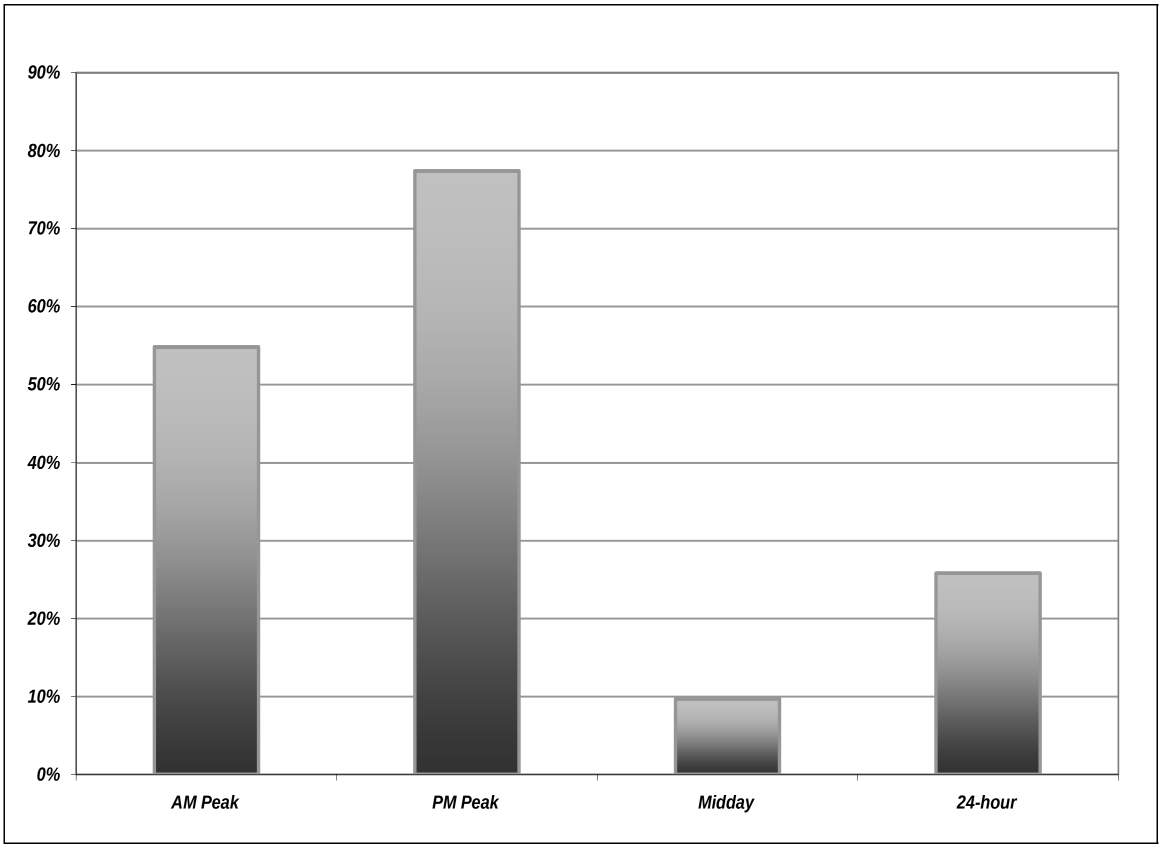
**Exhibit 4-11: Travel Modes Assigned**




Vehicle assignments are only classified by occupancy – i.e., single- or high-occupancy vehicles - in 16% of cases (all major cities and regions); otherwise, models use a single auto class. The transit-only category applies to a transit operator's model. Where transit is assigned, 50% of models also account for park and ride and 20% for pedestrian movements at transit locations, but no small- or medium-sized municipality that responded does either of these. As was seen in **Exhibit 4-10**, there is very limited forecasting of transit in municipalities under 250,000 population.

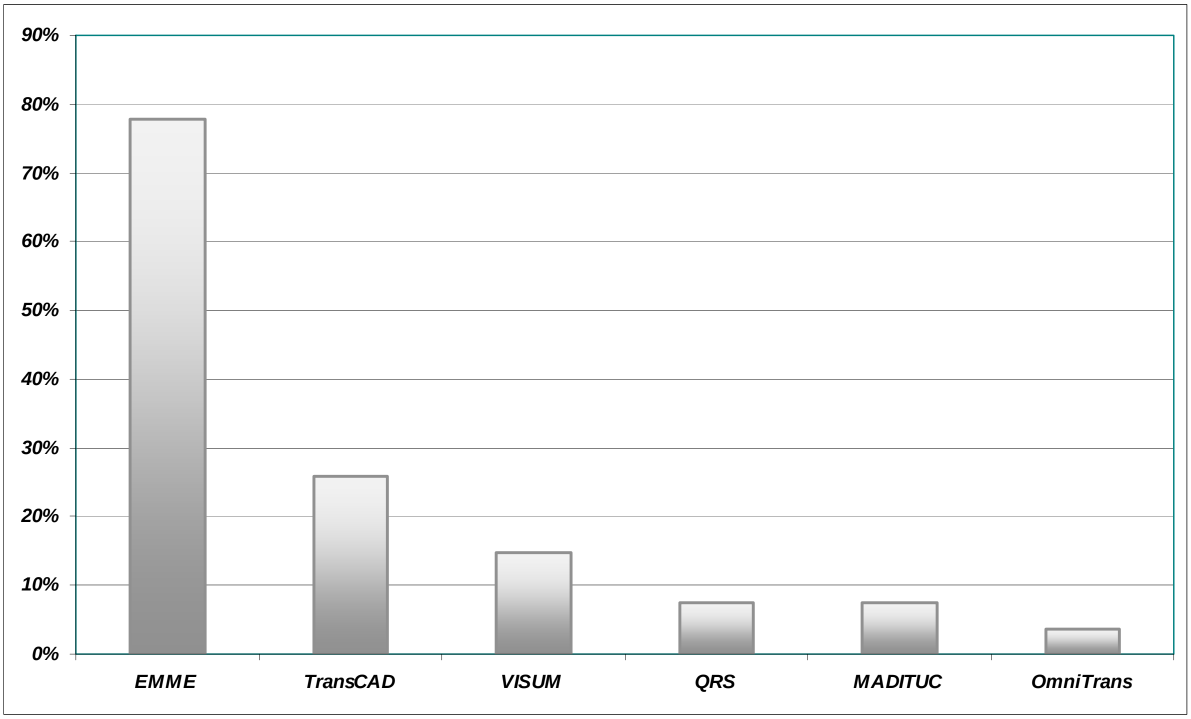
PM peak models are approximately 1/3 (35%) more popular than AM peak models across all organizations (without a preference for a particular peak at any specific municipality size). However, in many cases respondents use both, often with a 24-hour model as well. **Exhibit 4-12** summarizes the findings here—midday models find occasional use but only in conjunction with both AM and PM peak models.

**Exhibit 4-12: Times of Day Modelled**



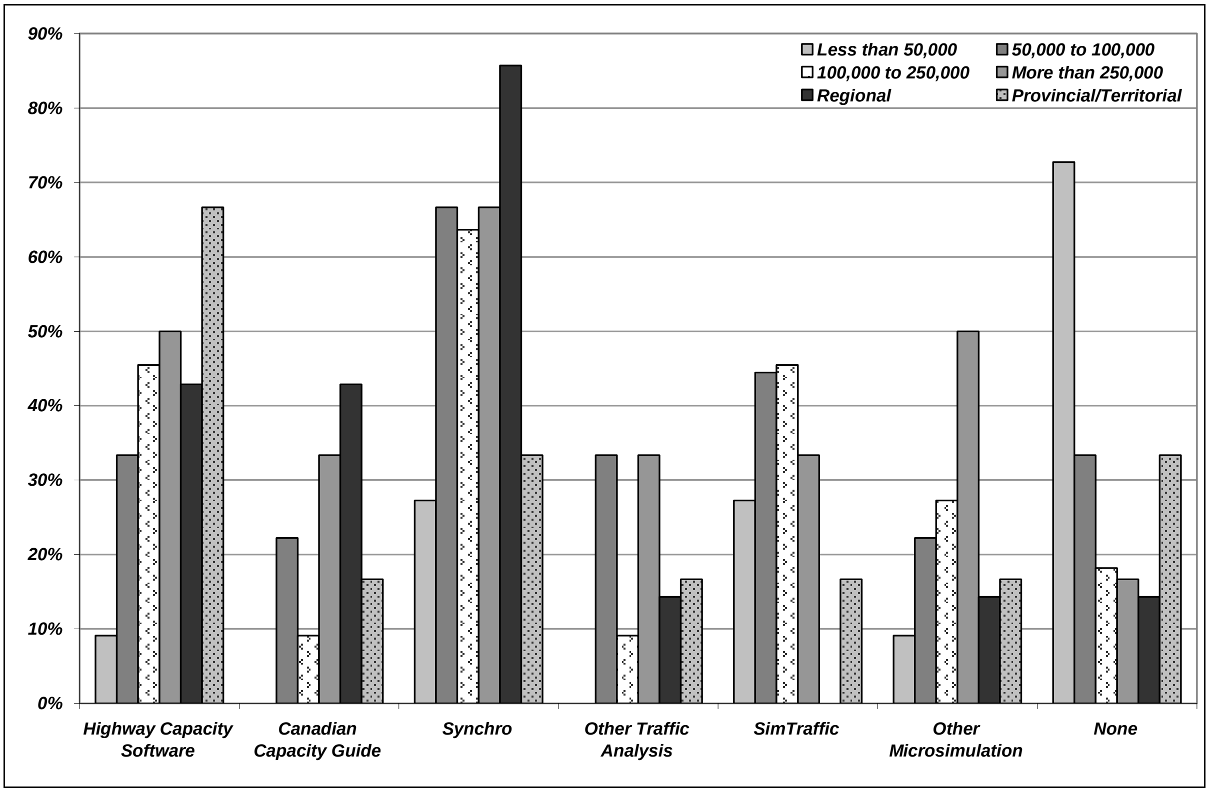

Organizations use a variety of software packages and tools to help them with preparing their travel demand models and forecasts. **Section 4.5** gives an inventory of these software packages and how they compare. In current use, EMME is the preferred travel demand modelling package in Canada by a substantial margin. As illustrated in **Exhibit 4-13**, EMME is used by 68% of organizations with demand forecasting models, followed by TransCAD (23%), VISUM (13%, usually in conjunction with EMME), QRS and MADITUC (6% each) and OmniTrans (3%). No municipality with a population less than 50,000 uses any of these packages. Among municipalities with populations between 50,000 and 250,000, EMME is still the most popular, used by 64% of respondents (compared with 14% for each of VISUM, TransCAD and QRS).

**Exhibit 4-13: Popularity of Travel Demand Tools**




For micro-simulation and traffic analyses, the breakdown of software by respondent is more complex, as seen in **Exhibit 4-14**. Almost a third of respondents (32%) reported using no traffic operations, signals or micro-simulation software at all, while many of the rest use only traffic operations packages such as Synchro (53%) or HCS (36%), though 39% use one of the traffic micro-simulators described in **Section 4.5.2**, usually SimTraffic. Use of micro-simulators is generally low except in major cities. When considering only small municipalities with less than 50,000 people, only 28% use any package, but in larger municipalities software use, at least for traffic analysis, quickly increases.

**Exhibit 4-14: Traffic / Micro-simulation Software Used by Type and Population**




## 4.4 Challenges and Opportunities

From the results presented in this chapter, it can be seen that many types of transportation planning tools have been applied by municipalities and regional authorities of all sizes across Canada. However, the small- and medium-sized communities surveyed repeatedly cited issues such as lack of funding, lack of available expertise and general lack of resources as challenges to the transportation planning process.

Specific to transportation planning methods and tools was the need for regular (and/or more frequent) traffic counting programs, the need for modelling in more detail at a local level (for areas part of a larger region), the need to acquire new software (or upgrade existing software such as EMME/2 to EMME3), the need for training (the latter especially to offset experience lost through retirements), and the need to implement more sophisticated data analysis methods such as car-following simulation. Addressing these issues would enable the municipalities in question to address their deficiencies in transportation modelling.

## 4.5 Inventory of Forecasting and Micro-simulation Tools

This section lists and compares some examples of commercial travel demand modelling and network micro-simulation software. It is not the intent of this study to recommend specific software for individual applications. Rather, the intent is to make the reader aware of the different commercial models that are available, and of their features and differences.

### 4.5.1 Travel Demand Forecasting Tools

The five demand forecasting packages compared here are, in alphabetical order with their developers:

- CUBE/TP+ (Citilabs, San Francisco, USA)
- EMME3 (INRO Consultants, Montréal, QC)
- QRS-II (AJH Associates, University of Wisconsin, USA)
- TransCAD (Caliper Corporation, Newton, MA, USA)
- VISUM (PTV AG, Karlsruhe, Germany)

These five packages were selected for this comparison because of their wide use in North America: all but CUBE/TP+ are used in Canada. Each of these packages supports four-step modelling, or individual stages of four-step modelling. **Table 4-3** below compares them and describes their individual approaches to building models. Other than QRSII, which has simplified calculations based on a set of default parameters, the packages have similar capabilities in terms of each component of the four-step process, and the user is unlikely to be restricted in modelling by choosing one of the other four over the others.

An important aspect to consider when deciding on a travel demand modelling package is how it can be combined with other software (especially GIS) that the user may already have or wish to acquire, and how much additional work is required to prepare input and interpret output data. This is because GIS is well established among municipalities for planning, engineering and other applications; and so GIS provides a natural platform for travel demand modelling for small- and medium-sized communities. The survey found that 67% of respondents from communities with populations under 50,000 use GIS for roadway inventory data, although no respondents from this population group used GIS to store traffic data. Larger municipalities are more likely to use GIS for a wider variety of data storage. In communities with populations between 100,000 and 250,000, 73% of respondents used GIS to store roadway inventory data. Of all respondents in this category who collect household information, 89% store the information using GIS.

**Table 4-3: Comparison of Travel Demand Forecasting Packages – Methods**

| Modelling methods | CUBE/TP+ | EMME | QRSII | TransCAD | VISUM |
|---|---|---|---|---|---|
| Types of generation model | Regression, cross-classification, trip rates, activity-based | Regression, cross-classification, trip rates | Trip generation parameters with attraction rates | Regression, cross-classification, trip rates, micro-simulation | Regression, cross-classification, trip rate activity schedules, time of day methods |
| Types of distribution model | Gravity, Fratar, discrete choice | Gravity or Fratar, adjustment with counts, any other matrix balancing procedure | Internal friction-factor calculations | Gravity, Fratar, simultaneous gravity, count estimation | Gravity with trip type / purpose, Fratar or trip chain building |
| Types of mode split model | Logit or nested logit (zonal or disaggregate) | Logit or nested logit (any demand function) | Transit can be modelled separately if required | Logit or nested logit, micro-simulation | Specific models by trip type / purpose, nested logit and time of day choice options |
| Types of road assignment | Junction-based modelling, toll and HOV modules | Multi-modal and multi-class equilibrium, flexible procedure | BPR function and intersection delay calculations | Stochastic user equilibrium | Multi-class/ multipoint, bi-criterion for road pricing, path-based equilibrium |
| Types of transit assignment | Discrete multi-routing | Multi-modal / multi-class, cost functions, fares and constrained capacity simulation | Calculations based on network and route inputs | Stochastic equilibrium with route capacities | Path choice model with direct assignment of itineraries |
| Ability to simulate TDM and road pricing / restriction measures | Yes | Yes | Yes | Yes | Yes |

It is important to note that no commercial GIS package currently has a travel demand model integrated within it. However, many travel demand models can exchange files with GIS. **Table 4-4** below outlines the interface flexibility of the different modelling packages with GIS and other software. Although TransCAD is itself a GIS, and consequently has the most seamless interaction, VISUM and CUBE also are designed to work well with GIS and other external programs. EMME and QRSII, however, depend on text-based input and output, although EMME has a library of external programs for converting graphical files into the specific EMME-readable format and now includes its own mapping toolset.

**Table 4-4: Comparison of Travel Demand Forecasting Packages – Interface Flexibility**

| Interface flexibility | CUBE/TP+ | EMME | QRSII | TransCAD | VISUM |
|---|---|---|---|---|---|
| Availability of GIS interface | Can use ArcGIS directly through CUBE Base interface | Requires separate external procedures to convert GIS files to EMME annotations; includes own mapping interface and tools. | No | TransCAD is a GIS and can exchange data with others | Can import from and export to GIS |
| Compatible input formats/software | ASCII, SHP, CSV, dBase, XLS, graphics | ASCII, SHP, dBASE, CSV | Text-based | ASCII, SHP, CSV, XLS, DGN, DXF, DBF, BIN, EMME/2, TP+, QRSII, graphics | Access, DBF, ASCII, CSV, TransCAD, XLS, graphics, EMME/2 and GIS formats |
| Compatible output formats/software | ASCII, SHP, CSV, dBase, XLS | ASCII, SHP | Text-based | ASCII, SHP, CSV, DXF, DBF, BIN, EMME/2, TP+, graphics | Access, DBF, ASCII, CSV, DXF, XLS, graphics, EMME/2 and GIS formats |
| Interface between software components | Modular system with modules added to base as required | Flexible modular structure combined into single entity | Single system with predefined types | Single integrated platform | Single system with specialized additional modules addable |

**Table 4-5** compares the software packages with regard to how easy they are to learn and use, along with some advantages and disadvantages cited for each in the literature review comparison. Each package has its own strong points and shortcomings, varying from a relatively simple and affordable, but more limited option in QRSII to the high flexibility but also high cost of VISUM. Given the complexity of the packages, the availability of comprehensive training is also a very important aspect when choosing one.

**Table 4-5: Comparison of Travel Demand Forecasting Packages – Usefulness**

| Usefulness | CUBE/TP+ | EMME | QRSII | TransCAD | VISUM |
|---|---|---|---|---|---|
| Availability of training | Training available for specific needs | Customized on-site training available | Web-based support | Custom training available | Customized on-site training available |
| Breadth of use | Reasonably commonly used--use is increasing | Industry standard in Canada | Not widely used | Widely used | Recently introduced, gaining popularity |
| Licence cost | $3,500-$12,000 (modular) | $9,000 | $400-$1,000 | $10,000 | $5,000 (base) or $20,000 (large) |
| 'Understandability' / staff resource implications | Modular structure enables flexibility and ease of use | Powerful but difficult specialized programming (macro) language | Comprehensive default parameter set simplifies model construction and makes it easy to use for inexperienced modellers | People familiar with GIS software have an advantage in learning it | Appears easy to work with, comparable to other products |
| Graphical abilities | Uses "Viper" interface for easy GIS import/export/ manipulation | Includes interface to display and edit data | Has limited display abilities (GNE) without GIS connection | Possesses full GIS abilities | Allows thematic mapping, has geographically-accurate network |
| Cited reasons for acquisition | Speed and capability | Flexibility, wide use | Ease of use and compatibility, allows simultaneous data and network input | GIS linkage, graphical ability | Ease of use, link to old TModel |

### 4.5.2 Micro-simulation tools

Micro-simulation tools allow practitioners to understand the interaction of an anticipated volume of trips within a transportation network. Whereas travel demand models establish the broad patterns of travel demand, based upon this demand (or otherwise creating origin-destination matrices), these tools simulate the individual behaviour of drivers, pedestrians, transit, and/or other network users and show the impacts of the interaction of these users on the network. In long-term transportation planning, municipalities can use micro-simulation to investigate the detailed effects of different network options and growth scenarios and to determine if the results are consistent with the goals of the community.

Different micro-simulation tools require different levels and types of data. Some micro-simulation tools require volumes directly at the intersection or link level while other tools use trip distribution matrices as input and assign vehicles to the network in addition to assessing operations and capacity.

This section compares nine different micro-simulators, namely:

- AIMSUN (Transport Simulation Systems, Barcelona, Spain)
- CORSIM (Department of Transportation, USA)
- Dynameq (INRO Consultants, Montréal, QC)
- DynaSmart-P (University of Maryland, USA)
- Integration (Virginia Technical University, USA)
- Paramics (Quadstone Paramics, Edinburgh, UK)
- Synchro/SimTraffic (TrafficWare Ltd, Sugar Land, TX, USA)
- TransModeler (Caliper Corporation, Newton, MA, USA)
- VISSIM (PTV AG, Karlsruhe, Germany)

Whereas the travel demand software market is older and has consolidated over the years, broad use of micro-simulators is newer – hence the larger number of packages considered here. Some of the packages (Dynameq, TransModeler and VISSIM) are intended for use with existing travel demand models produced by the same developers. CORSIM and Synchro have been used for traffic operations for several years, although generally for smaller networks. AIMSUN, Integration and Paramics are stand-alone network micro-simulation models. DynaSmart-P was developed in academia, where its current applications mostly reside.

**Table 4-6** summarizes the nine package.  Some packages simulate at the fully microscopic level—they model the dynamics of each vehicle separately. Others are mesoscopic—they aggregate some aspect of vehicular behaviour and so require fewer computational resources and data. (Travel demand models are macroscopic, because they develop the broad patterns of travel.)

**Table 4-6: Summary of Micro-simulators**

| Model | Complexity | Software description | Additional software features |
|---|---|---|---|
| AIMSUN | Microscopic | Models the behaviour of each individual vehicle throughout a period, with algorithms for determining driver behaviour in aspects such as car-following, gap acceptance and lane changing, models impacts of incidents and variable message signs. | Distinguishes between vehicle types, deals with different road and signal types, models bus/rail/water transport, transit/mixed lanes, park and ride, transit stops. |
| CORSIM | Microscopic | Simulates traffic flow, parking, queuing, incident and TMS impact, on either freeways or streets. Uses link-based routing and calculates link-based travel times. | Single network paths, static distribution functions, headways as parameters. Fixed 1-second timesteps, models bus/subway/water transport, transit stops. |
| Dynameq | Mesoscopic | Models vehicle behaviour with regard to signals, conflicting movements, lane permissions, lane weaving, queue congestion, using dynamic equilibrium iterative traffic assignment. | Conversion of static equilibrium process so as to allow intersection and queue modelling much faster than by micro-simulation. Has function to enable focus on a specific part of the network. |
| DynaSmart-P | Mesoscopic | Estimates traffic based on calculating for path dynamics, route choice and driver decisions. Combines dynamic assignment models for planning applications and traffic simulation models for operational studies. | Models basic network without changes in road geometry. Models individual travel decisions. Full toll road modelling. |
| Integration | Microscopic | Originally intended for research use. Simulates flow/driver behaviour attributes such as lane-changes and gap acceptance. Evaluates ITS scenarios. Lacks actuated signal modelling. | Includes less vehicle-interaction modelling than other microscopic models (originated from mesoscopic base). |
| Paramics | Microscopic | Models the movement and behaviour of individual vehicles and transit on local arterial and regional freeway networks. Uses link-based routing. Models driver reactions individually. Models pedestrian activity explicitly. | Allows 3D animation and colouring, displays performance measures with analyser module, models bus/rail/water transport, transit/mixed lanes, park and ride, transit stops. |
| Synchro / SimTraffic | Microscopic | Models traffic based on individual driver behaviour and additional other random events. Models and optimizes different types of signal control, intersection and road, and different vehicle types (including pedestrian). | Features 3D-visualization option and allows user-selected geometrical and control variations. |

**Table 4-6: Summary of Micro-simulators**

| Model | Complexity | Software description | Additional software features |
|---|---|---|---|
| TransModeler | Variable | Simulates traffic, calculates vehicle-based acceleration rates, lane changes, transit systems and actuated traffic control, depending on user-selected complexity, any paths including user-drawn ones can be modelled. | Used in combination with TransCAD, includes macroscopic, mesoscopic and microscopic simulation (users define type). |
| VISSIM | Microscopic | Development and testing of signal priority systems and logic, evaluation of traffic operations in signalized networks, weaving/merging analysis. Uses path-based routing (no nodes) and driver-behaviour algorithms for headways. Models pedestrian activity explicitly. | Features enhanced 3D animation technology and graphics, models and displays individual vehicle types, models bus/rail/water transport, transit/mixed lanes, park and ride, transit stops. |

Many micro-simulators, such as Paramics or VISSIM, require a large amount of data (much greater than that needed by travel demand regional models) in order to be able to produce useful results, and to be able to check those results once produced. If the user is unable to provide this level of data then the micro-simulator will not be able to help them, and they may be better off with a mesoscopic simulator like Dynameq. **Table 4-7** summarizes the data requirements.

**Table 4-7: Data Requirements**

| Model | Input data required to make use of software capabilities | Data required to validate software output |
|---|---|---|
| **AIMSUN** | Lane assignments/ geometries, OD demand matrices or flow rates and turning percentages, signal timing information. | Vehicle counts, occupancy, presence, speed and density at whatever level of aggregation should be required. |
| **CORSIM** | Network definition, lane configurations and capacities, pedestrian rates, grades, speed distributions, queue discharge times, signal timing information, free flow percentages, entry volumes with fill time. | Link counts, speeds, move time, delays, lane change counts, storage percentages, energy/emissions estimates. |
| **Dynameq** | Network data, OD flows by constant demand or by time-slice, link and intersection signal settings where analysis is specifically required, lane management strategies. | Volumes, speeds, times, delays. |
| **DynaSmart-P** | Network representation, spatial demand loading patterns, transit services, special-use lanes, signal-controlled intersections, depending on user requirements. | Volumes, speeds, times, delays. Also outputs individual vehicle trajectory file. |
| **Integration** | Network definition, lane configurations and capacities, freeflow and capacity speeds, traffic control devices, signal timing information, OD departure rates, incidents. | Link counts, speeds, delay, stops and stop lengths, OD generation counts, trip times. energy/emissions estimates. |

**Table 4-7: Data Requirements**

| Model | Input data required to make use of software capabilities | Data required to validate software output |
|---|---|---|
| **Paramics** | Similar to VISSIM, depends on OD matrices for input. | Similar to VISSIM. |
| **Synchro / SimTraffic** | Network/geometric data, lanes and lane functions, lane/crosswalk alignments, volumes, controls and phasing, signal and intersection types. | Volumes, speeds, times, delays, queue lengths, emissions estimates. |
| **TransModeler** | Network databases including geometries and lane configurations, user equilibrium assignment outputs, signal timing plans, OD trip matrices (for centroids, nodes or links), vehicle classes. Dependent on complexity of simulation chosen. | Traffic counts, speeds, times, delays, delay profiles. |
| **VISSIM** | Lane assignments/ geometries, OD demand matrices or flow rates, turning percentages by vehicle type, speed distributions (including acceleration and decelerations), signal timing information, pedestrians, grades. | Vehicle counts, speed limits, grades, lane change parameters, delay, stopped delay, stops, queue lengths, emissions, fuel consumption. |

## 4.6 Guidelines for the Selection of Analytical Tools

**Chapter 3** provided insight into choosing which long-term plans to do and outlined measures and indicators to measure progress and judge options against various goals. Once the type of long-term plan has been chosen, analytical and data requirements can be identified. **Table 4-8** provides guidelines for determining analytical requirements for given transportation plans. These guidelines are drawn from the best practices identified in the literature and in the survey, as noted. Their organization in these tables is based upon that prepared by Stone et al. for the development of recommended analytical procedures for communities of different sizes in North Carolina. However, unlike the North Carolina process, which to some extent must satisfy certain state or federal criteria for funding eligibility, these guidelines necessarily are less prescriptive in nature. As well, Canada lacks many of the statewide (province- or territory-wide) or nationwide datasets that are available in the United States.

**Table 4-8** defines communities in several ways:

- Size of population, according to four categories (less than 50,000; less than 100,000; less than 250,000; and, greater than 250,000).
- Transportation plan types, as identified through **Exhibit 3-3**.
- Approach to analytical tool.
- Urban context; that is, whether the community is part of a larger urban region or whether it is a stand-alone community.

- Approach.
  - Trip generation
  - Trip distribution
  - Mode choice
  - Trip assignment
  - External trips

- Tools

The table can be used to cross-reference plan types with analysis requirements based on community type and size.

**Table 4-8** distinguishes between stand-alone municipalities and those that are part of a larger urban region; the intent being that the latter commonly can access regional models and data. However, this is not always true: for example, some municipalities in Metro Vancouver have developed their own sub-area models, based upon the regional model. However, other municipalities, such as the District of North Vancouver and West Vancouver, do not have the resources to build or run sub-area models. Best practice suggests that each municipality, whether stand-alone or as part of a larger urban region, should have its own model or analytical capability, or should have access to a model or analytical capability that is sufficiently detailed to suit its needs.

## 4.7 Summary

This chapter began by providing background to the survey in describing demand forecasting methods, focusing in particular on the components of the four-stage model and how they work together, while also outlining other forecasting methods such as activity-based modelling and trends analysis. The chapter described best practices and approaches to the development of travel demand models and trends analysis for specific application to small- and medium-sized communities. It summarized the responses to the survey in the area of forecasting methods and tools, describing how approaches to modelling, from the decision whether or not to use a model to the modes looked at and the tools used to simulate them, varies by size and type of municipality or organization. The chapter then continued by describing the challenges and opportunities that surveyed small- and medium-sized municipalities are experiencing or have experienced in attempting to carry out these methods. It concluded by presenting a comparative inventory of the commonly used travel demand and micro-simulation modelling tools.

In summary, small- and medium-sized municipalities often have well-developed models or in the case of the smallest (less than 50,000) access to such models; however, they are very limited in simulation of any modes beyond private vehicles and constrained by lack of resources, funding and expertise. The two common, and related, themes are the lack of funding and resources, and the need to develop simplified tools or common rates. There is an identifiable difference between the small municipalities and those “medium-sized” examples between 50,000 and 250,000 in terms of model ownership and software use, although there is less difference in the variety of modes modelled. In the software selection field, EMME and Synchro are the clear favourites at present, a choice that transcends organization type and size.

## Table 4-8: Guidelines for Selection of Analytical Tools

| Size of Population | Urban Context | Plan Type | Approach | Trip Generation | Trip Distribution | Mode Choice | Trip Assignment | External Trips | Tools |
|---|---|---|---|---|---|---|---|---|---|
| Small (< 50,000) | Stand-alone, or part of a region but lacking a model; multi-modal | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>TDM<br>EA<br>Policy<br>AQ / congestion<br>Freight | Simple model, with coarse network and zone systems | Use local trip generation rates or rates from similar communities as basis for work / non-work trip rates. Use peak period rates if data support; if not, 24-hour Ensure all key trip purposes are covered | Gravity trip distribution preferred; Fratar also acceptable, for work / non-work. Or, apply factors per trend line | If transit exists: use factors based on observations | All-or-nothing assignment (simple network). Equilibrium assignment otherwise. | Apply model for external trips / through trips, if significant. Account for traffic, demographics, socio-economics and geography of external connections | Commercial travel demand model software |
| | Part of urban region; multi-modal | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ / congestion<br>Freight | Use sub-area of regional model, with appropriate detail for network and zones | Specialized trip generation rates and trip purposes specific to community | Ensure trip distribution is specific to local travel | If transit exists: Logit formulation, if comprehensive transit; otherwise factors | Equilibrium | Distribution model must account for urban trips that are external to the sub-area | Commercial travel demand model software |
| | Stand-alone or part of a region; roads only | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>EA<br>Freight | Direct demand (area-wide) | Multiple linear regression forecasts of ADT on key roads | | | | | Spreadsheet |
| | | | Trend analysis (specific facilities) | Growth factor, regression; power function offers flexibility if historical counts uneven or sporadic<br><br>Manual assignment acceptable if area is slow-growing, stable | | | | | Spreadsheet |

## Table 4-8: Guidelines for Selection of Analytical Tools

| Size of Population | Urban Context | Plan Type | Approach | Trip Generation | Trip Distribution | Mode Choice | Trip Assignment | External Trips | Tools |
|---|---|---|---|---|---|---|---|---|---|
| Medium (< 100,000) | Stand-alone, or part of a region but lacking a model | TMP<br>Sub-area<br>Corridor<br>EA<br>Budgeting<br>Dev charge<br>Policy<br>AQ / congestion<br>Transit | Four-step model, with appropriate network and zone detail | Use OD survey or rates from similar communities as basis for trip generation rates; for work / non-work trip rates. Develop for peak period. | Gravity trip distribution for work. Fratar trip distribution non-work. | If transit exists: Logit formulation, if comprehensive transit; otherwise factors | Equilibrium assignment otherwise. | Apply model for external trips / through trips, if significant. Account for traffic, demographics, socio-economics and geography of external connections | Commercial travel demand model software |
| | | TDM<br>Freight | Manual (spreadsheet) | Local trip generation rates, or rates from other similar communities | Freight: Manual distribution (spreadsheet) for base year. Forecast according to population / employment (Fratar) | TDM: Apply factors | Manual assignment. Forecast using growth factors, regression or power function | Apply factors | Spreadsheet |
| | Part of urban region | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /congestion<br>Freight | Use sub-area of regional model, with appropriate detail for network and zones | Specialized trip generation rates and trip purposes specific to community | Gravity for work and possibly other purposes; Fratar possible for non-work. | If transit exists: Logit formulation, if comprehensive transit; otherwise factors | Equilibrium | Distribution model must account for urban trips that are external to the sub-area | Commercial travel demand model software |

## Table 4-8: Guidelines for Selection of Analytical Tools

| Size of Population | Urban Context | Plan Type | Approach | Trip Generation | Trip Distribution | Mode Choice | Trip Assignment | External Trips | Tools |
|---|---|---|---|---|---|---|---|---|---|
| Large (< 250,000) | Stand-alone or part of urban region | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ / congestion<br>Freight | Four-step model, with appropriate network and zone detail. Develop separate model for freight | Use OD survey as basis for trip generation rates; for work / non-work trip rates. Develop for peak period. Use OD survey for trucks as basis for model. | Gravity trip distribution for work. Fratar trip distribution non-work. | Logit formulation, if comprehensive transit; otherwise factors | Equilibrium. Allow for peak spreading. | Apply model for external trips / through trips, if significant. Account for traffic, demographics, socio-economics and geography of external connections | Commercial travel demand model software |
| Very large (> 250,000) | Stand-alone or part of urban region | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /congestion<br>Freight | Four-step model, with appropriate network and zone detail | Use OD survey as basis for trip generation rates; for work / non-work trip rates. Develop for peak period. Use OD survey for trucks as basis for model. | Gravity trip distribution for work. Fratar trip distribution non-work. | Logit formulation, if comprehensive transit; otherwise factors | Equilibrium. Allow for peak spreading. | Develop external / through trip modelling process, using similar procedure | Commercial travel demand model software |

# 5. BEST PRACTICE IN TRANSPORTATION PLANNING DATA METHODS

The preceding chapter explored the methods and tools used for long-term transportation planning. These activities require a great deal of data, which can be costly or difficult to obtain. This chapter addresses the data needs. **Section 5.1** introduces the topic. **Section 5.2** discusses the types of data that Canadian authorities use and collect for long-term transportation planning. **Section 5.3** then discusses collection methods and frequencies for the different types of data: Given its importance, **Section 5.4** elaborates on travel surveys as a separate discussion. **Sections 5.5** and **5.6** discuss data storage, and data sharing and the purchase of external data sources, respectively. **Section 5.8** summarizes the chapter and identifies further challenges and opportunities.

## 5.1 Introduction

This report has already identified the importance of data in long-term transportation planning. Every component of the models and tools described above is dependent on data. Because of the importance of accurate and sufficient data, as well as the cost of obtaining data, best practices in this category are among the most interesting to small- and medium-sized communities. Information in this chapter focuses on the types of data that are required and sources for that data. Data are available both from external sources, and through internal data collection programs and this chapter includes information about commonly used methods of gathering data as well as innovations that improve data quality and increase accessibility for small- and medium-sized communities.

## 5.2 Types of Data Collected

Canadian municipalities already collect a wide variety of data. The results of the survey of practitioners exemplify this, with every type of data listed being collected by at least 12 of the 54 respondents.[17] All respondents indicated that they use or collect data. **Exhibit 5-1** shows the distribution of answers by data type. Each respondent was asked to select all data types collected in their municipality, so the percentages reflect the number of responses, not the percentage of municipalities that collect the types of data. The most common response was roadway inventory data, cited by 16% of respondents; followed by traffic or intersection counts (15%), population (demographic) counts at 12%, household counts and household OD surveys at 10% each, public transit data and employment counts at 9% each, and travel time surveys at 8%.

17 Later sections of the survey have fewer respondents, as five of the original 59 respondents did not complete all sections.

**Exhibit 5-1: Type of Data Collected**

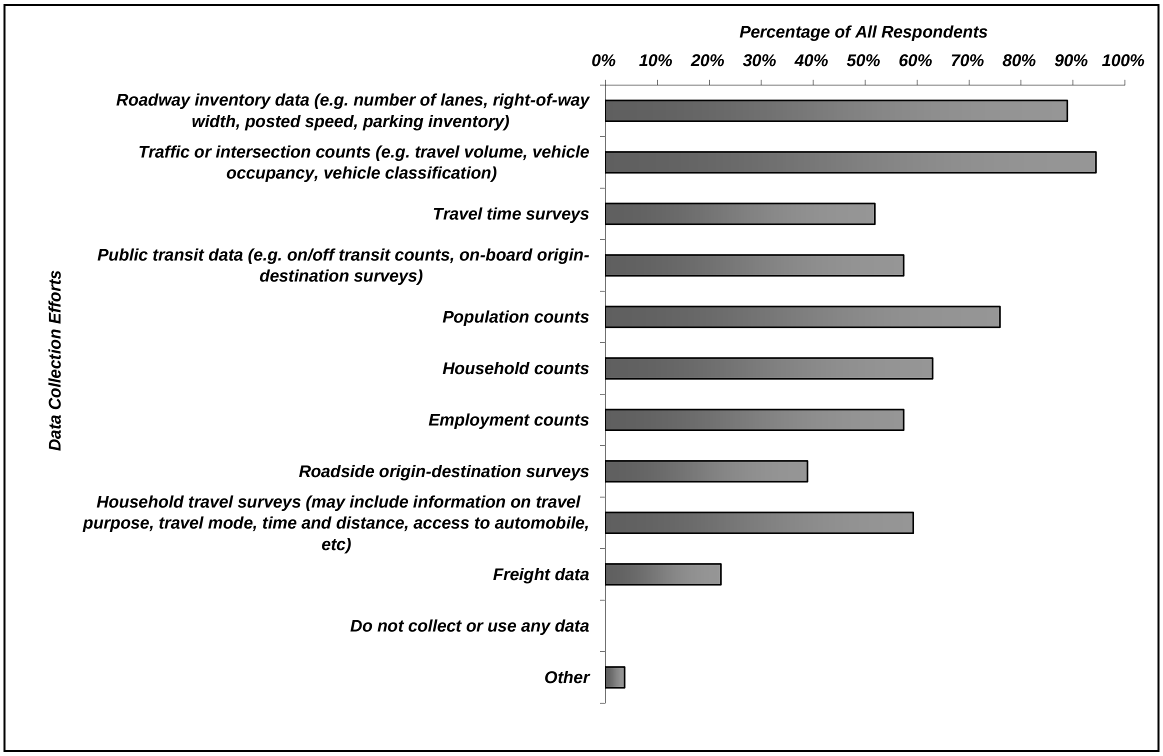
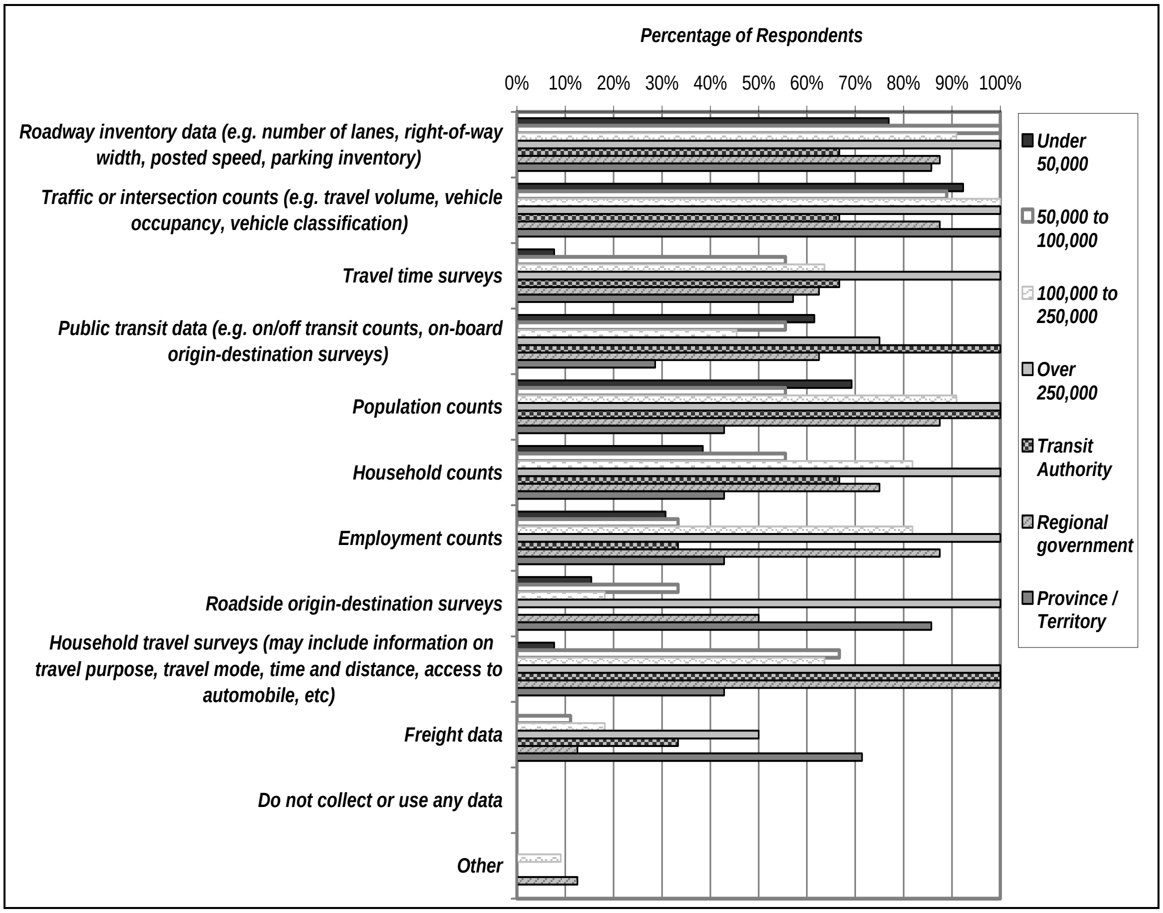



**Exhibit 5-2** indicates that data needs and collection efforts vary by type and size of organization. Forty-three of the respondents collect mid-block / segment counts, 43 respondents collect traffic or intersection counts, and another 39 agencies collect roadway inventory data: in both cases, the lowest number of citations came from transit authorities (although, importantly, some [two] transit authorities do collect these data).

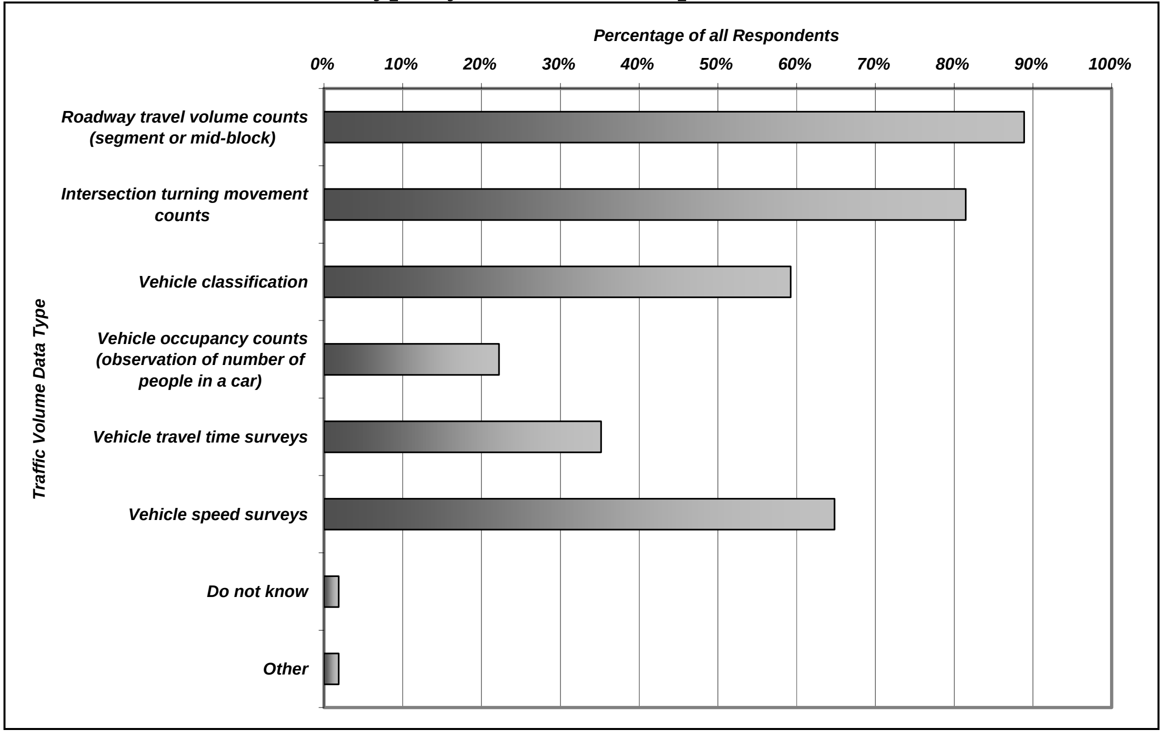
**Exhibit 5-2: Data Collection by Organization Type**




Most local governments with over 250,000 residents collect all types of data. Local governments with fewer than 50,000 residents are less likely to collect travel time surveys and household travel surveys; and none of these smaller municipalities collects freight data. In fact, freight data are collected by only 22% of all respondents in all categories, with only 14% of local and regional governments collecting freight data. Conversely, 71% of respondents classified as provincial or territorial organizations collect freight data. In other words, specialized data – such as freight data – tend to be collected by larger organizations.

Given their commonality, traffic counts, road inventory data, and population and other demographic counts could be considered as basic data for transportation planning. Almost all (94%) of respondents collect some kind of traffic data. This type of data is clearly instrumental in long-term transportation planning. **Exhibit 5-3** illustrates the different types of traffic data collected by survey respondents. The survey indicates that all organizations, regardless of size or type, collect at least some kind of data; and most commonly this includes basic data as a minimum. This also may reflect the availability of the data – i.e., another organization might be providing the data (such as population or household counts that are generated by the Census of Canada or from provincial statistical bureaus).

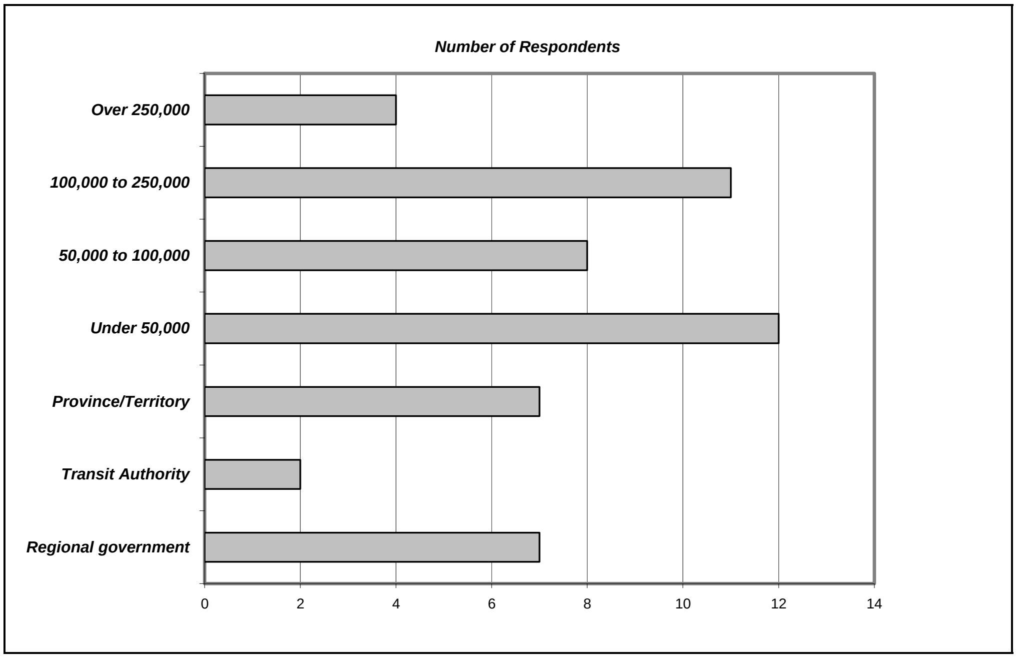
**Exhibit 5-3: Traffic Data Type by Number of Respondents**




To this end, **Exhibit 5-4** and **Exhibit 5-5** demonstrate, respectively, that the collection of traffic and intersection counts and of land use (demographic) data is pervasive among all types and sizes of respondents. It also can be seen from **Exhibit 5-5** that population data are collected most frequently, followed by household data and then employment data.

On the other hand, as **Exhibit 5-6** indicates, each of the respondent types conducted travel surveys. However, the types of surveys varied by community size, in that larger communities tended to conduct household origin-destination surveys while smaller communities used roadside surveys (and, as can be expected, transit agencies did not conduct roadside surveys).

## Exhibit 5-4: Traffic or Intersection Data Collection by Organization Type




## Exhibit 5-5: Land Use Data Collection by Organization Type

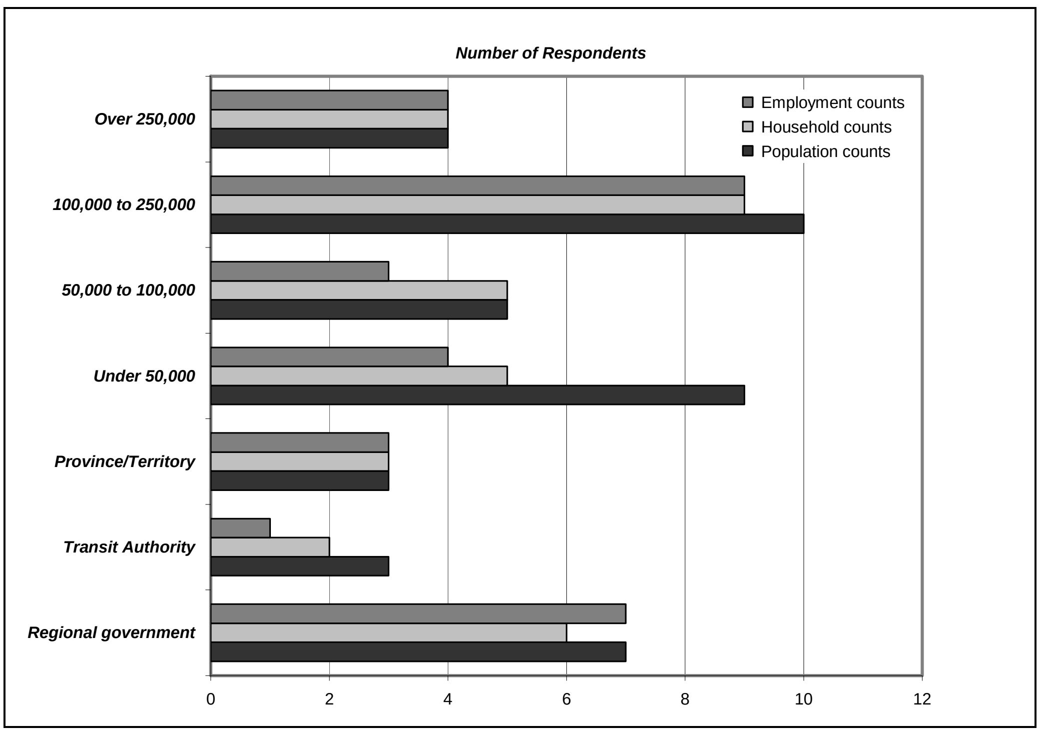
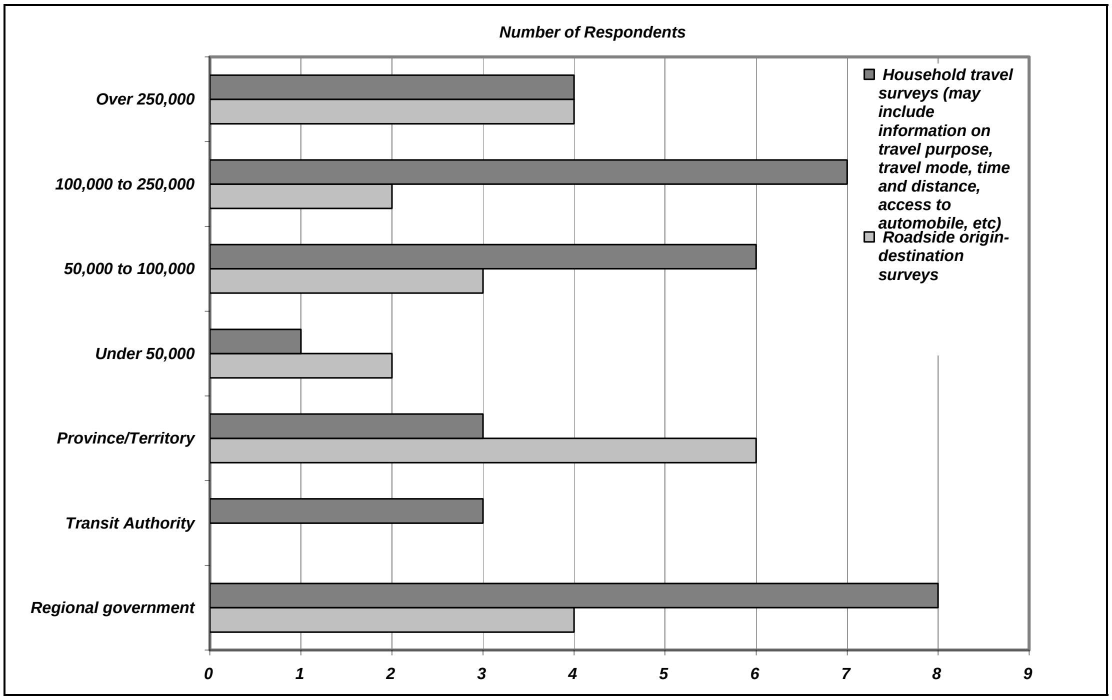


**Exhibit 5-6: Survey Collection Efforts by Organization Category**




## 5.2.1 Network Data

Travel demand forecasting calls for basic information about the transportation network. Information about the properties of each road section (link), including speed, capacity, lanes, and type of traffic control, is necessary if a model is desired. In addition, information about special generators is necessary for this type of analysis (TMIP & Texas Transportation Institute, 1999).

Approximately 89% of survey respondents collect roadway inventory data, a major component of transportation network data. This category is second only to traffic or intersection counts, which 94% of respondents collect.

## 5.2.2 Land Use / Demographic Data

Planning exercises utilize a variety of land use data, including household and employment data; and modelling typically requires these data to be available by traffic zone. These data allow transportation planners to understand the way land is used in each zone (Martin, W. A. TRB, McGukin, N., Barton-Aschman Associates, Inc., & Transportation Research Board, 1998) – i.e., they represent the economic-based activities that reflect the reasons passengers and goods are moved. As an extension of this, data such as population, household type, employment type, and auto ownership are useful for trip generation activities (TMIP & Texas Transportation Institute, 1999). Land use/economic data can also aid in sharing and transferring data from other sources, as discussed in **Section 5.6**.

### 5.2.3 Traffic and Transit Data

Some of the most utilized and most commonly collected data fall in the category of traffic and transit data. These data can encompass a wide range of collection types, from roadway volume counts and intersection turning counts, to origin-designation surveys of all types, speed information, and transit ridership data. These data have many applications, from long-term transportation planning to uses in traffic operation or micro-simulation, among others.

According to the survey of practitioners, almost all organizations collect traffic data, with 94% collecting traffic or intersection counts. Fewer organizations collect more in-depth traffic data, such as roadside origin-destination surveys at 39%. Approximately 57% of respondents collect transit data, such as on/off transit counts and on-board origin-destination surveys. Of all organizations surveyed, 78% have formal traffic count programs.

### 5.2.4 Freight Data

The availability and quality of freight data has significant impact on the quality and feasibility of integrating freight planning into a community's long-term freight transportation planning program. Important freight data includes commodity flow data, truck volume data, trip origin-destination data, travel time data, freight rates and costs, trip generation characteristics of different types of land uses, emissions from freight activity, and accident and safety data. Sometimes, these data are publicly available, but often they are not sufficiently detailed to be useful for planning purposes. Tools can be used to estimate local data based on regional, provincial, or federal information, or local data collection programs can be used to fill in missing data (Cambridge Systematics, Inc., TransManagement, Inc., TransTech Management, Inc., & Heanue, K, 2007).

There is a variety of freight data sources available. These sources include regional and provincial authority classification counts on major roadways, as well as records of collisions involving trucks. Interviews and surveys with major carriers can provide a valuable data source. To further expand on these sources, communities can consider conducting vehicle classification count programs, roadside intercept surveys, or freight facility surveys (Cambridge Systematics, Inc., TransManagement, Inc., TransTech Management, Inc., & Heanue, K, 2007).

As noted, few organizations conduct freight studies, especially small- and medium-sized local governments. Similarly, only 22% of organizations surveyed collect freight data.

## 5.3 Collection Methods and Frequencies

Transportation planning requires a variety of data, as seen in the preceding sections. In order to be available to users, authorities must first collect the data. Data collection is rapidly changing. This section provides insight into the different methods of collecting data, as well as how frequent various data collection activities should be completed.

Travel surveys provide critical information for transportation planning. They provide information about the trip-making characteristics of individuals and households, as well as broader travel information concerning mode choice, trip type and frequency. Traditionally, travel survey methods depended on face-to-face interviews conducted in homes, or along major roadways and transit routes, or at major transportation nodes. These kinds of surveys are increasingly costly and difficult to conduct. The development of mail and telephone surveys has made travel surveys less expensive and more efficient. Typical household surveys, conducted by mail and telephone are often supplemented with travel intercept surveys (Griffiths, R, Richardson, A. J., & Lee-Gosselin, M. E. H., 2007).

Looking forward, several practices that are currently state of the art, must become common practice if the quality and cost of travel surveys is to fall in line with needs. Practices such as mixed-mode survey design, where the respondent chooses to answer by telephone, internet, or in person, the use of the internet, advances in GPS linked with GIS and other automatic monitoring and remote sensing technologies are becoming more common (Griffiths, R, Richardson, A. J., & Lee-Gosselin, M. E. H., 2007). Forecasting models that focus increasingly on activity modelling approaches will require information gathered on specific travel activities.

There are also opportunities for small communities to increase the amount and efficiency of data they collect by implementing small, value-added changes to existing programs. For example, the collection of bicycle, pedestrian or heavy vehicle data during a regular traffic count program requires very little additional resources but may provide significant benefits to later analysis. Similarly, many count programs focus on commuter peak hours: extending the programs to times of day that represent peaks for other traffic may be required to address specific issues (for example, heavy truck peaks commonly occur in the mid-morning, or overnight).

Finally, there is great promise in the concept that policy makers may be able to utilize travel surveys as specific instruments of transport policy. Specifically, Griffiths et al. cite research that shows that a survey may make the respondent more likely to consider alternative transport options (Griffiths, R, Richardson, A. J., & Lee-Gosselin, M. E. H., 2007).

### 5.3.1 Continuous Data Collection

On-going data collection programs are invaluable to planners for preparing and evaluating long-term transportation plans. Historically, traffic data collection and transit system monitoring were only available to planners; however, strides in census data collection, continuous personal travel data, and ITS data bring considerable wealth to this field. Long-term transportation plans benefit from regular collection of all these data types (Limoges, E, Purvis, C. L., Turner, S, Wigan, M, & Wolf, J, 2007).

As seen in previous sections, census data provides planners with necessary land use and socio-economic data. In the United States, the American Community Survey (ACS) is changing the way that transportation planners collect census data. The program allows planners to access annual census data for areas of 100,000 or more in population, as well as "rolling average data" for smaller areas (Limoges, E, Purvis, C. L., Turner, S, Wigan, M, & Wolf, J, 2007).

Large-scale household travel surveys are also an important source of data for transportation planning. Over the past 40 years in the United States, these surveys were conducted through in-home face-to-face interviews at a frequency of approximately once per decade. Recently, there has been an international trend towards "continuous" household travel survey, where data are collected every day of each year. The Victoria Area Transport Survey in Melbourne, Australia is an example of one such survey (Limoges, E, Purvis, C. L., Turner, S, Wigan, M, & Wolf, J, 2007). Further to providing timely data, continuous travel surveys are advantageous financially because they require a relatively small annual budget, opposed to requiring large amounts sporadically (Griffiths, R, Richardson, A. J., & Lee-Gosselin, M. E. H., 2007).

Intelligent Transportation Systems that have the capacity to collect and archive data offer an excellent resource for planning data. Examples of technologies now in use include transit SmartCards, automated traffic signal detectors, GPS units and weight-in-motion devices. These data are typically continuous, recording 24 hours a day, seven days a week with significant detail. Already, planners are using ITS data for transportation planning, operations, and research including origin-destination studies and traffic model development and validation. As ITS capacities expand, there continues to be growth in the types of data collected and the applications for this data. Limoges et al. predict that ITS data will eventually supplement or replace traditional sampled traffic data programs. This transition will result in cost savings, as well as an increase in the amount and type of data available. ITS data have the potential to enable new types of analyses, such as travel reliability and discrete choice of individual drivers, to serve as a platform for coordination, and to provide feedback loops (Limoges, E, Purvis, C. L., Turner, S, Wigan, M, & Wolf, J, 2007).

### 5.3.2 Integration of GPS and Other Vehicle-Based Technologies

Global Positioning System (GPS) technology can be adapted as a tool in the data collection process. GPS can record trip origin and destination, along with start and finish times, trip length and duration, and travel routes. This technology supplements the use of handheld PCs and websites for traditional travel diary data collection methods. The Federal Highway Administration's Lexington study and travel surveys in The Netherlands have both investigated the use of automated diaries with GPS to add a spatial dimension to trip data collection (Limoges, E, Purvis, C. L., Turner, S, Wigan, M, & Wolf, J, 2007).

Other vehicle-based technologies allow for collecting vehicle fuel consumption data, which is essential as communities face increased concerns for protecting the environment in their daily transportation planning activities.

## 5.4 Travel (Origin-Destination) and Other Surveys

### 5.4.1 Current Practice

The types of data described in **Section 5.3** reflect the main types of data that small- and medium-sized communities collect, and also the types of data for which there are many applications (i.e., transportation planning may not be the primary reason for collecting these data).

However, the travel demand models described in **Section 4.2** require a more comprehensive profile of travel patterns and how these relate to the demographic and socio-economic characteristics of a community. Typically, these data are derived from an origin-destination, or revealed preference, survey. These surveys profile a sampled population's trips over a given time period (often, a 24-hour weekday; although some communities have focused on the a.m. commuter peak period). They capture data about a respondent's trips: where the trip started (trip origin), where it ended (destination), start time and end time, mode(s) used and purpose. A model that simulates the entire community requires a community-wide survey. These data are needed to calibrate each component of the model. Note that trip records are expressed in terms of the individual, as opposed to the vehicle.

Current best practice in origin-destination surveys is the household interview. The most comprehensive method is to conduct a telephone interview, of a random sample of households in the community: The selected household will be notified in advance of the interview (to allow for preparation), and an adult member will be called and asked to describe the trips made by each member of the household (or by all members except for children). The respondent also provides information regarding the characteristics of the household (e.g., number of vehicles available to the household) and of each person (age, occupation, driver's license availability, etc.).

Web-based surveys are becoming more common because of their low unit cost. However, there remain two biases in these surveys: first, in terms of who will respond to these (generally, more likely among younger, more computer-literate respondents, and less likely among older respondents, again as a function of experience with computers); and second, in that the survey is passive (there is no recourse to the respondent, in order to probe or clarify responses; unlike a telephone interview).

In smaller communities, practicality commonly dictates the use of roadside interviews at strategic locations on main corridors. This has the advantages of immediacy and the ability to probe and clarify responses; and they can be less expensive than household telephone surveys (depending on the number of survey sites). It also captures trips made by non-residents. However, roadside surveys typically capture only the current trip made by the respondent, and that is a vehicle-trip which may or may not be easily transferable into person-trips; and they cannot capture data on trips made on other modes (which may be captured by surveys on-board transit vehicles: again, mainly limited to the current trip [and usually the return trip]).

Given the cost of surveys, some Canadian communities have relied instead upon the Census of Canada's Place of Work / Place of Residence linkages by mode. These data have the advantages of a large sample size (20% of all households across Canada), of transcending municipal boundaries (meaning that commuting by non-residents is captured as well) and of having a lengthy history (in most Censuses since 1971). The linkages also can be tied directly to other demographic and socio-economic data in the Census. Since 1996, the usual mode to work also has been captured, which provides a useful profile of modal choice. However, they describe only the home-to-work commute, meaning that they do not capture en route stops or other trip purposes; and they depict a typical day in the week preceding the Census, rather than a specific point in time as a survey would. As well, confidentiality requirements mean that some spatial aggregation of the data may be required to avoid the potential for identifying individual respondents; and – because Statistics Canada publishes only high-level summaries - custom tabulations of the data must be purchased from Statistics Canada to be usable in model development. The current models for Halifax, Moncton and Saint John are based in part upon the Place of Work linkages (Hanson, T., 2008).

Another alternative is the development of synthetic origin-destination matrices, using ground counts. Several model software packages offer the ability to generate mathematically rigorous 'artificial' matrices. This has the advantage of avoiding survey costs; but there typically is no or limited connection between the resultant and demographic, socio-economic or network characteristics.

### 5.4.2 Best Practices for Small- and Medium-Sized Communities

As noted in **Section 5.2**, comprehensive origin-destination surveys tend to be restricted to larger communities. From a technical perspective, however, there are few limitations that preclude small- or medium-sized communities from conducting origin-destination surveys, since neither the best practice methods nor the sampling frames (etc.) are dependent on community size.

Rather, the key challenge is that of practicality in the face of limited resources. Five examples from the United States and Canada illustrate 'best practices' that could be applied to small- and medium-sized communities in Canada:

1. **Combined approach**. Lupa describes a 2002 household origin-destination survey that was conducted in Parkersburg, West Virginia, a region of 151,000 residents. Respondents were recruited randomly by telephone, and then were asked to complete a mail-back survey form.[18] The survey was intended to complement the US Census' Journey to Work data (similar to the Canadian Census' Place of Work linkages), by capturing both demographic and travel data across a 24-hour period and by focusing on non-work trips. Special attention was given to validating the trip rates (which were lower than the

18 The mail-back form is similar to the web-based survey in that both are passive (self-administered). However, given the aforementioned biases and the need to have access to a computer in order to participate in the web survey, the mail-back survey is a more pervasive and 'portable' tool.

comparable default rates in NCHRP 365, but still considered usable) and trip lengths (which were longer than those of other data sets – reflecting the semi-rural nature of the region – but were consistent with the Journey to Work data). (Lupa, M., 2004). This approach provides a cost-effective means of building upon existing data (Census), and focusing on capturing the missing information (non-work trips) and on the validation of specific relationships that are important to small- and medium-sized communities (trip rates and trip lengths).

2. **<u>Capture of non-auto trips</u>**. The share of transit and other alternatives to the auto often is low in small- and medium-sized communities. As a result, it can be difficult to capture sufficient data on these modes in an origin-destination survey. One often-proposed alternative is to use the characteristics of trips made by zero-vehicle households as a proxy for these modes. To this end, Bricka and Korepella describe an analysis of the 2001 Maricopa County (Phoenix, Arizona) origin-destination survey, which compared the demographic and travel characteristics of both zero-vehicle and transit-using households. (The use of large-city data provided sufficient numbers of both types of households to conduct the analysis.) The analysis found that although some demographic characteristics were similar (e.g., respondents in both groups were largely of minority descent), the travel characteristics varied significantly – for example, the average daily trip rate for transit-using households was three times higher than that reported for zero-vehicle households; and trip distributions and purposes varied significantly. The study thus placed into question the use of zero-vehicle households as a proxy for non-auto use. It proposed instead the over-sampling of transit-using households (or neighbourhoods). (Bricka, S., 2004). More broadly, this study serves to illustrate that caution is needed when transferring or substituting rates or data, and that efforts should be made in surveys of small- and medium-sized communities to ensure that data can be captured to address specific needs and issues that may be missed in the larger trends (e.g., characteristics of transit usage).

3. **<u>Multi-area surveys</u>**. The high costs of model development and data collection led the Oregon Department of Transportation to create a “generic” small urban area model that could be applied to the state’s many small- and medium-sized communities. The prototype was based upon joint survey data collected over several communities, for calibration in specific cities according to local conditions. To this end, the DOT conducted approximately 3,200 two-day household activity surveys in eight rural counties throughout the state. The rationale for this joint approach was twofold: it would be less costly than conducting individual surveys in each community (the traditional approach); and “a richer survey data base could be developed by combining the data from all of the areas rather than maintaining separate databases containing only the information specific to each area.” The survey data demonstrated strong similarities in travel characteristics among the different communities. In turn, this led to the question of whether similar similarities existing between these urban communities and those of smaller, rural communities: A subsequent survey of the latter confirmed these similarities, except along the coastal communities, which had a substantial amount of recreational travel. (Schulte, B. & Ayash, S., 2004). This approach provides a strategy

and a rationale for conducting combined travel surveys over several small- and medium-sized communities. It also demonstrates the utility of a two-day survey (rather than a one-day survey; i.e., to provide more depth to the responses and to an understanding of day-to-day variability); and to basing the survey on activities rather than on trips (i.e., focusing on the travel associated with individual's activities [which is easier to recall] rather than on the trip-making alone).

4. **GPS traces**. A New Brunswick study illustrates the potential of using GPS trip-loggers to capture travel in smaller, auto-dominated environments. The specific application was to elderly travellers in rural areas, who are almost entirely dependent upon the auto (i.e., there are few alternatives in rural areas to driving). The GPS loggers are small and mobile, and also are passive. Accordingly, participants' trips were traced using the GPS loggers. The GPS data were transferred onto a GIS map for manageability and reference. Follow-up interviews with participants identified complementary information, such as trip purpose and the presence of passengers. (Hildebrand, E. D., Gordon, M. J., & Hanson, T., 2004) This research demonstrates the applicability of GPS as a basis for conducting travel surveys; and it also demonstrates the utility of this method for focusing on the travel characteristics of a specific market.

5. **Capture of specific travel markets**. Tourism and recreation are growing economic segments. They are significant contributors to the economies of many small- and medium-sized communities. However, detailed data on travel characteristics often are lacking (i.e., beyond traffic counts and site-specific trip generation studies) – importantly, such travellers typically do not live in the community but their activities may constitute a significant proportion of local travel. Mallett and McGuckin describe the characteristics of recreational travel from the 1995 American Travel Survey and the 1995 Nationwide Personal Transportation Survey (i.e., large-area, multi-modal travel surveys). They note that recreational travel is growing, and that it is dominated by auto use over increasingly longer distances. They illustrate the importance of understanding these data in several ways:

   - Understanding the characteristics that determine modal choice.
   - Helping manage the seasonal congestion around attractions and recreational areas.
   - Ensuring that the full picture of travel across the entire road network is understood, in order to be able to address "growing environmental and social concerns about auto traffic impacts.
   - There has been a relative lack of attention given to recreational travel, in contrast to "the increasing amounts of energy and time Americans, especially baby boomers, devote to recreation." (Mallett, W. & McGuckin, N., 2000).

   This analysis demonstrates several points: the need to capture all components of travel that might be significant in a small- or medium-sized community; this travel may be generated by non-residents; it may be seasonal although acute; and, its characteristics may require wide-area travel information.

## 5.5 Data Storage

While new data may be required for specific projects or applications, officials and planners also can build upon existing data for their needs. Meaningful plans and effective decision-making both rely on data infrastructure. Data management programs must enable users to access data and understand its level of reliability (Tate-Glass, M. J., Bostrum, R, & Witt, G, 2007).

Geographic Information Systems gather, utilize, and share data in an effective manner. Data stored in GIS format can be more easily used for modelling purposed than traditional data storage types. In the US, the National Highway Planning Network provides a source of federal digital roadway data, but these are too limited for application in local or metro area models. In Canada, the Canadian National Highway System is available to planners. Planners in the US have two other GIS data sources available to them: TIGER Streets file, maintained by the US Census Bureau, and the US Geological Survey's Digital Line Graph files. Granato, in his 2006 study, utilized these sources as a base of underlying geography for traffic model networks, while he took the majority of relevant local data from local agencies responsible for the facilities under investigation (Granato, S & Ohio Department of Transportation, 2006). In Canada, similar geographical data are available through two online sources. The government of Canada provides geospatial data through GeoGratis, an online collection of free raster data, vector data, and ground control points. Additional geospatial data is also available through Geobase, a joint federal, provincial, and territorial government initiative.[19]

In order to develop a travel demand model network from GIS data, it is necessary to evaluate trade-offs between different data sources and approaches, and to choose the methods that are most applicable to the municipal needs. As the technology for both GIS and traffic forecasting mature, Granato anticipates that the data availability will improve. New data sources may include local agency road shape and land parcel files, and digital elevation model data and can be applied for potential detailed land use forecasting and right-of-way and estimating traffic impacts for grades and trucks, respectively (Granato, S & Ohio Department of Transportation, 2006).

## 5.6 Data Sharing and Purchasing

As seen in previous sections, models that can be highly useful for long term planning may also have significant data requirements. Data collection can be a time consuming and expensive task and small- and medium-sized communities may not have the resources to complete extensive data collection programs. Data sharing and purchasing can provide necessary information for the accuracy and upkeep of planning models.

[19] Data are available from GeoGratis at www.geogratis.gc.ca and GeoBase at www.geobase.ca

Regional, provincial / territorial and (in some cases) federal sources may be able to provide transportation planning data for some applications. Vehicle classification counts are often available for roads under the jurisdiction of provincial bodies. Also, collision data may be available from the RCMP or another police force or insurance institute (Cambridge Systematics, Inc., TransManagement, Inc., TransTech Management, Inc., & Heanue, K, 2007).

Generally, however, coherent and multi-/supra-jurisdictional sources for data in Canada are limited. This contrasts with the situation in the United States. Three examples illustrate how these broader data sources can be used for planning in small- and medium-sized communities:

- In recent research regarding modelling and data practices for medium-sized communities in North Carolina, Stone et al. suggest, for communities with populations between 10,000 and 50,000 that the collection of local survey data is not necessary. Instead, data available from federal (national) or state sources are sufficient, such as through the U.S. Census Bureau, Census Transportation Planning Package (CTPP) NCHRP Report 365, Highway Performance Monitoring System (HPMS), Travel Model Improvement Program (TMIP), Federal Emergency Management Agency (FEMA), the state DOT Traffic Engineering Accident Analysis System (TEAAS). In other words, data sources from other locations are available, even if local data are not. This is important for the current research, because although some of these sources may be usable in Canada, or there may be Canadian equivalents (e.g., provincial / territorial accident databases), there are no nation-wide datasets or sources in Canada; and provincial / territorial datasets may be limited and/or may vary by jurisdiction.

- Tate-Glass et al. (Tate-Glass, M. J., Bostrum, R, & Witt, G, 2007) note a call by transportation professionals in Kentucky for a national clearinghouse for data used for state-wide and regional planning. While inter-jurisdictional data are currently difficult to obtain, a national database would present the opportunity to utilize and compare data from other regions.

- A recent study explored the transferability of household travel data to allow data collected in one context to be utilized in another. The authors suggest that the development of a successful data transfer method may reduce the data collection needs of small- and medium-sized communities. The researchers grouped households from the US 2001 National Household Travel Survey (NHTS) into clusters focusing on a variety of data that influence travel behaviour. Clusters were developed according to income levels, time of life and other household information, as well as land use and urban form for the household's location. Based on the travel data of these clusters of households, the authors were able to create trip characteristics by purpose, travel mode and commute distance for each household type. The authors then transferred these data to other geographic areas and communities to predict the trip generation of that new area, without significant data collection. To improve the quality of the model, the authors collected a small local sample and improved the data using Bayesian updating. The authors found that the local sample could be limited to a sample size of 75 households per cluster for the most economic results (Zhang, Y & Mohammadian, A, 2007). In other words, the authors were able to use data from a nation-wide dataset (NHTS) in order to develop statistically reliable relationships that could be transferred among municipalities. No similar datasets exist in Canada, either at the national or provincial / territorial levels; thus precluding the development of transferable relationships that could be applied to Canadian municipalities.

## 5.7 Best Practices

The preceding sections have presented a wide range of data types and collection methods. Each type of long-term plan and model has different data requirements. Given the type of long-term plan, analytical and data requirements can be identified. **Table 5-1** outlines the data requirements to support different plan types and modelling applications.

These guidelines are drawn from the best practices identified in the literature and in the survey, as noted. Their organization in these tables is based upon that prepared by Stone et al. for the development of recommended analytical procedures for communities of different sizes in North Carolina. However, unlike the North Carolina process, which to some extent must satisfy certain state or federal criteria for funding eligibility, these guidelines necessarily are less prescriptive in nature. As well, Canada lacks many of the statewide (province- or territory-wide) or nationwide datasets that are available in the United States.

**Table 5-1** categorizes data needs in the following ways:

- Size of population.
- Transportation plan types.
- Data required.
- Source of data.

## Table 5-1: Guidelines for Addressing Data Needs for Analysis

| Size of Population | Urban Context | Plan Type | Approach | Data Required | Source of Data |
|---|---|---|---|---|---|
| Small<br>(< 50,000) | Stand-alone, or part of a region but lacking a model; multi-modal | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>TDM<br>EA<br>Policy<br>AQ /congestion<br>Freight | Simple model, with coarse network and zone systems | Trip generation rates<br>Trip distribution by work / non-work<br>Population and employment<br>Traffic volumes<br>Travel times | Household origin-destination surveys (local or multi-area, to enrich data base; GPS trace and telephone survey for specific issues)<br>Census Place of Work / Place of Residence linkages by mode<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts<br>Travel time surveys |
| | Part of urban region; multi-modal | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /congestion<br>Freight | Use sub-area of regional model, with appropriate detail for network and zones | Trip generation rates<br>Trip distribution by work / non-work<br>Transit ridership volumes<br>Population and employment<br>Traffic volumes<br>Travel times | Specialized trip generation rates specific to community<br>Household origin-destination survey<br>Census Place of Work / Place of Residence linkages by mode<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts<br>Travel time surveys |
| | Stand-alone or part of region; roads only | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>EA<br>Freight | Direct demand (area-wide)<br><br>Trend analysis (specific facilities) | Auto and truck traffic volumes<br>Population and employment<br>Facility characteristics | Traffic counts<br>Census, provincial / territorial or local population, employment counts<br>Road inventory database |
| Medium<br>(< 100,000) | Stand-alone, or part of a region but lacking a model | TMP<br>Sub-area<br>Corridor<br>EA<br>Budgeting<br>Dev charge<br>Policy<br>AQ /congestion<br>Transit | Four-step model, with appropriate network and zone detail | Trip generation rates<br>Trip distribution by work / non-work<br>Transit ridership volumes<br>Population and employment<br>Traffic volumes<br>Travel times | Specialized trip generation rates specific to community<br>Household origin-destination survey<br>Census Place of Work / Place of Residence linkages by mode<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts<br>Travel time surveys |

**Table 5-1: Guidelines for Addressing Data Needs for Analysis**

| Size of Population | Urban Context | Plan Type | Approach | Data Required | Source of Data |
|---|---|---|---|---|---|
| | | TDM<br>Freight | Manual (spreadsheet) | Trip generation rates<br>Trip distribution by work / non-work<br>Transit ridership volumes<br>Population and employment<br>Traffic volumes | Specialized trip generation rates specific to community<br>Household origin-destination survey<br>Census Place of Work / Place of Residence linkages by mode<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts |
| | Part of urban region | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /congestion<br>Freight | Use sub-area of regional model, with appropriate detail for network and zones | Trip generation rates<br>Trip distribution by work / non-work<br>Transit ridership volumes<br>Population and employment<br>Traffic volumes<br>Travel times | Specialized trip generation rates specific to community<br>Origin-destination survey<br>Census Place of Work / Place of Residence linkages by mode<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts<br>Travel time surveys |
| Large (< 250,000) | Stand-alone <u>or</u> part of urban region | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /congestion<br>Freight | Four-step model, with appropriate network and zone detail. Develop separate model for freight | Trip generation rates<br>Trip distribution by work / non-work<br>Transit ridership volumes<br>Population and employment<br>Traffic volumes<br>Travel times | Use OD survey as basis for trip generation rates; for work / non-work trip rates.<br>Use OD survey for trucks as basis for model.<br>Specialized trip generation rates specific to community<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts<br>Travel time surveys |
| Very large (> 250,000) | Stand-alone <u>or</u> part of urban region | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /congestion<br>Freight | Four-step model, with appropriate network and zone detail | Trip generation rates<br>Trip distribution by work / non-work<br>Transit ridership volumes<br>Population and employment<br>Traffic volumes<br>Commodity flows or truck OD<br>Travel times | Use OD survey as basis for trip generation rates; for work / non-work trip rates.<br>Use OD survey for trucks as basis for model.<br>Specialized trip generation rates specific to community<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts<br>Travel time surveys |

## 5.8 Summary and Recommendations

The availability of good, recent data for long-term transportation planning is a significant concern for many of the organizations surveyed. The collection of 'basic' data among respondents of all types generally is pervasive: specifically, road inventory data, traffic counts and demographic data. Other data are commonly collected, such as travel surveys; however, the method and coverage vary by organization type. Sources of data from which a community can draw in the absence of its own data, or from which it can 'transfer' relationships developed by others, are limited by the general absence of large-scale transportation planning databases at the provincial / territorial or national levels. This is in contrast to the United States, where such databases exist and are used for these purposes.

Many respondents noted that data collection is expensive. Some communities are making use of new storage and organization systems, such as GIS, although many feel that they have further to go in effectively implementing these systems. One respondent cited "[C]o-ordination of data and accessibility to other [data]" as a necessary improvement to data sources/collection and other respondents echoed this sentiment. More information regarding trip origin-destination and household travel behaviour would help many organizations. The ability of data collection programmes to meet transportation planning needs varies significantly for each community; however, another observation is applicable to all organizations involved in transportation planning: "… the more data we have, the better the planning we can do." Because of this, the challenges and opportunities facing data collection have wide-ranging implications for all transportation planning applications.

Urban transportation data collection is a rapidly expanding field due to emerging technology. The field also provides many challenges to municipalities as they address concerns including data privacy and confidentiality, changing priorities and budget constraints for data collection (Limoges, E, Purvis, C. L., Turner, S, Wigan, M, & Wolf, J, 2007).

Data access raises significant privacy issues, especially with respect to freight data. Transponders (i.e., passive, in-vehicle devices) have the capacity to provide significant freight data, although their acceptance by industry and politically still is not widespread (Tate-Glass, M. J., Bostrum, R, & Witt, G, 2007). Conflicts between data gathering and privacy are further complicated by more restrictive legislation in many countries. This type of legislation reduces the amount of data that can be collected as well as how it can be used (Griffiths, R, Richardson, A. J., & Lee-Gosselin, M. E. H., 2007).

The amount of transportation data being generated is increasing dramatically (Tate-Glass, M. J., Bostrum, R, & Witt, G, 2007). The greater availability of data through continuous data collection technologies, especially ITS, will challenge planners and analysts in several ways. New or more powerful analytical tools and procedures will be required to utilize the information in large, complex databases. Quality control also becomes a concern as end users must be able to trust that their data are of sufficient quality and accuracy (Limoges, E, Purvis, C. L., Turner, S, Wigan, M, & Wolf, J, 2007). Data management programs should enable users to identify the source of the data as well as the level of confidence and the availability of archival data (Tate-Glass, M. J., Bostrum, R, & Witt, G, 2007). However, a major challenge in justifying the necessary investments in data collection programs is that the greatest benefits, in most cases, fall to their successors instead of being immediately apparent (Tate-Glass, M. J., Bostrum, R, & Witt, G, 2007).

Data collection itself faces many challenges. Practitioners must be innovative when considering the increasing complexity of gathering data, especially when involving the public. The global trend towards multiculturalism and, accordingly, to multiple languages within an urban area poses a significant challenge. In addition, there are greater pressures on individual free time, and members of the public are less willing to participate in surveys (Griffiths, R, Richardson, A. J., & Lee-Gosselin, M. E. H., 2007).

Opportunities exist to utilize transportation data originally collected for one purpose for another, or to reduce the need for expensive data collection through less expensive data collection programs. Some applications of data transferability fall in this category. Another application for data transferability is to utilize traffic count information to estimate origin destination matrices. A paper by Abrahamsson proposes that OD matrices may be obtained by performing a type of “inverse” assignment. The “inverse” assignment calculates possible OD matrices which, when applied to the network, result in the observed traffic counts. This type of analysis will result in more than one possible OD matrix, as there are generally more OD-pairs than links with counts. To resolve this issue, the modeller must find the best OD matrix, using either a general model of trip distribution or statistical inference techniques. Abrahamsson found a number of techniques cited in a variety of literature, that are relatively successful in calculating an OD matrix from traffic count information (Abrahamsson, T, 2007).

# 6. BEST PRACTICE FOR THE INTERFACE WITH OTHER PLANNING APPLICATIONS

Long-term transportation planning data both take from and contribute to other planning applications. Land use information and priorities derived from community planning activities can have significant impacts for transportation planning. In turn, transportation planning data have applications in sub-area planning, traffic engineering, network micro-simulation and capital budget planning activities. This chapter describes interfacing practices employed by municipalities.

Smart interfacing can create efficiencies for small- and medium-sized communities. As discussed, these communities often face resource constraints that motivate innovations. Resource requirements can be reduced significantly through appropriate interfacing, especially when considering data gathering. This interface can be between different levels of government, or among different applications within the same authority. This chapter examines some ways that communities have and can interface to improve efficiency.

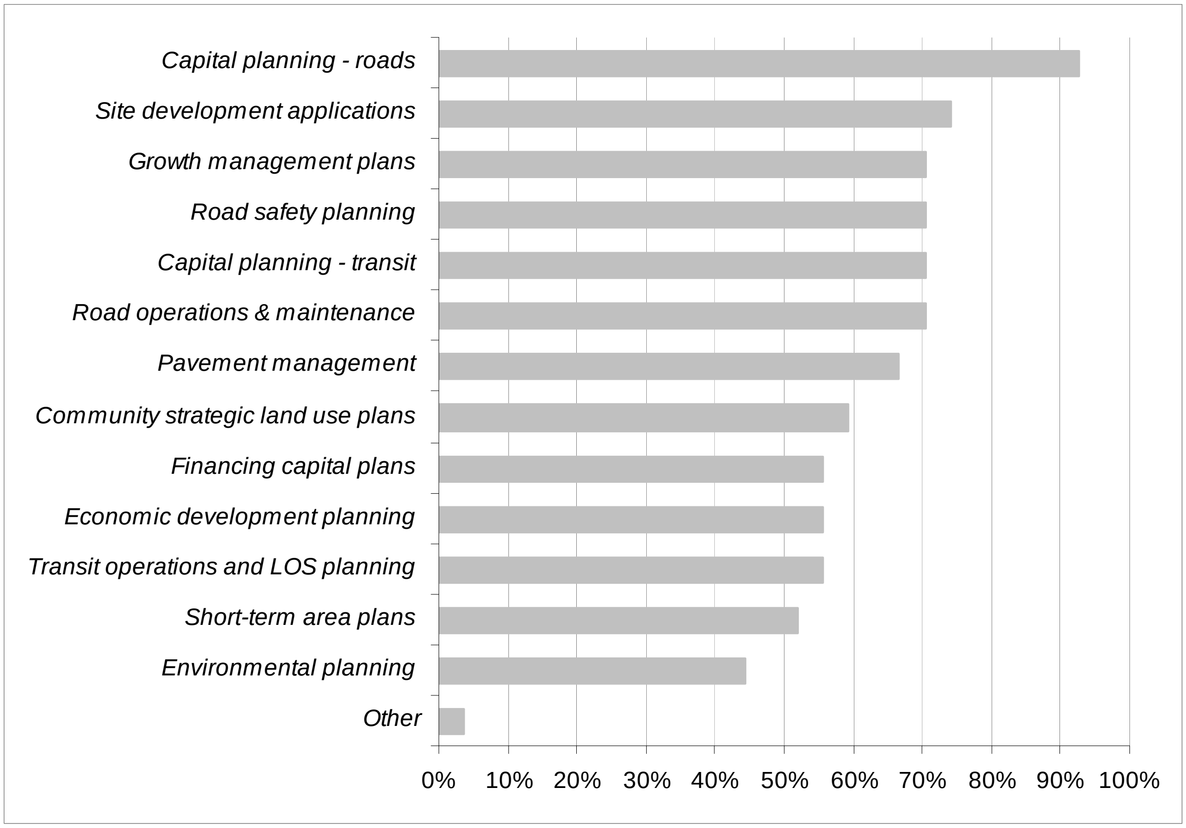
The remainder of this chapter is organized into three sections. **Section 6.1** considers the application of data. **Section 6.2** considers partnerships. Finally, **Section 6.3** summarizes the chapter.

## 6.1 Applications of Planning Data

Transportation data are valuable corporate assets gathered and processed at a considerable cost. As one source noted, “data asset[s] should be maximized by collecting once, storing once, and using many times” (AASHTO, 2002; City of Ottawa, 2003).

The range of usage of transportation planning data reported by the practitioners and summarized in **Exhibit 6-1** is extensive. Almost all respondents (93%) use transportation planning data in support of capital planning and financing for roads. Almost three-quarters of respondents - 74% - used long-term travel demand data in support of road operations and maintenance budgeting, transit capital planning, safety, growth management and development applications. Only 44% used the data for environmental planning.

**Exhibit 6-1: Utilization of Transportation Planning Data in Ancillary Applications**




The following sections discuss potential applications of long-term transportation planning and travel demand data into other corporate functions.

### 6.1.1 Transportation Financing

The evolving nature of transportation financing sources (especially including more private sources), increased levels of public scrutiny and accountability, and the specific information requirements of the private sector coupled with the need to compare investments according to global norms all have increased the need for credible, reliable and transparent travel forecasts. For example, in 'traditional' public sector projects, the decision-makers are local and political. Private sector projects involve investment banks, bond raters and insurers; and often these are multi-national organizations assessing competing infrastructure investments around the world.

The majority (93%) of respondents use transportation data to support capital infrastructure planning for roads. The range of applicable transportation data varies in accordance with the requirements set by infrastructure financing regulations but will often involve travel forecasts to accommodate growth.

Application of transportation planning data in support of financing capital investments in transit was identified by 10 of the 14 respondents that provide transit service. Unlike road infrastructure improvements that are financed by private interests to accommodate new traffic generated by their new land development (e.g., cost allocation for a proposed intersection improvement requires differentiation between growth-related and background traffic), transit data needs tend to focus on the overall demand captured or attracted by the system. Transit capital financing requires the explicit modelling of transit modal shares.

Roadway financing through public-private partnerships (P3) have opened up new opportunities for enhancements to the existing and future transportation networks realized in cooperation between private and public based financial resources. The public and private sectors jointly develop the P3 projects. One or more parties under terms and conditions of the P3 take on the responsibilities for meeting the performance requirements, design, construction, operations & maintenance, risk assumptions and financial obligations for the facility in question.

P3 projects could include tolling of existing roadways, the conversion of existing HOV (high occupancy vehicle) lanes to HOT (high occupancy toll) lanes; tolling of new facilities; imposing cordon pricing on roadways leading in and out of the most heavily congested part of an urban area. It is important to note that many of these types of projects, although not necessarily initiated by a small- or medium-sized community, could impact travel to, from or through the community and, it follows, the community's own transportation requirements. Also, as noted, the emergence of the private sector as the financial backer for transportation investments can change the information that is required from models and data; in particular, the reliability and accuracy of the data; the need to consider risk in the model outputs; and the transparency of the results.

P3 highway projects access private equity to finance front-end costs of project development and life-cycle costs of operation and maintenance. Financial decisions of private equity consortiums and banks involved with P3 projects pivot on access to and analysis of high quality transportation planning data generated by toll revenue demand forecasting models. The demand for the tolled facility, and the resultant revenues, is frequently modelled within the trip assignment component of a four-step model, expanded by procedures assessing the ability and willingness of potential users to pay. Purpose, mode and/or vehicle class can differentiate values of time. Willingness to pay is a variation of value of time that accounts for how much travellers value different attributes of the toll facility, such as safety and reliability (NCHRP 364).

### 6.1.2 Municipal Performance Measures

The increased public demand for accountability in the quality, effectiveness and efficiency in service delivery has triggered the need to develop a comprehensible and traceable set of corporate performance measures. Municipal performance measures can be qualitative or quantitative; can comprise broad statements or detailed analyses; include several or a selected few topics of particular interest to the community; and, can vary by depth and scope of approach. Transportation, due to the sheer magnitude of investment and the level of public interest it generates, has always received noticeable attention in municipal plans and performance measures. Characteristics such as size of the infrastructure, roadway safety, variations in levels and directional distribution of traffic flows, operational level of services, conditions of pavements and bridges, have been measured and compared over the years. In recent years, indicators designed to measure congestion, level of accessibility, modal shifts and sustainability have added to the list of measures.

Transportation planning data and travel forecasts enhance the performance measurement toolbox available to municipal planners and engineers. Congestion performance measures can address travel delay, fuel consumption, emissions of pollutants and greenhouse gases or congestion indices. Similarly, measurements of level of accessibility, modal shifts and sustainability are found in many municipal transportation master plans (see **Section 3.6**).

### 6.1.3 Energy and the Environment

Energy consumption and environmental impacts of transportation measure vehicular fuel consumption and the quantity of emission of greenhouse gases (GHG) and Criteria Air Contaminants (CACs). GHGs are a direct product of fuel consumption, whereas air contaminants vary according to the fuel sulphur content, the efficiency of the catalytic conversion process and the dynamics of the driving cycle. Air contaminants are known to have direct impact on human health – notably, through smog – whereas the global warming impacts of GHGs are perhaps broader in consequence. The three primary CACs are hydrocarbons (HC), also known as volatile organic compounds (VOC), carbon monoxide (CO) and oxides of nitrogen (NOx). Other CACs of interest include particulate matter (PM), ozone ($O_3$) and sulphur dioxide ($SO_2$). Climate change refers to the impacts of gases that absorb and trap heat in the atmosphere, i.e. greenhouse gases, the largest component of which is carbon dioxide ($CO_2$).

The measurement of GHGs and CACs depends on data such as vehicle-kilometres of travel, speeds and vehicle hours travelled supplied by travel demand or micro-simulation models.

## 6.2 Transportation Planning Partnerships

### 6.2.1 Internal and External Partnerships

Inter- and intra-agency cooperation in data collection, processing, storage and distribution is an important element in increasing efficiency and effectiveness of data viewed as corporate assets. Data collection surveys and the development and operation of travel demand forecasting models can be prohibitively expensive to a single agency. Travel demand forecasting models also require significant knowledge and investment, and accordingly provide another opportunity for cooperation. Sharing resources, promoting integration of services and stimulating exchange of information is best practice and there are several examples of such practices throughout the country.

A number of possible partnership and contracting models utilize the resources and expertise of organizations in a collaborative manner. Possible partners for municipalities include:

- Academic and research organizations
- Regional and provincial governments
- Other municipalities – both locally and nationally
- Outside agencies and consultants

Out of the 54 respondents to the survey, 21, or 39%, use travel demand forecasting models. Twelve of these owned the model and nine benefited from the mutual effort of building and operating the model, subsequently shared by others. As noted, Stone et al. listed four possible options for the development of transportation plans:

1. Develop transportation models in-house
2. Sub-contract model development and plan evaluation to outside agencies and consultants
3. Develop partnerships to accomplish modelling and transportation system evaluation
4. Utilize a variety of sub-models that may be more appropriate for the size, needs, and resources of communities. (14).

There are a number of examples of successful partnerships using the four options described above, as well as for similar partnerships in data collection and other planning activities. These are described below. Some of these partnerships were noted in **Section 4.3**, which described the current types of partnerships between the provinces and their municipalities for modelling and data.

Partnerships between small- and medium-sized communities and academic institutions can have significant benefits for all parties. In the United States, there are ten regional University Transportation Centers (UTCs). Their goal is "to advance U.S. technology and expertise in the many disciplines comprising transportation through the mechanisms of education, research and technology transfer at university-based centers of excellence (2004)". Several UTC / public partnerships have shown benefits, including providing opportunities for faculty to interact with the community, providing students with access to real world problems, providing public agencies with access to university resources, and making expertise available to small- and medium-sized communities that they may not otherwise have (2004).

Several examples of successful UTC / public partnerships exist. The University of Arkansas worked with the Northwest Arkansas Regional Planning Commission (NWARPC) to assess public transportation needs in four counties in Northwest Arkansas. The University provided study funding for the NWARPC. The University also provides ITS expertise to the regional body.

Similarly, in the TAC Smaller Cities Forum, some cities reported partnering with universities for data collection activities (Transportation Association of Canada et al., 2002).In another example, the Mountain Plains Consortium (MPC) of North Dakota State University established a transportation planning support program. The program performed model overhaul, model calibration, and sub-area and corridor analysis, among other activities. Small- and medium-sized communities were able to upgrade and update their existing travel demand models within an affordable fee structure. The University maintained and updated the software and provided expertise and training for the modellers. This program was very successful and had the potential for applicability at a greater scale (2004).

Many model development activities in the Greater Toronto Area / Hamilton (GTA/H) are undertaken under the umbrella of the Joint Program in Transportation, a joint venture between University of Toronto, the Ministry of Transportation of Ontario and GTA regional governments. This cooperation with local academia provides a good opportunity to exchange knowledge and new ideas between municipal sector and research groups. The academic home for the initiative also provides a 'neutral' and readily accessible basis for data and model development, as well as a basis for research.

In the GTA/H, local regional municipalities, the cities of Toronto and Hamilton, and the Ministry of Transportation of Ontario have a long and successful history of cooperation in data collection - notably, the Transportation Tomorrow (origin-destination) Surveys of 1986, 1991, 1996, 2001 and 2006; model and network development; and, the dissemination of modelling knowledge and expertise.

In Alberta, cities are required by legislation to create and update transportation plans on a regular basis. Capital works funding from the province depends on the completion of long-term transportation plans.[20] While Edmonton and Calgary have in-house staff and their own modelling capabilities, smaller cities rely on consultants to do their modelling. Consultants develop the model and update it when required. Between updates, the model normally resides with the consultant, since the cities have no in-house expertise to use the model. The staff's focus in small cities is on the delivery of projects and not directly in planning.[21]

Some specific challenges face smaller cities in attempting to develop models in-house. Many medium-sized cities require a more complex model to complete transportation planning exercises; however, these communities also struggle with resource limitations. Larger cities have modelling requirements that are significant enough to employ one or more full time modelling experts. These cities have the opportunity to attract some of the best modelling expertise because they offer full time work in the area of interest. This limits the supply of staff with modelling expertise for both smaller communities and consultants. A smaller community may only have enough modelling work to occupy a staff member for one or two

[20] Personal communication from Firoz Kara, February 22, 2008
[21] Personal communication from Jim Der, October 16, 2007

months of the year. This type of work does not attract staff with extensive modelling knowledge and may not allow a staff member with some knowledge enough exposure to extensively develop their skills without significant training.[22]

The City of Lethbridge is currently exploring the possibility of partnerships with other municipalities to secure resources in model development. The City already provides some services to smaller communities, sharing resources in signage, etc, where smaller communities may not have capabilities. They are now considering pursuing agreements with larger cities to share modelling staff. Since they do not have sufficient work to employ a full time modeller, it may be worthwhile to enter into an agreement with a larger city to create and/or maintain their model. This type of partnership allows the smaller city to access the resources of a larger city, while the larger city generates some revenue from the use of those resources.[23]

Quebec's partnership model includes a greater role for the province. The Ministère des Transports du Québec participates in the origin-destination surveys of major urban areas, and provides transportation modelling services to some municipalities in Quebec.[24]

### 6.2.2 Development of Resources

Related to the preceding discussion is the need to address the identified lack of resources. Two perspectives from the United States provide insight.

Brewster and Ren describe a series of sessions that was used to explain the process of travel demand modelling to the Thurston County, Washington, Regional Planning Council. Thurston County (Brewster, P. & Ren, J., 2002) has a population of 210,000, of which 93,000 people live in urban areas, including the state capital (2002 figures). The County has been active in integrating its transportation and land use plans. The relevance to this report is that Thurston's initiative helped to build an understanding among political decision-makers of the importance of technical tools and data in achieving the Council's goals:

> "The intent was not to make modelers out of the policy makers. Instead, it was to give them sufficient background so that they could understand and test assumptions driving the output, and effectively evaluate transportation and land use implications of policy decisions. We wanted to empower them to take a more active role in interpretation of model results and make more informed connections between the cause and effect of land use policies and transportation choices. There was also interest in documenting this information in such a way as to facilitate future policy maker education necessitated by the inevitable turnover on [Councils such as ours].

[22] Personal communication from Stephen Burnell, February 21, 2008
[23] Personal communication from Stephen Burnell, February 21, 2008
[24] Personal communication from Pierre Tremblay, October 16, 2007

Five 45-minute sessions were prepared, on such topics as why modelling is important; the four-step process and the inputs (land use). A summary booklet also was prepared, and is distributed to new Council members as part of their orientation.

Mann and Dawoud note how the "pendulum" swung with regard to models and resources, with the 1991 passage of the Intermodal Surface Transportation Efficiency Act (ISTEA). (Mann, W. & Dawoud, M., 1998) Prior to ISTEA, models were cumbersome, expensive to run and – because of a lack of funds to improve them – simple and straightforward. With ISTEA, "money flowed to Metropolitan Planning Organizations (MPOs) to increase staff and hire consultants to improve these models to address many policy sensitive variables, air quality issues, for in major investment [corridor planning] studies and other regional studies." One result is that the models are now more sophisticated and are capable of addressing all types of transit, HOV and pricing schemes. However, "they also are very time consuming making them infeasible to use for smaller subarea studies requiring turn-around times of only a few weeks. … A model that can be executed by local jurisdictions for numerous subarea studies in a quick turn-around time frame is needed now, or will be soon, by just about every MPO in the country."

The relevance here is three-fold: first, that resources require money; second, that models are needed for communities of all sizes to address the pertinent issue of the day; and, third, there is a need for simplified sub-area modelling.

## 6.3 Summary and Recommendations

Transportation data are valuable corporate assets that are gathered and processed at a considerable cost. As a 'corporate asset', the value of the data can be enhanced by maximizing their application to other functions, both vertically within the realm of transportation engineering and planning, and horizontally among other planning functions. Both apply to functions within the same organization and among organizations.

Survey respondents confirmed that the data are used vertically for a broad range of transportation applications (including site development, safety and operations), and also horizontally for economic development and planning. The data also are used for performance measures and monitoring, and to address energy concerns. The growing application of public-private partnerships in the delivery of infrastructure and service provides both new opportunities for using these data, as well as challenges in ensuring that changed data needs can be met.

Collaboration and partnership in model development and data collection is a valuable tool for small- and medium-sized communities with limited resources. This section included examples of collaboration between small- and medium-sized communities and local universities to upgrade both data and modelling capabilities, providing possible ways to combine resources (capital, human and expertise). Other opportunities for collaboration exist with regional and provincial bodies, other municipalities, and outside agents and consultants. Each type of partnership has advantages and disadvantages and small- and medium-sized communities should explore these relationships to find the ones that are most advantageous to all parties.

For small- and medium-sized municipalities, best practices comprise the following:

- Investigate public private partnerships as they apply
- Pursue partnerships with educational institutions, provincial and regional bodies, and consultants and other institutions where there is possibility for mutual benefit
- Utilize resources provided by TAC and other bodies, including US institutions where applicable
- Invest in employee education and training

# 7. PREPAREDNESS FOR THE FUTURE

Thus far, this report has described best practices for addressing existing long-term transportation planning needs. It also is important to look forward and consider emerging issues. Some of these issues were identified by the Project Steering Committee. Others arose from the survey or were outlined in the literature. **Section 7.1** introduces these issues. **Section 7.2** investigates the current successes and weaknesses of long-term transportation planning in Canadian municipalities, as identified by the survey respondents. **Section 7.3** presents details about the emerging issues, expands on their importance and gives examples of how agencies are approaching these issues. TAC, the sponsor of the current research, already has an essential role in transportation planning in Canada. **Section 7.4** considers TAC's possible role in the context of similar organizations elsewhere. It also includes ideas and options that would allow TAC to take on other roles and potentially lend more support to long-term transportation planning exercises in small- and medium-sized communities. Finally, **Section 7.5** summarizes the chapter.

## 7.1 Introduction

This section identifies new, emerging issues; we attempt to gauge agencies' level of readiness and responsiveness to those issues in the areas of methods, tools and data. The emerging issues identified in collaboration with the PSC are climate change, increased interest in public transit as an alternative to driving, and new funding sources emerging in response to new challenges.

The world, and Canadian's view of the world, has rapidly changed in the past years, with the natural environment and surrounding issues taking on a more prevalent role. A series of CBC / Environics polls from May, 2004, January, 2006, and November 2006 shows the environment, as a political issue, increasing in awareness of Canadians (CBC News, 2007). Globally, the Intergovernmental Panel on Climate Change (IPCC) provides perspective into emissions trends, the impacts of those emissions, and mitigation measures. Global GHG emissions have grown 70% from 1970 to 2004, with the growth from transport increasing by 120% in the same period (Intergovernmental Panel on Climate Change, 2007b). There is significant observational evidence that regional climate changes are affecting natural systems, including changes in snow, ice, and frozen ground, hydrological systems, terrestrial biological systems, and marine and freshwater biological systems. These changes, and anticipated future changes, may have negative impacts for humanity, including changes in the distribution of fresh water, net reduction in crop productivity, increased risk to coastal communities, and net negative human health impacts. In North America, the IPCC predicts that challenges to coastal areas and water resources may be some of the most significant, along with disturbances from pests, diseases, and fire in forest areas. The Social Cost of Carbon (SCC) can be expressed in monetary terms, based on the aggregate net economic costs of damages from climate change. The average value of peer reviewed estimates of the SCC for 2005 is US$43 per tonne of carbon, but there is a significant range within the estimates (Intergovernmental Panel on Climate Change, 2007a). Effective transportation planning has a role to play in addressing climate change, and many of the emerging issues examined in this chapter reflect that role.

Energy is another factor influencing the emerging issues discussed in this chapter. There is a relationship between energy and climate change through the conversion of some energy sources to GHG emissions, but because of some unique considerations, energy merits separate consideration. Energy is essential to transportation and as speed increases, energy use also increases. Humanity desires more convenient and rapid access to goods and services and increased energy consumption is required to meet that demand.

The majority of transportation energy comes from one source, oil, which further complicates the reliance of the transportation sector on energy. There are approximately 1 trillion barrels of conventional oil reserves available globally, enough for 37 years of consumption at the current rates, and as much as 1 trillion additional barrels remain undiscovered. Economically recoverable unconventional resources and currently unrecoverable unconventional resources raise this number even higher, with total estimated oil reserves nearing 20 trillion barrels. Total oil resources may be able to take humanity well into the next several centuries at current consumption rates. The immediate issue, therefore, is not necessarily the supply itself, but the access to and cost of oil. Existence of sufficient oil reserves does not guarantee availability, as seen in the oil shocks of the 1970s. Geopolitical concentration of resources, the influence of Organization of Petroleum Exporting Countries (OPEC), increasing cost to access unconventional resources, and increasing demand may all influence oil prices and therefore the transportation sector of the economy (Greene, D. L. & DeCicco, J. M., 2007).

Air pollution, also tied to climate change, is another challenge prompting some of the emerging issues discussed in this chapter. A paper by Green and DeCicco citing the US Department of Transportation notes that vehicles are responsible for:

- 78 % of all carbon monoxide emissions
- 45 % of nitrogen oxide emissions
- 37 % of hydrocarbon emissions
- 27% of all anthropogenic fine particulate matter emissions (Greene, D. L. & DeCicco, J. M., 2007)

These emissions have both environmental and human health consequences. Technological improvements in vehicles have reduced the amount of air pollution per vehicle-kilometre; however, this can be offset by ever-increasing travel activity (i.e., vehicle use).

Municipalities are aware of these emerging challenges. They are looking for opportunities to meet them. Five survey respondents cited the ability to forecast and plan for alternative modes and transit as an area in which the available tools and methods do not meet the needs. One respondent commented in response to emerging issues that “[in the] longer term may need to develop additional models to account for land use planning / transportation planning interaction."

## 7.2 Current Successes and Weaknesses

Before looking at the challenges and opportunities, it is important to understand what successes and weaknesses Canadian transportation planning organizations face today as they look forward at their needs and level of preparedness for the future.

The survey conducted as part of this study asked practitioners six questions about their needs and successes in different aspects of long-term transportation planning. The responses addressed a wide range of topics. They offer significant insight into the current state of the practice and into the factors that must be addressed in moving forward. The many success stories offer insight into what works for Canadian communities.

**Table 7-1** through **Table 7-6** provide a summary of the most common needs and successes expressed by the respondents. Each of the six tables addresses a specific question in the survey. The comments have been edited for clarity and to ensure anonymity. French comments have been translated into English: these translations appear in italics.

Not all of the respondents' comments are included and some responses have been divided into separate quotes since they fall under multiple subjects. This discussion is intended as a synopsis: The complete listing of the comments is provided in Appendix B.

### 7.2.1 Key Points

Throughout the respondents' answers to the six needs / successes questions, several major areas are prominent. Certain key factors are instrumental to the success of organizations – they appear repeatedly as reasons for success and are required repeatedly as needs.

- Staff resources: A lack of staff experienced in modelling and data, need for more training, insufficient staff complement.
- The importance of good data was recognized.
- Need for data sharing and cooperation between different levels of government (to build up data and minimize/share costs)
- Need for appropriate tools and data to account for the increasing importance of alternate modes
- Lack of funding, or need for sustained funding
- Need for political and community support for data and modelling initiatives.

## Table 7-1: Comments Summary – Ability of Existing Methods and Tools to Meet Needs

Question: **How well do your existing transportation planning methods and tools meet your needs (e.g., for transportation plan development, operational analysis, transit planning, planning for other modes, investment decision-making, etc.)? In what areas are they deficient?**

| | Resource Limitations – Staff and/or Funds | Political support / integration with others | Technical limitations and improvements | Rapid growth | Need to expand programming/strategy |
|---|---|---|---|---|---|
| Number citing | 6 | 2 | 8 | 1 | 14 |
| Sample Comments | Staff resources so that instead of responding to complaints and reviewing studies, we can be more proactive in identifying areas where we can initiate emerging ideas.<br><br>Inadequate qualification or lack of experience of staff makes advancement in techniques and tools difficult. Increasing sophistication of public enquiries require more resources.<br><br>Model development is mainly done by consultants off site. This makes in-house expertise tough to acquire. Workload is so heavy that work is farmed out due to short timelines. | More integration with local municipal planning efforts would benefit - consideration for development impacts is required.<br><br>Only work when [our] Council agrees and commits to the plan recommendations. | The [regional government] would like to have the ability to improve trip assignment capabilities on the network, improve volume-delay functions, improve zone definitions…, and bridge the gap between traffic operations and long-term planning through micro-simulation capability.<br><br>Fairly well; deficiencies more to do with lack of understanding of tool limitations.<br><br>Deficient in-house ability to update or modify transportation model.<br><br>*Major static model limitations in processing congestion conditions.* | …City needs to take control of the transportation planning model and provide ongoing model update in response to rapid development changes and overlapping development traffic influences… | Need to develop strategic transportation plan over the next couple of years to get proper policies and methods in place.<br><br>Proactive transportation planning at the county/regional level is a fairly new role. We are still trying to determine the most efficient means of gathering, maintaining and utilizing transportation information.<br><br>Our tools are currently deficient in transit operations analysis and planning, park-n-ride activities, household structure-based trip generation, trip chaining and distribution, mode choice between transit modes, non-motorized modes, commercial / truck trips, external travel.<br><br>In longer term may need to develop additional models to account for land use planning / transportation planning interaction.<br><br>Transportation planning has not happened in the past. We are in the process of reorganizing… to provide these services, however, it will be another 2 to 3 years before staff resources, training and systems are all in place. In the mean time, we rely on [our regional government]. |

# Table 7-2: Comment Summary - Improvements Needed

Question: **What improvements to your organization's existing transportation planning methods and tools would be needed to address any deficiencies or gaps?**

| | Resource Limitations – Staff and/or Funds | Political support / integration with others | Technical limitations and improvements | Knowledge and research needs | Need to expand programming/strategy |
|---|---|---|---|---|---|
| Number citing | 15 | 3 | 11 | 3 | 12 |
| Sample Comments | Additional experienced staff with the purchase of specific software related to traffic.<br><br>More available staff and/or consultants.<br><br>Dedicated staff to planning, not stretched between planning, design and operations.<br><br>Staff resources and capital funding.<br><br>Additional staff to manage the transportation planning, we are currently very reactionary.<br><br>I believe that there is a need to address the demographics and the fact that the department will be losing a number of staff through retirement. This will lead to a loss of knowledge and therefore training opportunities will be needed into the future.<br><br>More training and qualified staff. | Commitment at decision level to accept and act on plan results and to support long term planning.<br><br>Clear identification of modal priorities.<br><br>Inter-municipal and inter-agency integration is good. Currently working with municipalities and other regional agencies to enhance integration. | Purchase of specific software related to traffic.<br><br>Transportation forecast model/software.<br><br>Stronger, more rigorous tools.<br><br>Increase ability to use micro-simulation for short term planning.<br><br>Ongoing need to upgrade tools to keep up with state of the art. increasing focus on micro-simulation of individual / vehicle travel.<br><br>Need for modelling at the local level.<br><br>*Need to factor in commercial trips; special surveys required. Dynamic monitoring of congestion and of rush hour times.*<br><br>*We would like to be able to plan off peak periods using our modelling software.*<br><br>*Lack of data, qualified staff, and knowledge of EMME-3.* | Best practices from other organizations - tailored to our needs.<br><br>Research and study of available information.<br><br>Increased knowledge of available methods, tools, practices. | Need to be updated to reflect current issues.<br><br>Long-term modelling for transit.<br><br>We require a long-term strategic plan for planning methods and tools to be effective.<br><br>Manage supply and demand to encourage modal shift.<br><br>Establishment of a firm traffic counting program that covers every area of the City in a reasonable amount of time.<br><br>Revisions to [our] Official Plan to include transportation issues, etc.<br><br>Regular updates of studies.<br><br>Possibly investing in a micro-simulation transportation model.<br><br>Operational analysis requires further sophistication by using car following theory techniques.<br><br>*Tools appear satisfactory, but their frequent use could be more important.*<br><br>*Increase our knowledge of integrated planning tools for transit and urban planning.* |

## Table 7-3: Comment Summary - Data

Question: **What improvements to your organization's existing data sources or data collection activities, or new data, would be needed to address any deficiencies or gaps?**

| | Resource Limitations – Staff and/or Funds | Data sharing | New data / fill gaps | Data storage and management |
|---|---|---|---|---|
| Number citing | 9 | 4 | 15 | 9 |
| Sample Comments | Additional technical support staff.<br><br>Additional resources to evaluate data.<br><br>Sufficient resources (staff/funds) for community size and growth.<br><br>More funding for data collection, more staff dedicated to data collection.<br><br>There is a lack of guaranteed funding / timing for future surveys.<br><br>Would like to have the funding to have more complete traffic count information collected on a regular basis. | Better sharing and collection of data.<br><br>Improved access to Works traffic data for long-term planning.<br><br>More centralized and rationalization of data collection by Municipalities and regional transit agency. Currently working with staff on this initiative.<br><br>Co-ordination of data and accessibility to others. | Focus on performance of non-auto modes.<br><br>Employment inventory - Goods movement survey.<br><br>Incorporate interchange ramp counts into the annual programs.<br><br>Network performance as measured by actual travel times experienced by public an increasingly emergent issue.<br><br>*Study on the economic status of the people using public transit.*<br><br>Additional information on trip origin/destination, household travel info would be useful.<br><br>*Need for systematic and classified counting plans in urban areas (screen-line approach with counting of all trips by vehicles and people). Need for systematic travel time reports, data on generation of trips to industrial and commercial sites.*<br><br>*We are in the process of preparing a [new] OD survey, and the data collection will most certainly be improved, as it is with every OD survey. I do not yet have the specific improvements that will have to be made, however. Nevertheless, we will have the most data and best planning possible* | Integration of existing asset management systems and addition of data for assets not now covered.<br><br>Enhanced land use and network data in GIS; can be used to improve model.<br><br>Improvements to the operation of our database and integration with the collision data.<br><br>Fully utilize data from camera-controlled intersections.<br><br>Consistent methods and better validation of collected data.<br><br>Better integration of traffic data and our GIS system.<br><br>*Need for continuity in our data collection (updating).*<br><br>*Have permanent counting stations, regularity in obtaining data, more access to ITS in our projects.]* |

## Table 7-4: Comments Summary - Factors for Success

Question: **What existing factors contribute to the success of your transportation planning process?**

| | Good data | Local connection, leadership, public support, and strong partnerships | Good, well maintained tools/strategies and technical strength | Low needs level | Experienced staff |
|---|---|---|---|---|---|
| Number citing | 10 | 26 | 11 | 4 | 15 |
| Sample Comments | Good defendable data.<br><br>There is a reasonably extensive and consistent historical database on development, population, household, traffic etc.<br><br>Increased richness of data available.<br><br>Manipulation and presentation of data.<br><br>*The richness of our OD surveys (households) allows for very robust analyses. These constitute the cornerstone of our process.*<br><br>*We use a totally disaggregated survey, i.e. tied to postal code, which gives a great deal of detail and information.*<br><br>*Access to limited data but it is reliable and fairly recent (OD survey), relevant and effective databases such as the OD survey.* | Good public input and consultation process.<br><br>Strong administrative leadership.<br><br>Good working relationships with other departments and sections (works department design, traffic, infrastructure staff, regional transit, Current and policy planning branches).<br><br>A Transportation Master Plan that has been embraced by staff, politicians and the community. An integrated organizational structure that breaks down silos.<br><br>Historical community knowledge. Sound City Council leadership.<br><br>Good relations with staff from [other local] municipalities and other regional agencies and good communication.<br><br>Adequate resources provided to do the job; plus strong leadership shown within organization for importance of good planning.<br><br>*Exchange of best practices between transit organizations,* | Continual upgrading to the Transportation Master Plan.<br><br>1. Existence of a VISSIM transportation planning model… and the existence of well-prepared transportation plans every 5-7 year periods. 2. The existence of historical Transit Master Plan, Bicycle Trail Master Plans, Parking Master Plans, Major Area Structure Plans and Neighbourhood Area Structure Plans. 3. There is an established planning process among different city departments.<br><br>Improvement to analytical tools.<br><br>Flexible and adaptable to emerging issues.<br><br>Sustained commitment of resources on given projects (ie. not bouncing around to the hot spots).<br><br>Proper travel demand and performance measurement tools.<br><br>Linked to regional growth strategy, comprehensive approach, standard evaluation process. | We have not yet reached the level of congestion which would drive a more rigorous planning regime. Also funding is there.<br><br>Small size of the transportation network has been in our favour with the limited staff. | Passionate staff, knowledgeable staff,<br><br>Experienced staff with local knowledge.<br><br>In-house, dedicated modelling staff.<br><br>Staff with historical knowledge of area. New staff trained in most recent methods.<br><br>Staff dedication.<br><br>*Quality of consultants.*<br><br>Technical abilities of the planners.<br><br>*Multidisciplinary teamwork also helps a great deal by bringing more analytically-minded people and more operationally-minded people together*. |

## Table 7-5: Comments Summary - Problems with Existing Process

Question: **What are the main problems with existing processes of planning, delivering and implementing the findings of transportation planning projects?**

| | Financial | Political/communication | Workload/time constraints | Strategies and organization | Tools and data |
|---|---|---|---|---|---|
| Number citing | 11 | 14 | 12 | 7 | 6 |
| Sample Comments | Financial considerations.<br><br>Inadequate funding and resources.<br><br>Funding availability.<br><br>Committing resources to the completion of corridor preservation for medium/long term corridors/improvements identified in the studies.<br><br>The rising cost of implementation.<br><br>Funding from senior levels of government.<br><br>Lack of funding to implement identified needs.<br><br>Lack of funding.<br><br>*Financial [funding] availability.*<br><br>*Insufficient budgets.*<br><br>Disconnection of [travel demand forecast] from some of the capital plans. | Political acceptance of changes.<br><br>Alignment of staff, council, and public vision.<br><br>Lack of commitment by decision makers.<br><br>Some projects are split between Works and Planning departments; even with good ongoing communication it is tricky coordinating findings amongst all staff involved.<br><br>Difficulties in co-ordinating administration efforts with changing political priorities.<br><br>Lack of political will to examine changes in technology.<br><br>Special interest groups.<br><br>Political realities and development pressures do not always align with community desires.<br><br>Need for higher level support for longer term transportation planning.<br><br>*Difficulty obtaining consensus on planning assumptions among all stakeholders in a region.* | Day to day workload influences on planning projects.<br><br>Compressed timelines, lack of resources.<br><br>[Not enough] time to consult with all stakeholders.<br><br>*Lack of internal resources.*<br><br>Fast development | There is a lack of existing policies/standards/guidelines to sufficiently and defensibly address the challenges that we face with various development proposals.<br><br>Short range vision.<br><br>Importance between transportation and planning not fully recognized. Need transportation to be involved from very beginning of any process.<br><br>Not enough software tools to simulate future conditions.<br><br>Too much consultant input. | Can't program larger city wide reviews.<br><br>Traffic counts not done nearly often enough.<br><br>*We have poor knowledge of the various development projects in [the region], and we are not yet sufficiently involved in these processes to develop public transit in new locations in [the region]. As well, we have a lack of bus availability, which prevents us from implementing new services at rush hour.*<br><br>*Difficulty forecasting employment development, difficulty obtaining count data that is sufficiently complete to validate models.*<br><br>*[Require] more effective tools for data analysis.* |

## Table 7-6: Comment Summary - Technical Limitations

Question **What technical limitations do you encounter in your transportation planning processes (e.g. staff expertise, consultant expertise, data availability)? How do you plan to address these issues in the future?**

| | Funding / lack of staff | Experience | Tools / process | Data | Interface with consultants |
|---|---|---|---|---|---|
| Number citing | 10 | 14 | 3 | 16 | 3 |
| Sample Comments | Funding to hire experts.<br><br>Lack of staff resources, too many demands on existing staff.<br><br>As we grow the need for additional staff and organizational restructuring will be needed.<br><br>Attracting / retaining qualified staff an issue, the organization needs to be seen as a worthwhile place to work.<br><br>No major problems to date, however with the demographics of the staff, knowledge will be lost through retirements. Rigorous learning plan will be developed for all staff to ensure this “problem” is mitigated.<br><br>Insufficient staff level with the necessary experience need to increase the salary grid levels to make this happen. | Technical experience, qualifications.<br><br>Staff expertise needs to be developed to address the issues.<br><br>Technical limitations are being addressed by the evolution of projects into more complex undertakings thus the business case for improvements in expertise and availability can be presented and action taken.<br><br>Staff expertise, consultant expertise. Better process for hiring, procurement.<br><br>More training sessions.<br><br>*For projects involving the priority network or reserved lanes, we lack traffic expertise, which we must obtain from the consultants. The lack of resources should also diminish when several people are hired this autumn.* | Need modelling.<br><br>GIS is very advanced. We use TES to store traffic and collision data, which directly interfaces with the GIS.<br><br>*For development projects, we are going to institute a process with [the City] that will involve the [transit agency] in the various projects.* | Data integrity and delays in receipt of data from sources.<br><br>Data availability in terms of goods movement, more detailed transit ridership data, network data in GIS - we continue to investigate opportunities to improve our data sources through new projects and funding<br><br>Data and in particular the analysis and the streamlining of how each municipality within the region interprets the data, e.g. collision data.<br><br>Data availability, updated hardware and software systems.<br><br>Better process [for] data collection and dissemination.<br><br>*One of the major limitations involves the lack of data on trips other than those by people; data on commercial trips is rare and often inconsistent (i.e. truck, train, marine and air modes).*<br><br>*Difficulty collecting all relevant and necessary data in order to produce an accurate summary and thereby meet the desired long-term planning objectives (the most optimally possible).* | Consultant expertise...we are experiencing issues with quality control.<br><br>Consultants do not listen to local input.<br><br>Consultant expertise is in high demand to meet the need of the rapid growth. |

- Need for an overall transportation planning strategy with regular updates and regular, complete data collection

Essentially, respondents are saying that they recognize the need to be able to respond to emerging issues such as sustainable transportation; however, they are constrained by a lack of sustained funding, insufficient staff resources and a desire for more or up to date tools and data. (In contrast, in the United States, the augmentation of staff resources and development of tools and data for small- and medium-sized communities has been driven largely by the 1990 ISTEA [and subsequent] legislation, which required enhanced transportation planning in these communities and provided sustained funding to achieve this.)

The Transportation Association of Canada is playing an important role in many of the relevant topics: a Climate Change Task Force; Sustainable Transportation Standing Committee; the Transportation Planning and Research Standing Committee (which sponsored this study); the Urban Transportation Council; and – perhaps most important – the Small Cities Forum. Each of these bodies (and others) is relevant to the topic; however, a direct focus around the needs of small- and medium-sized communities would contribute significantly to the promotion of best technical practices in modelling, tools and data in these communities.

## 7.3 Challenges and Opportunities

A variety of factors will influence policy makers' demands on transportation planning. Many of these factors are already evident in current affairs and public pressure. Griffiths et al. address six points that will influence policy makers' demands of the environment surrounding travel surveys (Griffiths, R, Richardson, A. J., & Lee-Gosselin, M. E. H., 2007). These six points, and the political will and influence surrounding them, are applicable to all parts of transportation planning. They are:

- Concern with greenhouse gases, air quality, and urban congestion.
- Emphasis on sustainable transportation systems that demand greater use of non-motorized, transit and non-transport based solutions to traditional transportation problems.
- Increased consideration for urban freight and commercial vehicles.
- The growing capacity of ITS technologies.
- Attention to user-pays solutions, such as toll roads and other road pricing options.
- Privatization of transportation systems, both road and public (Griffiths, R, Richardson, A. J., & Lee-Gosselin, M. E. H., 2007).

The following two sections address many of these concerns, under the rubrics of environmental concerns and public transit. A discussion of emerging funding completes this section.

### 7.3.1 Environmental Concerns

The IPCC suggests several measures that may be effective in reducing GHG emissions by transport. Overall, however, the effect of the mitigation options listed may face counteraction by growth in the transportation sector. It remains important to pursue these measures where possible. For transportation planning, it is important to recognize that emissions reduction is a co-benefit of addressing other challenges, including traffic congestion, air quality, and energy security. Mitigation measures include modal shift from road to rail and to inland and coastal shipping. Other measures include encouraging a shift from low-occupancy to high-occupancy passenger transportation. Land-use, urban planning, and opportunities for non-motorized transport may also mitigate GHG emissions (Intergovernmental Panel on Climate Change, 2007b).

Christopher et al. suggest that there are viable strategies available to policy makers to reduce GHG emissions. The first is to encourage reductions in GHG through reductions in the use of private automobiles. Policy makers can accomplish this through policies that aim to change travel behaviour, such as pricing mechanisms (which influence modal choice, the need to make a trip, and so on) and denser land use (which is more efficient to serve by transit, and which promotes short-distance, walkable/cyclable trips). The second strategy is to encourage the development of new technologies that reduce the consumption of petroleum fuels, either through increased efficiency, or through the use of alternative fuels. These strategies are not mutually exclusive, and policy makers can employ them simultaneously (Christopher, R, Biehl, S, Cherwek, V, & Schick, J. R., 2007).

Public concern with environmental issues, such as greenhouse gases, air quality, and urban congestion require policy makers to explore wide-ranging strategic transportation solutions using travel forecasting models that require more and more accurate information (Griffiths, R, Richardson, A. J., & Lee-Gosselin, M. E. H., 2007). Sixty-four percent of survey respondents indicated that they consider Environmental Quality Indicators when evaluating the results of transportation planning studies. However, not all types and sizes of communities place the same importance on environmental indicators. Only 50% of municipalities with populations under 50,000 considered environmental indicators, while 75% of municipalities with populations over 250,000 considered these indicators. Eighty-six percent of provincial organizations considered the environmental indicators.

Currently, the distinct nature of transportation and emissions models, as well as inaccuracies in local values for speed, traffic adjustments by season and day of week, and travel on local streets, cause substantial inaccuracies in predictions of GHG emissions. Better integration of transportation and emissions models will achieve more accurate emissions information. In addition, more information is needed about the impacts of innovations, such as pay-at-the-pump insurance and car-sharing, on travel behaviour (Savonis, M, 2007).

Transport Canada outlined strategies for sustainable transportation planning in a 2005 study (Transport Canada & TAC, 2007). The study identifies twelve principles of sustainable transportation in Canada:

1. Integration with land use planning
2. Environmental health
3. Economic and social objectives
4. Modal sustainability
5. Transportation demand management
6. Transportation supply management
7. Strategic approach
8. Implementation guidance
9. Financial guidance
10. Performance measurement
11. Public involvement
12. Plan maintenance (Transport Canada & TAC, 2007)

Best practices in long-term transportation planning, as presented in this study, address many of these principles.

### 7.3.2 Interest in Public Transit

Transit in small- and medium-sized communities traditionally fills a very specific niche. Work by Andreas shows that the majority of transit users in mid-sized cities - that is, in cities with populations between 50,000 and 500,000 - are captive riders. (These are travellers who do not have access to a car and/or who may be limited to transit for economic or demographic reasons [e.g., they are not old enough to have a driver's license].). In addition to these riders, there are generally 'semi-captive' riders: These are traditional 'captive' riders according to demographic and socio-economic measures, but who normally find an alterative to transit. Most riders express interest in moving to other modes if possible. Planners must remember this, as the current users of a transit system in a mid-sized city may opt for other modes in the future (Andreas, W. J., 2007).

In response to the challenge of attitudes towards transit and loss of ridership, Andreas also showed that in many cases infrequent users would be more likely to be transit customers if authorities made some small, specific improvements to the transit system. The characteristics of the infrequent users are often similar to those of the 'semi-captive' group. It may be possible to increase ridership by targeting these two groups with service improvements that are tailored to the groups' needs. Measures focus on reliability of service, as well as customer service, limited and rapid transfers, and direct routing (Andreas, W. J., 2007). All of these measures should be considered when creating and implementing transit plans.

### 7.3.3 Emerging Funding Sources

As discussed at the TAC-sponsored 2002 Smaller Cities Forum, financing is a major issue for smaller cities. Major concerns include the discretionary nature of transportation funding, the lack of stability, the large cost of major projects, and the integration of development cost charges. In addition, small cities with small budgets often have problems accessing provincial funding because they cannot meet the percentage of project funding required from the local municipality (Transportation Association of Canada et al., 2002).

Feedback from the 2002 forum also stated that development cost charges are of particular concern for smaller cities. There appear to be significant differences in the management of the charges across Canada, and limited satisfaction in using development charges as a funding source. There must be balance in the funding of transportation projects between developers and municipalities. A variety of methods of managing development cost charges was suggested by the different communities in attendance (Transportation Association of Canada et al., 2002):

- Some funding can be recovered after the development is complete through utility and road levy charges, as in Red Deer, Alberta.
- The developer could build the collectors and residential streets and share 25% cost of the arterial.
- If the developer comes forward with an unsolicited major development, the developer may be forced to pay for any additional lanes required by the development, as in Grande Prairie, Alberta.
- Alternative methods including pay-as-you-go, or having a reserve fund, such as a levy from property tax and development charges that can be placed in reserve to accommodate a 20-year plan.

Other possible funding sources include funding through earmarked portions of utilities, or utilizing some alternative taxation. Public private partnerships are often not an option for small communities, since projects are normally too small and have limited resources to accommodate the management process (Transportation Association of Canada et al., 2002).

In 1997 a TAC briefing on the financing of urban transportation proposed a new financing model for urban transportation (Transportation Association of Canada, 1997). This proposed model attempted to meet nine criteria. It suggested that the new financing model be stable and predictable, transparent, least cost, simple, supportive of local access to funds in line with local responsibilities, user pay, dedicated, inclusive of public involvement, and show measurable results. While each community must find an urban transportation financing plan that is suited for their specific circumstances, these goals are applicable to all. Some useful options include user fees, in addition to more traditional financing sources. User fee options include gasoline and licence fees, auto commuter levies, parking fees, toll roads and bridges, roadway congestion pricing, property development charges, and right of way fees. Although not all options are applicable for all small- and medium-sized communities, policy makers can garner practical ideas from this list (Transportation Association of Canada, 1997).

In sum, several mechanisms exist for funding, and the topic has been examined from a variety of perspectives. However, there is a need to relate long-term transportation planning to funding; and (from the perspective of this study) to focus this on the specific needs of small- and medium-sized communities.

## 7.4 TAC Role and Support

The mission of the Transportation Association of Canada (TAC) is to "promote the provision of safe, secure, efficient, effective and environmentally and financially sustainable transportation services in support of Canada's social and economic goals (Transportation Association of Canada, 2007)". TAC provides Canadian transportation professionals and other interested parties with a variety of services, including an annual conference and exhibition, technical guides and syntheses of practice, courses and seminars, a transportation library, and other services (Transportation Association of Canada, 2007). In the United States, and internationally, different organizational schemes address the provision of transportation information and services.

One significant American organization is the Transportation Research Board (TRB). TRB has a mandate that incorporates the exchange of information, sponsorship of meetings and forums, publication, and the formation of task groups to address topics in response to government transportation needs. It is, in many respects, a technology transfer agency. Technology transfer allows transportation professionals to apply information from research and other newly developed technology as quickly as possible to fulfill the needs of their communities. The process is more expansive than the simple transmission of information; it is actual applied innovation resulting from direct interaction between technology sponsors and users (Irwin, L. H., 2007).

Technology transfer involves four components:

- "Identification of user needs (via questionnaires, focus groups, market research, and direct contact, to name a few methods)

- Information exchange (via newsletters, manuals, videos, training courses, demonstrations, direct technical assistance, software, etc.)

- Implementation of research findings (which can include licensing, training, marketing, and more)

- Feedback (to the developers and manufacturers of the technology concerning problems identified, suggestions for improvement, etc.) (Irwin, L. H., 2007)"

Technology offers opportunities to improve communication and experience sharing, but institutions must invest in the process of technology transfer. A variety of tools, including global communications, microcomputers, and virtual-reality technology is making communication easier (Irwin, L. H., 2007).

A portion of the work undertaken and/or sponsored by TAC is research-oriented. In the US, research collaboration is becoming an increasingly popular way of funding transportation research. With a budget of $15 to $20 million USD per year from the state departments of transportation, the National Cooperative Highway Research Program (NCHRP) is the most significant collaborative research forum in the United States. Projects to be conducted by the NCHRP are selected by the American Association of State Highway and Transportation Officials' Standing Committee on Research and administered by the TRB. A second US collaborative research program is a pooled-fund research program administered by the Federal Highway Administration. There are also international organizations that include collaborative research components. The Road Transport Research Program, which is a branch of the Organization for Economic Cooperation and Development (OECD) uses resources from OECD member countries to administer a research program (Hedges, C & Harrington-Hughes, K, 2007).

TAC is also responsible for a library and information database. A study by the FHWA cited by Hedges et al. (Hedges, C & Harrington-Hughes, K, 2007) found that investment in information services can yield a benefit to cost ratio over 10:1. Agencies that invest in information services see benefits in reduced cost of research, technology development and operations, quicker implementation of innovations and time savings, and more effective decision making. Other major transportation research resources exist and transportation professionals are already utilizing their resources. These include the Transportation Research Information Service and the International Road Research Documentation database. Transportation professionals are also increasingly relying on the World Wide Web as an information source. This increased amount of information necessitates the use of information professionals who are proficient at integration, analysis, and management of information. Information technology and advances in the way information is stored and accessed will continue to change the way society exchanges information and conducts research. The organization, storage, and retrieval of information present challenges moving forward in transportation planning. One body that is attempting to address these issues is the Bureau of Transportation Statistics through the creation of a National Transportation Library (Hedges, C & Harrington-Hughes, K, 2007).

## 7.5 Summary

Survey respondents were asked to comment on how well their analytical tools and data met their needs. Several recurrent needs were apparent. These are listed below:

- Staff resources: A lack of staff experienced in modelling and data, need for more training, insufficient staff complement.
- The importance of good data was recognized.
- Need for data sharing and cooperation between different levels of government (to build up data and minimize/share costs)
- Need for appropriate tools and data to account for the increasing importance of alternate modes.
- Lack of funding, or need for sustained funding.
- Need for political and community support for data and modelling initiatives.
- Need for an overall transportation planning strategy with regular updates and regular, complete data collection.

Ways of addressing three emerging topics were identified: these are environmental concerns (including Climate Change), public transit and emerging funding sources.

Finally, a possible role of TAC in technology transfer and support (related to research and to broadening the knowledge-base in these topics) was discussed.

# 8. SUMMARY

The Transportation Association of Canada (TAC), along with a number of sponsors, commissioned iTRANS Consulting Inc. to conduct the research project, *Best Practices for Technical Delivery of Long-Term Transportation Planning Studies in Canada*. This draft report describes the findings of the research. The research focused on the analytical tools and associated data that support long-term transportation planning practices of small- and medium-sized communities in Canada. The resultant report is intended to be a guide for municipalities having between 10,000 and 250,000 residents, although – as can be seen from the ensuing text – the results clearly are equally applicable to larger communities; and much of the research in best practices reflects these larger communities. In addition, it is important to note that the research has considered two types of small- and medium-sized communities: self-standing communities, and those that are part of a larger urban region – this is important, because the needs of the two types may differ. The research drew from the literature of best practices in Canada, the United States and overseas; and from an internet survey of Canadian governments.

The research was organized around five related topics:

1. Applications – that is, the types of long-term transportation planning studies to which analytical tools and data are applied.

2. Best practices in analytical tools and models.

3. Best practices in data methods.

4. Ancillary applications of the tools and data (optimizing the investments and broadening their applicability).

5. Assessment of existing tools and data, and identification of the types of needs.

The research develops a two-part guide for practitioners: The first part allows practitioners to determine the type of transportation plan according to their needs. The second part then is used to identify the analytical tools and data that should be applied to meet the planning needs.

This final report is available for free download in English and French from the TAC website at www.tac-atc.ca. It will also be showcased at the TAC Annual Conference in Toronto in September 2008.

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# 10. QUICK GUIDE FOR APPLICATION OF BEST PRACTICES

This guide identifies the best practices in analytical tools, models and data to support the technical delivery of long-term transportation plans. The tools, models and data are used to forecast the demand for travel, which in turn is key to identifying future needs for transportation infrastructure and services. The guide is based upon, and must be read in conjunction with, a recent research study prepared for the Transportation Association of Canada, *Best Practices for Technical Delivery of Long-Term Transportation Planning Studies in Canada*.

The guide is designed to assist transportation planners in making choices and responding to the long-term transportation planning needs of their communities. Communities across Canada differ vastly in their challenges and opportunities and in their populations, resources and needs. Because of this diversity, this guide does not attempt to provide a "one size fits all" solution, but gives a catalogue of options for municipalities facing a wide variety of challenges.

The guide is organized into two sequential parts that trace the progression from need to tools and data. **Section 10.1** begins by identifying the different types of long-term transportation plans and the relationship among them. It identifies 'triggers' that determine which types are appropriate for a particular situation. It also identifies a possible sequence of next steps, depending again on the particular situation. Based upon the identified needs, **Section 10.2** then describes the analytical tools, models and data that would be appropriate to different situations. **Section 10.3** summarizes the guide.

## 10.1 Sequence and Selection of Transportation Plan Type

Every agency must select the types of long-term transportation plans that are required for its specific needs. **Section 3.2** listed several different types of plans, which are described briefly below:

- **Transportation master plans or strategies** (TMP) address the transportation needs of a municipality or region as a whole. A TMP identifies the transportation goals of the community. Normally, a TMP uses some form of traffic forecasting and network analysis along with stakeholder consultation to determine the deficiencies in the network and to plan for future needs. Bicycle and pedestrian master plans also assess transportation needs, but rely less on demand and more on the community's vision. Bicycle and pedestrian TMPs include strategies and plans for route selection and connectivity; implementation and construction; supporting plans and facilities such as bicycle parking and shower facilities; and education and marketing campaigns. The active transportation network must be integrated with other modes and provide inter-modal connectivity and this integration should also be considered in bicycle and pedestrian master planning.

- **Sub-area or neighbourhood transportation plans** (NTP) identify challenges and goals specific to a certain study area or predefined neighbourhood within a municipality. These sub-areas do not normally have their own municipal governments, but fall under the larger umbrella of the municipality. Sub-area or neighbourhood transportation plans accomplish the same goals as TMPs in a more detailed way.

- **Corridor planning studies** respond to changes in the use of a corridor, due to changing land use, increased traffic volume, or some other challenge or change.

- **Transportation capital programmes / budgets** estimate the needs of the community for infrastructure improvements, as well as their staging, timing and costs. The frequency of studies depends greatly on the community's level of growth and on the associated need for infrastructure. The results of a network-wide need assessment carried out at the Master Plan level are subsequently applied, with some modification to timing and staging, to the annual capital budget.

- **Development charge studies** (DC) identify the portion of transportation capital investments to be funded by benefiting parties, including developers.

- **Transit service or operational plans** investigate the feasibility of initiating or expanding transit service or review of the operation of existing service. Transit plans assess the transit needs of the community and determine how to best provide for those needs.

- **Policy or research / background studies** cover a wide variety of subjects, such as funding. These studies can include changes to overriding policy, research into funding mechanisms, or background and research studies to fill specific knowledge gaps.

- **Travel demand management studies** (TDM) investigate techniques to reduce demand on the transportation network by reducing the number of trips. TDM plans may identify methods of reducing the total number of person-trips, such as telework initiatives, or to reduce the number of vehicle-trips, such as increased use of alternative modes.

- **Air quality / congestion management studies** quantify the environmental cost of congestion and/or high traffic volume in an area or corridor and provide recommendations to improve air quality and decrease congestion.

- **Freight / goods movement plans or strategies** identify many of the same issues as TMPs but focus specifically on goods movement. These plans should encompass goods movement by all available modes and identify network deficiencies and future needs.

- **Environmental Assessment / Functional Planning studies** (EA) are more detailed plans for improvements in specific corridors and areas that address environmental concerns, including impact on property, natural and built features, utilities, etc. These plans typically involve extensive public consultation.

The discussion of transportation planning types is important, because analytical and data requirements – the focus of this guidebook and the underlying research - may vary by study type. The different types of transportation planning studies may or may not be linked to each other. As well, the need for a given study type may be mandated by law in one community, but may be initiated in another only according to need. A single *legal* or *procedural* hierarchy does not exist – in contrast to the United States, where federal (i.e., nation-wide) funding and air quality requirements largely, though not entirely, have dictated this need. As a result, a key need for this guide is to organize the different types into a *functional* paradigm. This allows transportation planners to understand how the different components relate to each other, regardless of the starting point (i.e., the issues that determine the need for a particular study); and also the types of studies that should be used to address a particular issue.

Ideally, a transportation master plan or strategy should be the starting point, because it provides the overriding direction for long-term transportation planning in a community. The survey found that 93% of local and regional governments do conduct, or are involved in conducting, some sort of TMP. The remaining 7% comment on TMPs completed by others. A TMP is the building block upon which all other transportation planning activities can be built. It allows a community to identify its goals and challenges. Once goals and challenges are known, these can trigger other types of plans.

The studies included here are not the only ones that affect long-term transportation planning. Two other categories of transportation studies should be noted: These are asset management programs and planning studies with a different focus than the long-term transportation plans discussed above.

Asset management programs allow government organizations to understand what assets they have, the life cycle of those assets, and how the assets are performing. Hard assets (i.e. roads, bridges, etc.) can have life cycles much longer than the common horizon of a long-range transportation plan. After a hard asset has been constructed it may be physically difficult, expensive, or politically unpopular to remove it. As a result, long-range transportation plans must consider the impacts of proposed network improvements on the organization's hard assets beyond the final horizon year of the study.

Good asset management programs also provide important data to the long-range transportation planning process. Transportation planners should consider life cycle when timing infrastructural improvements. For example, if a bridge has 15 years remaining in its life cycle, and capacity analysis indicates that the connection will require an additional lane in 20 years, it may reduce life cycle cost to build the additional width when the bridge is replaced in 15 years. This type of knowledge can provide great value to the long-range transportation planning process.[25]

The second category qualifies as a type of transportation planning study. However, studies in this category differ from the types discussed above, in two ways: they have a smaller spatial scale and/or they have a short-range orientation. They include parking studies, safety assessments and traffic impact studies (i.e., traffic studies to support the approval of individual site development plans). These studies can identify issues and concerns that must be addressed on a larger scale through one or more of the long-term transportation planning studies discussed above. They also may be triggered by findings of a long-term transportation plan.

**Exhibit 10-1** illustrates the relationship between different planning exercises. This type of structure should be applicable to most communities, although the exact format may differ by community. The arrows in the illustration are all two directional and - because all parts of the transportation network are connected - all plan types are connected in some way. Issues identified in one plan should be incorporated into future, related plans. The following paragraphs provide more detail about these relationships.

The **Community Plan or Official Plan** provides important parameters, such as land use and community goals to the **TMP**. In turn, this TMP, and TMPs completed in the past, determine the road (and, if applicable, transit) network schedule included in the Community Plan or Official Plan. This relationship brings the transportation network into the context of other types of plans.

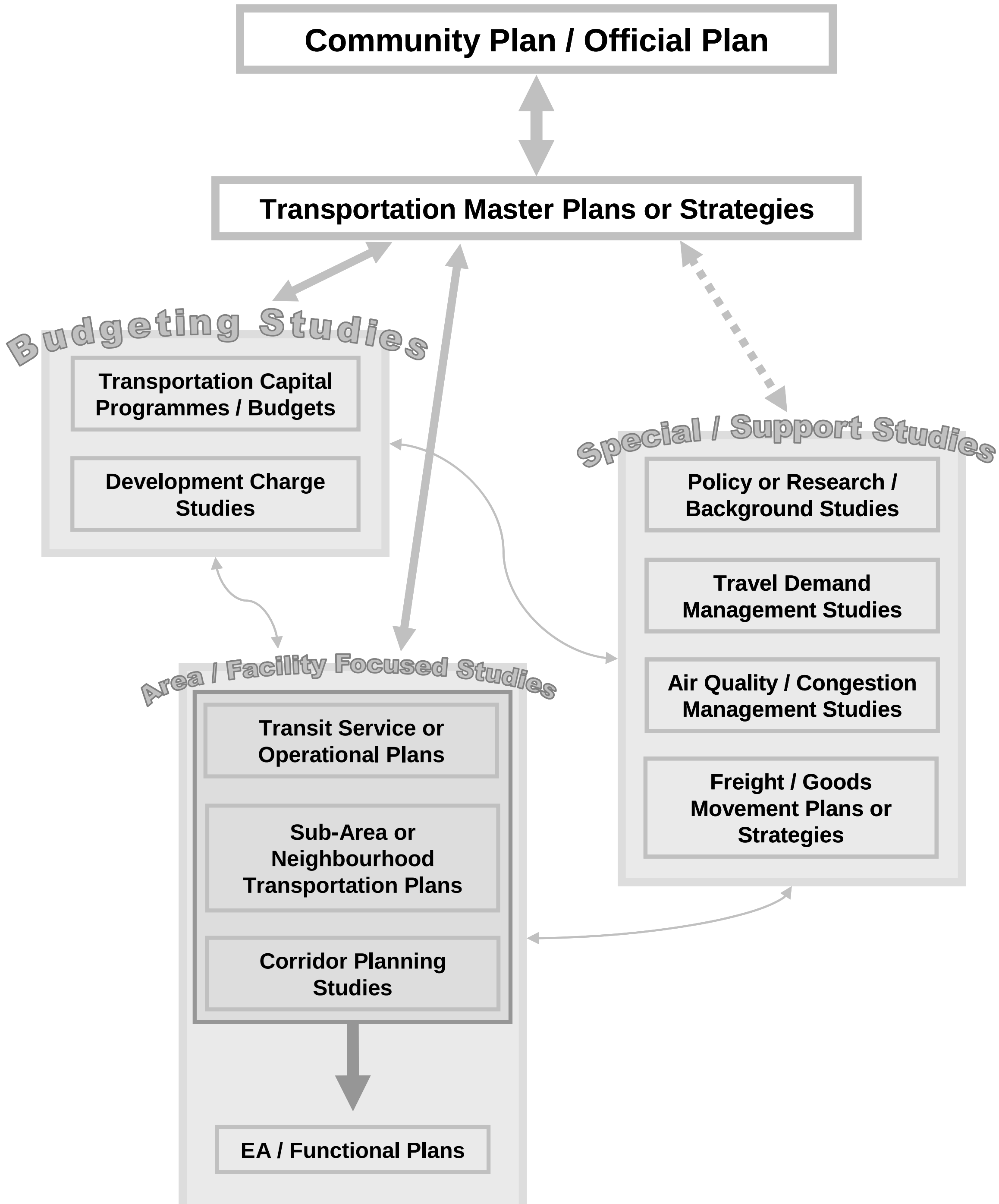
On the diagram, there three other categories of plans below the TMP. These are **Budgeting Studies**, **Area / Facility Focused Studies** and **Special / Support Studies**. These plans are also major building blocks of the transportation system.

**Budgeting studies**: **Transportation Capital Budgets** and **Development Charge Studies** flow out of the needs assessment of the TMP, but past studies should be considered when the TMP is updated – it is important to understand what has been recommended and completed in the past when updating the TMP.

**<u>Area / Facility Focused Studies</u>:** These studies centre on specific locations, systems, or corridors where the land use, traffic patterns, or operations, are changing. The TMP identifies these as physical locations, or study areas, that require more in-depth investigation. If the plan recommends physical improvements, the study process can move to an EA / Functional Plan.

[25] Personal telephone communication with Dr. Lynne Cowe Falls, University of Calgary, April 17, 2008..

**Exhibit 10-1: Study Relationships**



A TMP should consider the need for transit in the community and if the existing system, if one exists, is meeting those needs. This helps identify if there is need for further, more in-depth study. If the TMP does not identify a need for transit, or if another organization has responsibility for transit planning, a municipality may not need to complete a transit study or operational plan. Where a transit plan is needed, or has been completed, the requirements of the transit system should be considered throughout the remainder of the TMP and, in turn, in the Community Plan. This allows key roadways, land use areas, and other amenities to be designed with transit in mind.

**Special/Support Studies**: The four plans identified as Special/Support Studies address specific needs. These needs may arise from the TMP or from other challenges facing the community, as discussed later.

The sequence described above is the ideal, 'top down' process. As described, problems and issues may be identified in the TMP which then "trickle down" and are addressed in different ways in other types of plans. The results of these plans are then incorporated into future updates of the TMP and the process is repeated.

The preceding approaches are applicable to communities of different sizes; and to communities that are part of a larger urban region or which stand-alone. Because small- and medium-sized communities may not have the staff resources to conduct specific work in each of these important areas, integration is extremely important. In addition, a complete transportation planning program incorporates many study types or focus areas (Cambridge Systematics, Inc., TransManagement, Inc., TransTech Management, Inc., & Heanue, K, 2007).

Based upon the preceding discussion, and upon principles of sustainable transportation planning developed by TAC and Transport Canada, this guide now develops five "Key Elements of Transportation Planning." The Key Elements are used to choose the type of plan to complete and what considerations to integrate into those plans. They also are used in the discussion of Evaluation Measures and Performance indicators, which was introduced in Section 3.5. The Key Elements of Transportation provide a guideline to planners attempting to address all the needs of the community.

**Key Elements of Transportation Planning**

1. Acknowledge that transportation is tied to other areas of planning and work with groups in these other subject areas to integrate different planning strategies
   a) Integrate transportation planning and land use planning
   b) Integrate transportation planning and economic planning

2. Consider the "Triple bottom line:" Evaluate based on Economic, Social, and Environmental Indicators
   a) Plan a transportation network for all modes – auto, active (pedestrian, bicycle, and other), transit, goods movement.

b) Balance modal split to provide the greatest benefit to the community
c) Consider the needs of all socio-economic groups
d) Consider environmental impacts
e) Limit environmental impacts, and resource and energy use by make the best use of existing infrastructure
f) Consider safety and security provisions integral to the transportation network

3. Consider the spatial focus
   a) Identify the immediate study area
   b) Consider the impacts on the larger network

4. Utilize supply-side and demand-side solutions
   a) Consider the impacts of changes to supply
   b) Integrate Transportation Demand Management into all planning practices

5. Plan and carry out a measurement strategy
   a) Choose best practices performance indicators and evaluation measures
   b) Set goals consistent with the needs of the community's vision
   c) Collect data and measure progress
   d) Reassess

The top-down sequence of transportation planning described earlier in this section is not always feasible for small- and medium-sized communities. Often, plans respond to different triggers or challenges that arise in some other way. When asked if its planning methods and tools meet the stated needs, one survey respondent stated that it operates in "[a] reactive environment, very little proactive measures as a result of staff resources available and financial considerations." This guide encourages municipalities to develop a process of regular updates, identifying challenges and completing the appropriate plans to address those challenges, then incorporating the results back into their TMP. In other words, the process may be 'bottom up;' meaning that a specific need – for example, for a corridor plan – ultimately could trigger the need for a comprehensive TMP.

The flowchart in **Exhibit 10-2** illustrates how municipalities move from triggers to different types of studies. Although the flowchart does not represent every trigger and path to long-range transportation planning studies, it does reflect a thought process that is consistent with the best practice guiding principals of long-range transportation planning. The flowchart addresses the following steps. Note that step 2 and step 3 may be inversed in some cases:

1. Identify triggers – Triggers may result from a number of sources. Some examples are:
   a) Another long-range transportation plan (i.e. recent TMP identified a recent decrease in Air Quality = Air Quality Concerns)
   b) Public feedback (i.e. complaints about a particular location of traffic congestion = Traffic Congestion)
   c) A more localized transportation plan (i.e. TIS identified impacts on the larger transportation network from a large development = Large Development)

d) Staff knowledge (i.e. staff identify parking shortage along a commercial corridor = Parking shortage / parking management)

2. Determine the spatial realm of the project – Transportation planning projects should have a defined study area in which the majority of the analysis will focus. For example, a study can be spatially limited to a corridor or a neighbourhood, although the actual impacts of the project may extend outside the determined study area. It is important to define the spatial scope of a study, but then to consider the impacts to other parts of the transportation network. This concept of spatial scope is reflected in the exhibit. These considerations may play a small role in the study itself, but should be considered for further study through other study types or for integration into the next TMP. Not all examples in the flow chart have this step quantified.

3. Determine the study focus – all studies should adhere to the guiding principles of transportation planning and take a balanced approach; however, meaningful study must have a clear focus. A freight study, for example, is focussed on the freight transportation network, but also must consider the impacts of the freight transportation network on other modes. In the same way, a Corridor Planning Study should consider all modes of transportation in a corridor, as well as supply and demand management when responding to a trigger such as 'Traffic Congestion'.

The trigger and resulting study serve as a start point to enter the transportation planning strategy process shown in **Exhibit 10-1**. Ultimately, however, the findings of the individual studies should provide input to, or inform, the development of a new TMP or update. All communities should complete regular updates to a TMP and the findings of individual studies allow communities to refocus goals, adjust data collection needs, and/or incorporate land use and transportation network changes..

In every case where a corridor plan or NTP recommends a new project (i.e. a new roadway, improvements to an existing roadway, etc.) the next step could be an environmental assessment. **Exhibit 10-2** does not include this relationship, which is shown in **Exhibit 10-1**.

When using **Exhibit 3-3** it is very important to understand that the rectangles represent possible study types, not the considerations for individual studies. For example, the Traffic Congestion trigger leads first to a spatial question – is the congestion localized to a route – to determine whether further study should be limited to a route, to a neighbourhood, or whether a city-wide study should be done. Once the spatial realm has been identified, a corridor plan, neighbourhood plan, or TMP may be warranted to study the problem in more detail. The study, whatever form it takes, should address the key elements of transportation planning described above and consider all potential solutions to the congestion, including multi-modal solutions and demand management. At this point, the study may find that sufficient capacity cannot be provided, and that a larger scale TDM plan may be required. This is not the only possible outcome of the study – for example, it may find that transit system as a whole needs to be reassessed, leading to a Transit Study. Alternatively, a Corridor study may find that changes to this corridor will have wider implications and lead to a revision of the TMP.

**Exhibit 3-3** also acknowledges that studies have set scopes and limitations. A Corridor or Neighbourhood Transportation plan should consider TDM within the scope of the plan; however, it is not feasible to do a large scale TDM plan within the smaller scope of a localized study. Because of this, the exhibit shows the option of a full TDM study if there are capacity constraints that cannot be addressed within the Corridor or Neighbourhood Plan. This is not the only route that may lead from a Corridor or Neighbourhood plan to a TDM study. A full TDM study may also be needed if public consultation showed that the community supports demand management measures that cannot be fully explored within the context of the original Corridor or Neighbourhood plan.

## 10.2 Analytical Tools and Data

In addition to choosing the types of plans to complete and the intensity of those plans, municipal governments also need to make choices about the type of long-term transportation forecasting they plan to do, how they plan to complete the forecasting, and the type of data needs with which they will be faced.

Given the type of long-term plan, analytical and data requirements can be identified. **Table 10-1** and **Table 10-2** provide guidelines for determining analytical requirements and the supporting data requirements, respectively. These guidelines are drawn from the best practices identified in the literature and in the survey, as noted. Their organization in these tables is based upon that prepared by Stone et al. for the development of recommended analytical procedures for communities of different sizes in North Carolina. However, unlike the North Carolina process, which to some extent must satisfy certain state or federal criteria for funding eligibility, these guidelines necessarily are less prescriptive in nature. As well, Canada lacks many of the statewide (province- or territory-wide) or nationwide datasets that are available in the United States.

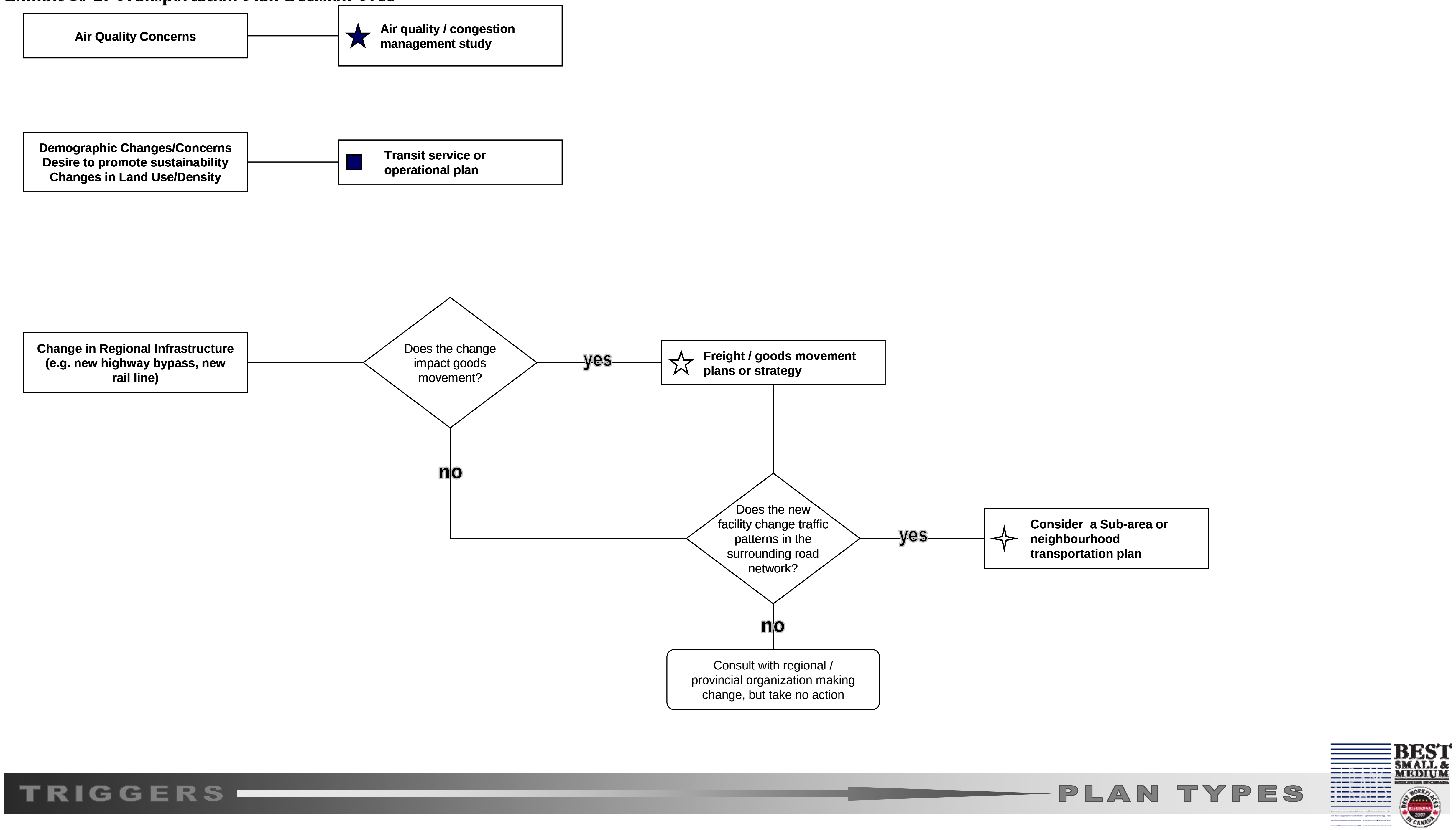
**Table 10-1** defines communities in several ways:

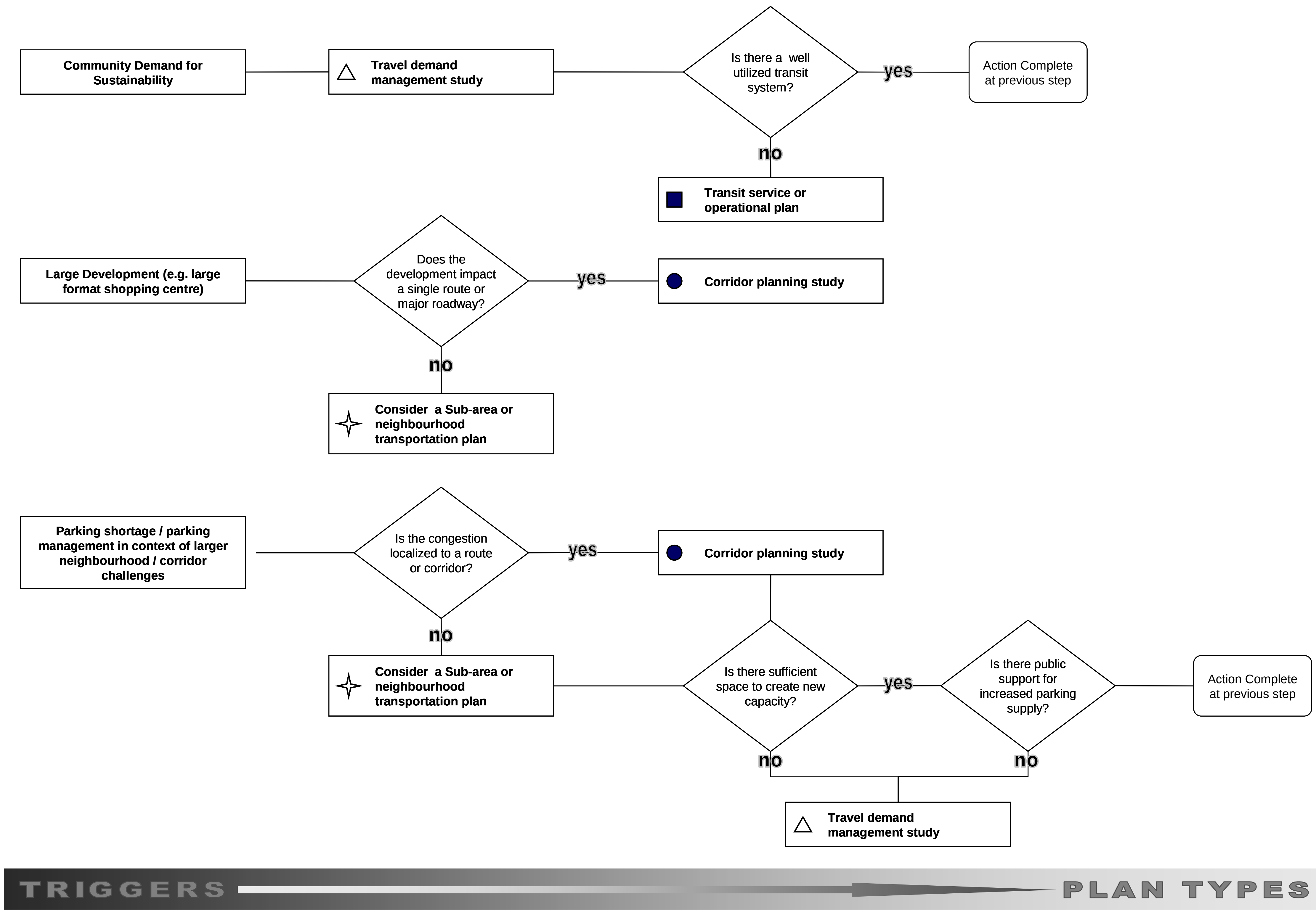
- Size of population, according to four categories (less than 50,000; less than 100,000; less than 250,000; and, greater than 250,000).
- Transportation plan types, as identified through **Exhibit 10-2**.
- Approach to analytical tool.
- Urban context; that is, whether the community is part of a larger urban region or whether it is a stand-alone community.
- Approach: (trip generation, trip distribution, mode choice, trip assignment, external trip modelling)
- Tools

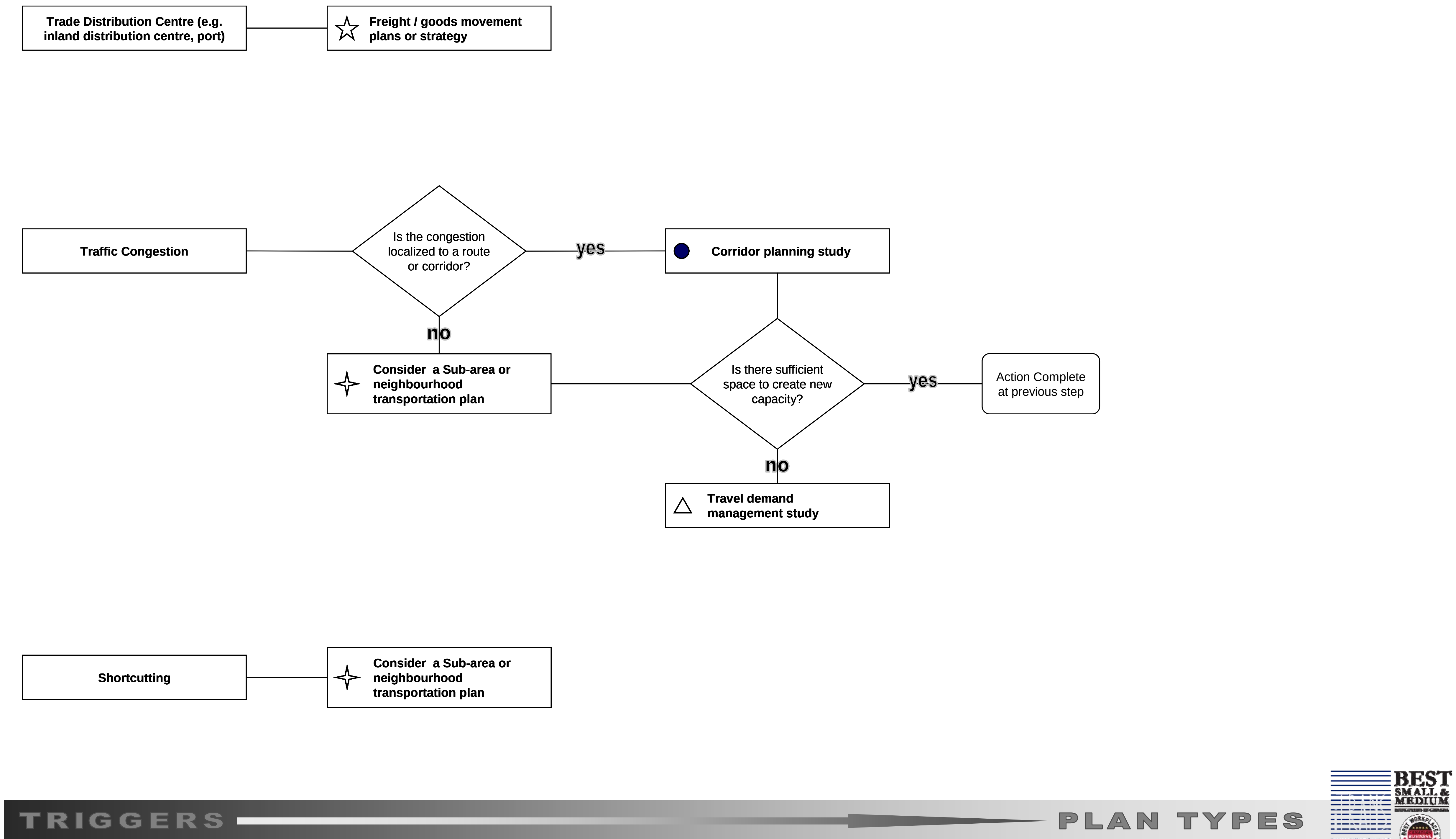
**Table 10-2** categorizes data nee ds in the following ways:

- Size of population.
- Transportation plan types.
- Data required.
- Source of data.

**Exhibit 10-2: Transportation Plan Decision Tree**




Community Demand for Sustainability
Travel demand management study
Is there a well utilized transit system?
yes
Action Complete at previous step
no
Transit service or operational plan
Large Development (e.g. large format shopping centre)
Does the development impact a single route or major roadway?
yes
Corridor planning study
no
Consider a Sub-area or neighbourhood transportation plan
Parking shortage / parking management in context of larger neighbourhood / corridor challenges
Is the congestion localized to a route or corridor?
yes
Corridor planning study
no
Consider a Sub-area or neighbourhood transportation plan
Is there sufficient space to create new capacity?
yes
Is there public support for increased parking supply?
Action Complete at previous step
no
no
Travel demand management study
TRIGGERS
PLAN TYPES


Trade Distribution Centre (e.g. inland distribution centre, port)
Freight / goods movement plans or strategy
Traffic Congestion
Is the congestion localized to a route or corridor?
yes
Corridor planning study
no
Consider a Sub-area or neighbourhood transportation plan
Is there sufficient space to create new capacity?
yes
Action Complete at previous step
no
Travel demand management study
Shortcutting
Consider a Sub-area or neighbourhood transportation plan
TRIGGERS
PLAN TYPES

## Table 10-1: Guidelines for Selection of Analytical Tools

| Size of Population | Urban Context | Plan Type | Approach | Trip Generation | Trip Distribution | Mode Choice | Trip Assignment | External Trips | Tools |
|---|---|---|---|---|---|---|---|---|---|
| Small<br>(< 50,000) | Stand-alone, or part of a region but lacking a model; multi-modal | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>TDM<br>EA<br>Policy<br>AQ / congestion<br>Freight | Simple model, with coarse network and zone systems | Use local trip generation rates or rates from similar communities as basis for work / non-work trip rates. Use peak period rates if data support; if not, 24-hour. Ensure all key trip purposes are covered | Gravity trip distribution preferred; Fratar also acceptable for work / non-work. Or, apply factors per trend line | If transit exists: use factors based on observations | All-or-nothing assignment (simple network). Equilibrium assignment otherwise. | Apply model for external trips / through trips, if significant. Account for traffic, demographics, socio-economics and geography of external connections | Commercial travel demand model software |
| | Part of urban region; multi-modal | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /cong’n<br>Freight | Use sub-area of regional model, with appropriate detail for network and zones | Specialized trip generation rates and trip purposes specific to community | Ensure trip distribution is specific to local travel. | If transit exists: Logit formulation, if comprehensive transit; otherwise factors | Equilibrium | Distribution model must account for urban trips that are external to the sub-area | Commercial travel demand model software |
| | Stand-alone or part of a region; roads only | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>EA<br>Freight | Direct demand (area-wide) | Multiple linear regression forecasts of ADT on key roads | | | | | Spreadsheet |
| | | | Trend analysis (specific facilities) | Growth factor, regression; power function offers flexibility if historical counts uneven or sporadic<br><br>Manual assignment acceptable if area is slow-growing, stable | | | | | Spreadsheet |

## Table 10-1: Guidelines for Selection of Analytical Tools

| Size of Population | Urban Context | Plan Type | Approach | Trip Generation | Trip Distribution | Mode Choice | Trip Assignment | External Trips | Tools |
|---|---|---|---|---|---|---|---|---|---|
| Medium (< 100,000) | Stand-alone, or part of a region but lacking a model | TMP<br>Sub-area<br>Corridor<br>EA<br>Budgeting<br>Dev charge<br>Policy<br>AQ /cong'n<br>Transit | Four-step model, with appropriate network and zone detail | Use OD survey or rates from similar communities as basis for trip generation rates; for work / non-work trip rates.<br>Develop for peak period. | Gravity trip distribution for work. Fratar trip distribution non-work. | If transit exists: Logit formulation, if comprehensive transit; otherwise factors | Equilibrium assignment otherwise. | Apply model for external trips / through trips, if significant. Account for traffic, demographics, socio-economics and geography of external connections | Commercial travel demand model software |
| | | TDM<br>Freight | Manual (spreadsheet) | Local trip generation rates, or rates from other similar communities | Freight: Manual distribution (spreadsheet) for base year. Forecast according to population / employment (Fratar) | TDM: Apply factors | Manual assignment. Forecast using growth factors, regression or power function | Apply factors | Spreadsheet |
| | Part of urban region | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /cong'n<br>Freight | Use sub-area of regional model, with appropriate detail for network and zones | Specialized trip generation rates and trip purposes specific to community | Gravity for work and possibly other purposes; Fratar possible for non-work. May require destination-choice model, if have major special generator (e.g., airport) | If transit exists: Logit formulation, if comprehensive transit; otherwise factors | Equilibrium | Distribution model must account for urban trips that are external to the sub-area | Commercial travel demand model software |

## Table 10-1: Guidelines for Selection of Analytical Tools

| Size of Population | Urban Context | Plan Type | Approach | Trip Generation | Trip Distribution | Mode Choice | Trip Assignment | External Trips | Tools |
|---|---|---|---|---|---|---|---|---|---|
| Large (< 250,000) | Stand-alone or part of urban region | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /cong'n<br>Freight | Four-step model, with appropriate network and zone detail. Develop separate model for freight | Use OD survey as basis for trip generation rates; for work / non-work trip rates. Develop for peak period. Use OD survey for trucks as basis for model. | Gravity trip distribution for work. Fratar trip distribution non-work. | Logit formulation, if comprehensive transit; otherwise factors | Equilibrium. Allow for peak spreading. | Apply model for external trips / through trips, if significant. Account for traffic, demographics, socio-economics and geography of external connections | Commercial travel demand model software |
| Very large (> 250,000) | Stand-alone or part of urban region | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /cong'n<br>Freight | Four-step model, with appropriate network and zone detail | Use OD survey as basis for trip generation rates; for work / non-work trip rates. Develop for peak period. Use OD survey for trucks as basis for model. | Gravity trip distribution for work. Fratar trip distribution non-work. | Logit formulation, if comprehensive transit; otherwise factors | Equilibrium. Allow for peak spreading. | Develop external / through trip modelling process, using similar procedure | Commercial travel demand model software |

## Table 10-2: Guidelines for Addressing Data Needs for Analysis

| Size of Population | Urban Context | Plan Type | Approach | Data Required | Source of Data |
|---|---|---|---|---|---|
| Small (< 50,000) | Stand-alone, or part of a region but lacking a model; multi-modal | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>TDM<br>EA<br>Policy<br>AQ /congestion<br>Freight | Simple model, with coarse network and zone systems | Trip generation rates<br>Trip distribution by work / non-work<br>Population and employment<br>Traffic volumes<br>Travel times | Household origin-destination surveys (local or multi-area, to enrich data base; GPS trace and telephone survey for specific issues)<br>Census Place of Work / Place of Residence linkages by mode<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts<br>Travel time surveys |
| | Part of urban region; multi-modal | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /congestion<br>Freight | Use sub-area of regional model, with appropriate detail for network and zones | Trip generation rates<br>Trip distribution by work / non-work<br>Transit ridership volumes<br>Population and employment<br>Traffic volumes<br>Travel times | Specialized trip generation rates specific to community<br>Household origin-destination survey<br>Census Place of Work / Place of Residence linkages by mode<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts<br>Travel time surveys |
| | Stand-alone or part of region; roads only | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>EA<br>Freight | Direct demand (area-wide)<br><br>Trend analysis (specific facilities) | Auto and truck traffic volumes<br>Population and employment<br>Facility characteristics | Traffic counts<br>Census, provincial / territorial or local population, employment counts<br>Road inventory database |
| Medium (< 100,000) | Stand-alone, or part of a region but lacking a model | TMP<br>Sub-area<br>Corridor<br>EA<br>Budgeting<br>Dev charge<br>Policy<br>AQ /congestion<br>Transit | Four-step model, with appropriate network and zone detail | Trip generation rates<br>Trip distribution by work / non-work<br>Transit ridership volumes<br>Population and employment<br>Traffic volumes<br>Travel times | Specialized trip generation rates specific to community<br>Household origin-destination survey<br>Census Place of Work / Place of Residence linkages by mode<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts<br>Travel time surveys |

## Table 10-2: Guidelines for Addressing Data Needs for Analysis

| Size of Population | Urban Context | Plan Type | Approach | Data Required | Source of Data |
|---|---|---|---|---|---|
| | | TDM<br>Freight | Manual (spreadsheet) | Trip generation rates<br>Trip distribution by work / non-work<br>Transit ridership volumes<br>Population and employment<br>Traffic volumes | Specialized trip generation rates specific to community<br>Household origin-destination survey<br>Census Place of Work / Place of Residence linkages by mode<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts |
| | Part of urban region | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /congestion<br>Freight | Use sub-area of regional model, with appropriate detail for network and zones | Trip generation rates<br>Trip distribution by work / non-work<br>Transit ridership volumes<br>Population and employment<br>Traffic volumes<br>Travel times | Specialized trip generation rates specific to community<br>Origin-destination survey<br>Census Place of Work / Place of Residence linkages by mode<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts<br>Travel time surveys |
| Large<br>(< 250,000) | Stand-alone <u>or</u> part of urban region | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /congestion<br>Freight | Four-step model, with appropriate network and zone detail. Develop separate model for freight | Trip generation rates<br>Trip distribution by work / non-work<br>Transit ridership volumes<br>Population and employment<br>Traffic volumes<br>Travel times | Use OD survey as basis for trip generation rates; for work / non-work trip rates.<br>Use OD survey for trucks as basis for model.<br>Specialized trip generation rates specific to community<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts<br>Travel time surveys |
| Very large<br>(> 250,000) | Stand-alone <u>or</u> part of urban region | TMP<br>Sub-area<br>Corridor<br>Budgeting<br>Dev charge<br>Transit<br>Policy<br>TDM<br>AQ /congestion<br>Freight | Four-step model, with appropriate network and zone detail | Trip generation rates<br>Trip distribution by work / non-work<br>Transit ridership volumes<br>Population and employment<br>Traffic volumes<br>Commodity flows or truck OD<br>Travel times | Use OD survey as basis for trip generation rates; for work / non-work trip rates.<br>Use OD survey for trucks as basis for model.<br>Specialized trip generation rates specific to community<br>Census, provincial / territorial or local population , employment counts<br>Screenline or intersection counts<br>Travel time surveys |

The tables distinguish between stand-alone municipalities and those that are part of a larger urban region; the intent being that the latter commonly can access regional models and data. However, this is not always true: for example, some municipalities in Metro Vancouver have developed their own sub-area models, based upon the regional model. However, other municipalities, such as the District of North Vancouver and West Vancouver, do not have the resources to build or run sub-area models. Best practice suggests that each municipality, whether stand-alone or as part of a larger urban region, should have its own model, or should have access to a model that is sufficiently detailed to suit its needs.

## 10.3 Summary

Based on the information gathered through this study and the experience of the consultants and PSC members, this chapter develops a quick reference guide to assist communities in assessing what types and intensities of plans, modelling strategies and other long term transportation planning practices suit their needs. The chapter is intended to serve as a stand-alone guide. This guide is not absolute and does not address every possible circumstance, but is meant to be used as a handbook of suggested practices. Communities are encouraged to use this section to aid in the development of their own planning policies and strategies, in order to inform their own specific circumstances and decisions.

The guide has two parts. The first part addresses the relationship between different types of long-term transportation plans. It identifies ‘triggers’ that determine which types are appropriate for a particular situation It also identifies a possible sequence of next steps, depending again on the particular situation. Based upon the identified plan types, and taking into account the particular circumstances of the community (i.e., size and urban context), the second part describes the analytical tools, models and data that would be appropriate to different situations.

# Appendix A
# Survey Instrument

# Best Practices for Technical Delivery of Long-Term Transportation Planning Projects—Section 1

## Best Practices for Technical Delivery of Long-Term Transportation Planning Projects in Canada

### Introduction

Thank you for participating in our survey. The survey is a key part of a nation-wide research project, *Best Practices for the Technical Delivery of Long-Term Transportation Planning Projects in Canada*. The research focuses on the technical analytical tools, forecasting models and data that are used to develop these plans, particularly in small to medium sized communities. The research is sponsored by the Transportation Association of Canada (TAC), and is funded by several governments at all levels from different parts of the country. This survey is being sent to the governments and agencies that are responsible for carrying out transportation plans in municipalities of all sizes throughout Canada.

The survey is divided into five Sections:

**Section 1: Community Profile and Planning Framework** - asking about the type of transportation planning studies you do and for which you need analytical tools, models or data.

**Section 2: Long-Term Transportation Planning Study Analytical Methods and Tools** - asking about technical aspects of transportation studies including: evaluation indicators, evaluation measures, parameters and structure of travel demand forecasting model (if you have one) or other analytical methods of estimating future travel demand (e.g. regression analysis)

**Section 3: Data Collection Protocols** - inquiring about data collection programs and data storage methods.

**Section 4: Interface With Other Planning Applications** - inquiring about complementary uses of the transportation planning tools, results of transportation planning studies and application of transportation data.

**Section 5: Lessons Learned** - asking about your assessment of the existing situation and potential future needs.

Before you begin the survey, it will be helpful to have assembled information and consulted with others in your organization about:

- Population size, area (in hectares) and lane-kilometers of roads,
- Size of the 2007 transportation capital budget,
- Methods of evaluating planning alternatives (Indicators and measures),
- Methods to forecast traffic or travel (travel demand models, trend analysis or other),
- Information on data sets used or developed by your organization including type and frequency of data collection, geographical units of data (e.g. population data collected at community, census tracks or traffic zone level).

Having this prior knowledge about the transportation planning practices followed by the organization will expedite the completion of the survey. The survey can be completed in 1 hour time. Key terms are defined for you and provided in the "**Reference Sheet**" below.

Within each Section, you can move backwards or forwards to review your responses, using the "**Previous Page**" and "**Next Page**" buttons. At the end of each Section, you will be asked to press "**Submit Survey**". This signifies the end of that Section of the survey. Once you press "Submit Survey", your answers for that Section become final and cannot be changed.

Please **DO NOT** use the back button on your browser at any time while completing this survey. Instead, use the previous button provided at the bottom of the survey form.

If you **get disconnected** from the survey at any time, please go to: http://vovici.com/wsb.dll/WSPersistentSurveyList .

You must **use the same computer** with which you originally entered the survey.

Your responses to this survey are **confidential** at all times, including when you are online and after it has been completed. When the results of the survey are tabulated and reported, your responses will be aggregated with others in such a way that individual responses will be unidentifiable.

If you require any further clarification, please direct your questions or comments to:

David Kriger, P.Eng. MCIP
iTRANS Consulting Inc.
1-613-722-6515, ext. 5612
Best-practice@itransconsulting.com

Or

Elizabeth Szymanski, B.A.
iTRANS Consulting Inc.
Toll free no.: 1-888-860-1116, ext. 5340
Best-practice@itransconsulting.com

## Section 1: Community Profile and Planning Framework

### Community profile

This section asks for some basic information that describes your municipality and organization.

Please provide your contact information **(items marked with a * are required)**

1) *Name:

________________________________________

2) *Email:

________________________________________

3) *Telephone Number:

________________________________________

4) *Organization:

________________________________________

5) Department / Branch /Section:

________________________________________

6) May we contact you again if we require additional information or clarification?

❍ Yes
❍ No

7) Please indicate the **administrative designation** of your organization. Please select one only.

❍ Local government (city, town, municipality, county, township, parish, community, borough)
❍ Regional government (regional district, regional municipality, communauté métropolitaine, conseil d'agglomération, mountain resort municipality)
❍ Rural municipality, communauté rurale, municipal district, district municipality
❍ Transit authority
❍ Regional transportation authority
❍ Provincial / Territorial ministry, department or agency
❍ Other (please specify)

If you selected other please specify:
_______________________________________________

8) Please provide information on the following **key characteristics** of your municipality:

| | |
|---|---|
| Population: | ____________________ |
| Year of population count: | ____________________ |
| Area (hectares): | ____________________ |
| Total road-kilometers under your jurisdiction: | ____________________ |
| Does your organization operate public transportation? (Y/N) | ____________________ |
| 2007 total transportation capital budget amount (including long-term infrastructure studies and construction budget): | ____________________ |

**Planning framework**

9) In what **types of transportation planning studies** is your organization involved? What is the nature of that involvement?

This question lists several common types of transportation planning studies. For each type, please indicate the response that **best describes your organization's involvement.** Please use the "Other" category and the "Additional comments" box to identify types of studies that are not otherwise listed. Please select all that apply.

| | Has primary or sole responsibility including overseeing consultants | Conducts with other governments / agencies | Does not conduct / may comment on studies by others | Does not conduct / no involvement at all |
|---|---|---|---|---|
| Sub-area or neighbourhood transportation plans | ❍ | ❍ | ❍ | ❍ |
| Corridor planning studies | ❍ | ❍ | ❍ | ❍ |
| Transportation capital programmes / budgets | ❍ | ❍ | ❍ | ❍ |
| Development charge studies | ❍ | ❍ | ❍ | ❍ |
| Transportation master plans or strategies | ❍ | ❍ | ❍ | ❍ |
| Transit service or operational plans | ❍ | ❍ | ❍ | ❍ |
| Policy or research / background studies (e.g., funding) | ❍ | ❍ | ❍ | ❍ |
| Environmental assessment studies | ❍ | ❍ | ❍ | ❍ |
| Travel demand management studies | ❍ | ❍ | ❍ | ❍ |
| Air quality / congestion management studies | ❍ | ❍ | ❍ | ❍ |
| Freight / goods movement plans or strategies | ❍ | ❍ | ❍ | ❍ |
| Other (please | ❍ | ❍ | ❍ | ❍ |

| | | | | |
|---|---|---|---|---|
| specify) | | | | |

10) Approximately **how many of these studies** have you conducted or been involved with over the past 3 years?

| | None (0) | Fewer than 5 | 5 to 10 | More than 10 |
|---|---|---|---|---|
| Sub-area or neighbourhood transportation plans | ❍ | ❍ | ❍ | ❍ |
| Corridor planning studies | ❍ | ❍ | ❍ | ❍ |
| Transportation capital programmes / budgets | ❍ | ❍ | ❍ | ❍ |
| Development charge studies | ❍ | ❍ | ❍ | ❍ |
| Transportation master plans or strategies | ❍ | ❍ | ❍ | ❍ |
| Transit service or operational plans | ❍ | ❍ | ❍ | ❍ |
| Policy or research / background studies (e.g., funding) | ❍ | ❍ | ❍ | ❍ |
| Environmental assessment studies | ❍ | ❍ | ❍ | ❍ |
| Travel demand management studies | ❍ | ❍ | ❍ | ❍ |
| Air quality / congestion management studies | ❍ | ❍ | ❍ | ❍ |
| Freight / goods movement plans or strategies | ❍ | ❍ | ❍ | ❍ |
| Other (please specify) | ❍ | ❍ | ❍ | ❍ |

11) Has your organization sought **funding support from any of the following types of program** over the past 3 years? Please select all that apply.

❍ Federal programs
❍ Provincial/territorial programs
❍ Joint federal-provincial/territorial programs
❍ No

12) Please list which Provincial / Territorial programs you have sought funding from in the past three years:

___

13) Please list which federal programs you have sought funding from in the last three years:

___

14) Please list which joint federal-provincial/territorial programs you have sought funding from in the past three years:

___

# Best Practices for Technical Delivery of Long-Term Transportation Planning Projects-Section 2

### Section 2: Long-term transportation planning study methods and tools

This section is divided into three parts:
- -Issues and decisions that must be addressed in long-term transportation planning studies
- -Information requirements for evaluation and decision-making
- -The analytical methods and tools that are used to supply the required information

### Issues and decisions that must be altered in long-term transportation planning studies

1) What **types of issues or decisions** must be addressed in your long-term transportation planning studies? Please check all that apply.

- ❑ Adoption of a public policy by your organization's council or government
- ❑ Input to public policy development at regional/provincial/territorial level
- ❑ Funding approvals for implementation of a specific facility, service or program
- ❑ Implementation staging of a specific facility, service or program
- ❑ Budget preparation and approval
- ❑ Development approvals and schedule
- ❑ Input to funding, infrastructure staging and budgeting at regional or provincial/territorial level
- ❑ Existing land use specifications
- ❑ Preparation for a legal defence
- ❑ Other (please specify)

If you selected other please specify:

______________________________________________

### Information requirements for evaluation and decision-making

Investment or programming decisions and the choice of one planning alternative over another are commonly determined by comparing the performance of these alternatives against a set of evaluation measures. In turn, the choice of evaluation measures is often dependant on project objectives, available analytical tools and benchmark data. The following questions ask about the evaluation measures your organization uses for transportation planning projects at the municipal plan level, the applicability of tools and access to sufficient data to undertake comparative analyses of the results.

2) What **performance indicators** do you usually consider while evaluating the results of transportation planning studies? Please check all that apply.

- ❑ Infrastructure needs and deficiencies

- ❑ Travel mode indicators (e.g. travel by car, public transit, carpooling or walking)
- ❑ Land use indicators (e.g. impact on density)
- ❑ Environmental quality indicators (e.g. land, water, air)
- ❑ Economic indicators
- ❑ Other
- ❑ None / not applicable

3) Which evaluation measures do you consider in determining **infrastructure needs and deficiencies**? Please check all that apply.

- ❑ Volume to capacity ratios at screenlines / travel corridors
- ❑ Volume to capacity ratios on roadway sections
- ❑ Per-capita peak-period travel times as compared to benchmark values
- ❑ Percentage of roads congested at peak times as compared to benchmark values
- ❑ Per-capita peak-period vehicle kilometres travelled as compared to benchmark values
- ❑ Accessibility (e.g., changes in travel time due to construction of a new facility)
- ❑ Network continuity
- ❑ None / not applicable
- ❑ Other (please specify)

If you selected other please specify:

________________________________________________

4) Which evaluation measures do you consider in determining the **effects on travel mode**? Please check all that apply.

- ❑ Per-kilometre average travel costs as compared to benchmark values
- ❑ Changes in number of trips made by passenger car
- ❑ Changes in number of trips made by transit
- ❑ Changes in number of trips made on foot or on bicycle
- ❑ Changes in auto / non-auto modal split
- ❑ Changes in number of trips made by carpool/vanpool
- ❑Number of trips reduced by telecommuting/ working from home
- ❑ None / not applicable
- ❑ Other (please specify)

If you selected other please specify:

________________________________________________

5) Which **land use** measures do you consider? Please check all that apply.

- ❑ Impact on urban form / urban sprawl
- ❑ Impact on land use type, mix or density
- ❑ None / not applicable
- ❑ Other (please specify)

If you selected other please specify:

________________________________________________

6) Which **environmental** measures do you consider? Please check all that apply.

- ❑ Changes in Greenhouse gas emissions (GHG)
- ❑ Changes in emissions of other air pollutants
- ❑ Variation in energy (fuel) consumption
- ❑ Impact of noise / vibration
- ❑ Visual impact
- ❑ Changes in water run-off
- ❑ Impact on water absorption rate
- ❑ Impact on environmentally sensitive areas
- ❑ Impact of traffic volumes on neighbourhoods and/or residential areas
- ❑ Impact on agricultural land
- ❑ Impact on heritage area
- ❑ None / not applicable
- ❑ Other (please specify)

If you selected other please specify:

______________________________________________________________

7) Which **economic** measures do you consider? Please check all that apply.

- ❑ Cost-benefit analysis
- ❑ Implementation, capital and construction costs
- ❑ Operational and maintenance costs
- ❑ Cost of land acquisition
- ❑ Cost of congestion due to delays
- ❑ Financial affordability
- ❑ None / not applicable
- ❑ Other (please specify)

If you selected other please specify:

______________________________________________________________

8) Please list any **other evaluation measures** that you consider. Please describe:

______________________________________________________________
______________________________________________________________
_______________________________________________________

9) How well does your current set(s) of evaluation criteria reflect **community needs and aspirations**?

______________________________________________________________
______________________________________________________________
_______________________________________________________

10) How well does your current set(s) of evaluation criteria address **new or emerging issues** such as sustainable transportation, using transit to reduce environmental impacts, or soliciting new capital funding sources?

______________________________________________________________
______________________________________________________________
_______________________________________________________

**Analytical methods and tools**

11) **What method best describes** how your organization **estimates future traffic volumes or travel demand**? Please select one only.

- ❍ Traffic forecasting or travel demand forecasting model
- ❍ Trend analysis
- ❍ Other
- ❍ None / not applicable

**Traffic forecasting or travel demand forecasting model**

The following questions concern travel demand modelling, and the spatial and temporal extent of modelling forecasts. The term “model” denotes a spreadsheet or commercial software (such as EMME, TransCAD, VISUM, QRS, etc.) that is used to forecast traffic or travel demand. In your previous answer you indicated you use a model--please use the "**Previous Page**" button to revise your answer if this is not the case.

***This section includes technical questions that might require the assistance of your modelling staff.***

12) When was the model introduced to your organization?

- ❍ Less than 1 year ago / recently
- ❍ Less than 5 years ago
- ❍ Over 5 years ago

13) Does your organization exercise full control over and ownership of the model?

- ❍ Yes
- ❍ No

14) If not, who owns the model?

- ❍ Other agency (e.g. regional district, province or territory)
- ❍ Transit operator
- ❍ Owned jointly by other government / transit operator
- ❍ Consultant
- ❍ Other (please specify)

If you selected other please specify: ______________________________

15) Who are the everyday users of the model? Please check all that apply.

- ❑ Staff of your organization

❑ Other agency (e.g. regional district, province or territory)
❑ Transit operator
❑ Consultant
❑ Other (please specify)

If you selected other please specify:
______________________________________________

16) What **upgrades, enhancements or additions** to the model are you aware of having been completed within the past 3 years?

______________________________________________
______________________________________________
______________________________________

17) What procedures did you use to **calibrate the model**? Please check all that apply.

❑ Statistical estimation of parameters
❑ Statistical goodness-of-fit techniques, such as R square
❑ Comparison of simulated and observed traffic and/or transit volumes at screenlines
❑ Comparison of simulated and observed trip matrix totals
❑ Comparison of corridor travel times or speeds
❑ Do not know
❑ Other (please specify)

If you selected other please specify:
______________________________________________

18) What procedures did you use to **validate the model**? Please select all that apply.

❑ Peer review
❑ 'Reasonableness' checks or range checks
❑ Sensitivity tests (of input parameters)
❑ Level of simulation of observed conditions
❑ Application of partitioned data set (i.e., reserve part of the data set on which the model is calibrated, for use in validation)
❑ Do not know
❑ Other (please specify)

If you selected other please specify:
______________________________________________

19) Which of the following travel modes do you forecast? Please check all that apply.

| | Forecasted in your model | Not considered |
|---|---|---|
| Auto driver (auto vehicle) | ❑ | ❑ |
| Auto passenger | ❑ | ❑ |
| Transit passenger | ❑ | ❑ |
| Park-and-ride / Kiss-and-ride | ❑ | ❑ |
| Walk | ❑ | ❑ |
| Cycle (non-motorized) | ❑ | ❑ |

| | | |
|---|---|---|
| Trucks | ❑ | ❑ |
| Other (please specify below) | ❑ | ❑ |

20) Are your organization or any of your staff members of any of the following? Please select all that apply.

❑ Software user group (please specify)
❑ On-line listserve (e.g., TMIP)
❑ Mailing list for software / technology news
❑ None / not applicable
❑ Other (please specify)

If you selected other please specify:

________________________________________

21) Which **types of trips** do you forecast? Please check all that apply.

❑ Person trips
❑ Auto trips
❑ Transit trips
❑ Truck / commercial trips
❑ External trips
❑ Tourist trips
❑ Special generators
❑ Do not know
❑ Other (please specify)

If you selected other please specify:

________________________________________

22) Do you use the traditional **four-stage modelling** approach (trip destination, trip distribution, modal split and trip assignment)?

❍ Yes
❍ No
❑ Do not know

23) Do you specifically forecast:

| | Yes | No |
|---|---|---|
| Trip generation | ❍ | ❍ |
| Trip distribution | ❍ | ❍ |
| Modal split | ❍ | ❍ |
| Trip assignment | ❍ | ❍ |

24) On which networks do you perform **trip assignment**? Please check all that apply.

❑ Auto network
❑ Transit network
❑ Heavy vehicle networks

❑ Other (please specify)

If you selected other please specify:

______________________________________________

25) You indicated that you perform **trip assignment on the auto network**. Which of the following do you consider? Please check all that apply.

❑ Passenger cars only – no distinction by occupancy
❑ Passenger cars – distinguished by Single Occupancy Vehicle and High Occupancy Vehicle
❑ Other (please specify)

If you selected other please specify:

______________________________________________

26) You indicated that you perform **trip assignment on the transit network**. Which of the following do you consider? Please check all that apply.

❑ Assignment capped by transit capacity
❑ Assignment not capped by the capacity of the transit system
❑ Pedestrian movements within stations or at key transfer points
❑ Park-and-ride / kiss-and-ride
❑ Other (please specify)

If you selected other please specify:

______________________________________________

27) Please describe the approach used:

______________________________________________
______________________________________________
______________________________________________

28) What **software tools** do you presently use in your travel demand modelling practice? Please select all that apply.

❑ EMME
❑ VISUM
❑ TransCad
❑ CUBE/TP+
❑ QRS
❑ Do not know
❑ Other (please specify)

If you selected other please specify:

______________________________________________

29) What are the **horizon years** of your travel demand forecast? Please list all or type “do not know”.

30) Which **forecast periods** do you model? Please check all that apply.

- ❑ AM peak hour
- ❑ AM peak period
- ❑ AM peak hour and shoulder hours
- ❑ Mid-day-peak hour
- ❑ Mid-day peak period
- ❑ PM peak hour
- ❑ PM peak period
- ❑ PM peak hour and shoulder hours
- ❑ 24-hours
- ❑ Do not know
- ❑ Other (please specify)

If you selected other please specify:

31) If "Peak Period" selected--please indicate the duration of the period (in hours--e.g. 3.0). If more than one peak period is modelled, please indicate the duration of each.

**Trend analysis**

The following questions ask about the tools and methods you use to determine trends.

32) What **trend analysis methods** do you use? Please select all that apply.

- ❑ Regression analysis
- ❑ Time series analysis
- ❑ Growth rate or growth factor
- ❑ Other (please specify)

If you selected other please specify:

33) What **tools** do you use? Please select all that apply.

- ❑ Spreadsheet (e.g. Excel spreadsheet)
- ❑ Database (e.g., Access)
- ❑ Specialized travel demand / traffic analytical software
- ❑ Do not use (manual / judgment)
- ❑ Other (please specify)

If you selected other please specify:

34) Please indicate what **specialized travel demand / traffic analytical software** tools you use:

**Other methods of forecasting traffic or travel demand**

35) Please describe any other way(s) in which you estimate future traffic volumes or travel demand:

This concludes Section 2 of the survey. If you are satisfied with your responses, please press "Submit Survey" to be taken to the next Section.

# Best Practices for Technical Delivery of Long-Term Transportation Planning Projects-Section 3

**Section 3: Data collection protocols**
This section asks about the data that are applied to or collected for your transportation planning studies. These data may be collected in-house or on behalf of your organization; or they may be purchased or assembled from other sources

1) Do **you collect or use** any of the following data? Please check all that apply. If you collect or use data not listed here, please select the "Other" category and you will be given a chance to describe this.

❑ Roadway inventory data (e.g. number of lanes, right-of-way width, posted speed, parking inventory)
❑ Traffic or intersection counts (e.g. travel volume, vehicle occupancy, vehicle classification)
❑ Travel time surveys
❑ Public transit data (e.g. on/off transit counts, on-board origin-destination surveys)
❑ Population counts
❑ Household counts
❑ Employment counts
❑ Roadside origin-destination surveys
❑ Household travel surveys (may include information on travel purpose, travel mode, time and distance, access to automobile, etc)
❑ Freight data
❑ Do not collect or use any data
❑ Other

2) For the following data please list the type of **data storage formats.** Please check all that apply.

| | Spreadsheets / database | Geographic Information Systems | Paper copy (may include reports or maps) | Other | Not applicable |
|---|---|---|---|---|---|
| Roadway inventory data | ❑ | ❑ | ❑ | ❑ | ❑ |
| Traffic or intersection counts | ❑ | ❑ | ❑ | ❑ | ❑ |
| Travel time surveys | ❑ | ❑ | ❑ | ❑ | ❑ |
| Public transit data | ❑ | ❑ | ❑ | ❑ | ❑ |
| Population counts | ❑ | ❑ | ❑ | ❑ | ❑ |
| Household counts | ❑ | ❑ | ❑ | ❑ | ❑ |
| Employment counts | ❑ | ❑ | ❑ | ❑ | ❑ |
| Roadside origin-destination surveys | ❑ | ❑ | ❑ | ❑ | ❑ |
| Household travel surveys | ❑ | ❑ | ❑ | ❑ | ❑ |
| Freight Data | ❑ | ❑ | ❑ | ❑ | ❑ |
| Other | ❑ | ❑ | ❑ | ❑ | ❑ |

3) What **roadway inventory data** do you actively collect? Please check all that apply.

❑ Street network
❑ Road classification
❑ Road jurisdiction
❑ Recorded traffic volumes
❑ Number of lanes
❑ Posted speeds
❑ Right-of-way width
❑ Intersections location and attributes
❑ Location of traffic signals
❑ Location of roadway signage
❑Location of transit bus stops and shelters
❑Transit routes
❑ On-street parking inventory
❑ Off-street parking inventory
❑ Traffic zones / model zones
❑ Planning districts (blocks, areas)
❑ Environmentally significant areas (woodlots, protected areas, green space)
❑ Hydrology (rivers, creeks etc)
❑ Elevation (mountains, ravines, valleys)
❑ Other (please specify)

If you selected other please specify:

______________________________________________

4) You indicated that you store data in GIS format. Please tell us which **GIS software** package(s) you use.

❑ Autodesk
❑ MapInfo
❑ ArcGIS / ArcView
❑ Intergraph
❑ MapPoint
❑ TransCad
❑ Oracle Spatial
❑ GeoTools
❑ Chameleon
❑Do not know
❑ Other (please specify)

If you selected other please specify:

______________________________________________

5) Does your organization have a formal or ongoing **traffic volume count program**?

❍ Yes
❍ No

6) What traffic volume counts do you collect or have access to? Please check all that apply.

❑ Roadway travel volume counts (segment or mid-block counts)
❑ Intersection turning movement counts
❑ Vehicle classification
❑ Vehicle occupancy counts (observation of number of people in a car)
❑ Vehicle travel time surveys
❑ Vehicle speed surveys
❑Do not know
❑ Other (please specify)

If you selected other please specify:

---

7) **How often** do you collect traffic volume data? Select all that apply.

❍ Quarterly or seasonally
❍ Bi-annually
❍ Annually
❍ Every second year
❍ Every three to five years
❍ No specific schedule / as needed
❍ Combination of scheduled program with as needed supplementary counts
❍ Do not know
❍ Other (please specify)

If you selected other please specify:

---

8) For what **time periods** are traffic volume data collected? Please check all that apply.

❑ Peak hour(s)
❑ Peak period(s)
❑ 24-hours
❑ Week long (including weekends)
❑ Depends on count application
❑ Do not know
❑ Other (please specify or discuss your selection)

If you selected other please specify:

---

9) How is **segment or mid-block traffic volume data** reported and stratified? Note: this question does not apply to intersection counts.

❑ Each direction of traffic separately
❑ Both directions of traffic combined

10) What is the **smallest time interval** used to report or summarize the data?

❑ Less than 15 minutes
❑ Quarter-hour (15 minute) interval
❑ Half-hour (30 minute) interval
❑ Hour (60 minute) interval
❑ Provide total count only

Do not know
❑ Other (please specify)

If you selected other please specify:

______________________________________________

11) Do you apply **adjustment factors** (seasonal, day of week, month)?

❍ Yes
❍ No

12) What is the principal source of the adjustment factors?

❍ Developed in-house
❍ Acquired from another agency
❍ From the literature
❍ Do not know
❍ Other (please specify)

If you selected other please specify:

______________________________________________

13) Does your organization operate **active permanent counting stations**?

❍ Yes
❍ No

14) **How many** permanent counting stations do you operate?

______________________________________________

15) How often do you collect travel time surveys?

❍ Annually
❍ Every second year
❍ Every three to five years
❍ No specific schedule / as needed
❍ Do not know
❍ Other (please specify)

If you selected other please specify:

______________________________________________

16) Travel time data are usually collected for:

❍ Selected roadway segments/where needed
❍ Always the same roadway segments
❍ Travel corridors
❍ Network wide program
❍ Do not know

18) What method is used to record travel time data?

❑ Manual travel time recording (flatting car technique or similar)
❑ Geographic Positioning System (GPS) travel time tracking
❑ In ground/surface tube detectors
❑ Do not know
❑ Other (please specify)

If you selected other please specify:

______________________________

19) What **public transit data / transit passenger counts** do you collect or have access to?

❑ On/off board count
❑ On-board Origin-Destination survey interview
❑ Interviews / service satisfaction surveys of current patrons
❑ Stated preference surveys
❑ Historical survey data
❑ Do not know
❑ Other (please specify)

If you selected other please specify:

______________________________

20) **How often** do you collect transit ridership data?

❍ Daily
❍ Quarterly, semi-annually, annually
❍ Every second year
❍ Three to five years
❍ No specific schedule / as needed
❍ Do not know
❍ Other (please specify)

If you selected other please specify:

______________________________

21) What is the **smallest area unit** for which **population or household data are available** in most cases? Please comment on any exceptions in the comment box below.

❍ Municipal area
❍ Blocks
❍ Districts
❍ Census tracts
❍ Traffic zones
❍ Neighbourhood
❍ Do not know
❍ Other (please specify)

If you selected other please specify:

______________________________

Additional comments:

______________________________

22) **How often** do you update population and/or household counts?

- ❍ Sub-annually
- ❍ Annually
- ❍ Every second year
- ❍ Every census year
- ❍ No specific schedule / as needed
- ❍ Do not know
- ❍ Other (please specify)

If you selected other please specify:

________________________________________

23) What is **the smallest area unit** for which **employment data are available** in most cases? Please comment on any exceptions in the comment box below.

- ❍ Municipal area
- ❍ Blocks
- ❍ Districts
- ❍ Census tracts
- ❍ Traffic zones
- ❍ Neighbourhood
- ❍ Do not know
- ❍ Other (please specify)

If you selected other please specify:

________________________________________

Additional comments:

________________________________________

24) **How often** do you update employment counts?

- ❍ Sub-annually
- ❍ Annually
- ❍ Every second year
- ❍ Every census year
- ❍ No specific schedule / as needed
- ❍ Do not know
- ❍ Other (please specify)

If you selected other please specify:

________________________________________

25) What types of vehicles are included in your **roadside origin-destination surveys**? Please check all that apply.

- ❑ Personal vehicles only
- ❑ Trucks / commercial vehicles
- ❑ Buses
- ❍ Do not know
- ❑ Other (please specify)

If you selected other please specify:

______________________________________________

26) **How often** do you conduct roadside origin-destination surveys?

❍ Annually
❍ Every second year
❍ Census years
❍ No specific schedule / as needed
❍ Do not know
❍ Other (please specify)

If you selected other please specify:

______________________________________________

27) When was the latest roadside origin-destination survey completed?

______________________________________________

28) What **method** do you use **to collect information on household travel** characteristics?

❑ Telephone interview survey
❑ On-line / web-based survey
❑ Mailback survey / census
❑ Road-side interviews
❍ Do not know
❑ Other (please specify)

If you selected other please specify:

______________________________________________

29) **How often** do you collect data on household travel characteristics?

❍ Annually
❍ Every second year
❍ Every census year
❍ Every three to five years
❍ Every 10 years
❍ No specific schedule/ as needed
❍ Do not know
❍ Other (please specify)

If you selected other please specify:

______________________________________________

30) When was the latest survey completed?

______________________________________________

31) What is the **scope of your freight data collection**?

❑ Sample of area employers

- ❑ Sample of logistics companies
- ❑ Sample of commercial vehicles passing through a specific point(s) (e.g. scale)
- ❍ Do not know
- ❑ Other (please specify)

If you selected other please specify:

______________________________

32) **How often** do you collect data on freight travel characteristics?

Daily
- ❍ Annually
- ❍ Every second year
- ❍ Three to five years
- ❍ No specific schedule / as needed
- ❍ Other (please specify)

If you selected other please specify:

______________________________

33) What **other data** do you collect?

______________________________
______________________________
______________________________

34) Do you **share** your transportation data collection or data dissemination efforts? (Please check all that apply).

- ❑ Across departments within your organization
- ❑ Across jurisdictions (i.e., organizations other than yours)
- ❍ With private sector (e.g. developers)
- ❑ Other (please specify)

If you selected other please specify:

______________________________

35) Do you **purchase or obtain from external sources** any of the transportation data listed in Question 1 from external sources?

- ❍ Yes
- ❍ No

36) Please identify data which you purchase or obtain from external sources. Please check all that apply.

Roadway inventory data
Traffic or intersection counts
Travel time surveys
Public transit data
Population counts

Household counts
Employment counts
Roadside origin-destination surveys
Household travel surveys
Freight Data
Other

37) Who are **the users of the data** you identified from the list above? Please check all that apply.

- ❑ Staff
- ❑ Municipal or regional council
- ❑ Regional government
- ❑ Provincial / territorial government or regulatory agencies
- ❑ Federal government or regulatory agencies
- ❑ Transit authority
- ❑ Land developers
- ❑ Consultants
- ❑ Academics
- ❑ Area residents/ Members of the Public
- ❑ Private enterprises
- ❑ Carriers (all modes)
- ❑ Other (please specify)

If you selected other please specify: ________________________________________

38) If you do not use any of the data listed in Question 1, please describe how you prepare transportation plans currently:

________________________________________________________
________________________________________________________
____________________________________________

This concludes Section 3 of the survey. If you are satisfied with your responses, please press “Submit Survey” to be taken to the next Section.

# Best Practices for Technical Delivery of Long-Term Transportation Planning Projects-Section 4

### Section 4: Interface with other planning applications

This section asks about other uses of the long term transportation planning tools, methods and data, and the in-house resources and expertise that you have available.

1) What is **the range of use**, beyond direct use in planning studies, for the long term transportation planning and travel demand data generated or funded by your organization? Please check all that apply.

- ❑ Capital infrastructure planning – roads
- ❑ Road operations and maintenance
- ❑ Pavement management and road rehabilitation planning
- ❑ Capital infrastructure planning – transit
- ❑ Transit operations and level of service planning
- ❑ Road safety planning
- ❑ Growth management plans
- ❑ Community strategic land use plans (short and long term)
- ❑ Short term neighbourhood or area plans
- ❑ Site development applications
- ❑ Environmental planning
- ❑ Economic development- planning
- ❑ Securing funding sources for capital plans
- ❑ No other application
- ❑ Other

2) Who is the lead in developing long term capital infrastructure planning for roads under your jurisdiction?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

_______________________________________________

3) Who is the lead in developing road operations and maintenance for roads under your jurisdiction?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

---

4) Who is the lead in developing pavement management and road rehabilitation planning for roads under your jurisdiction?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

---

5) Who is the lead in developing capital infrastructure planning for transit under your jurisdiction?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

---

6) Who is the lead in developing transit operations and level of service planning for transit under your jurisdiction?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

---

7) Who is the lead in developing road safety planning for roads under your jurisdiction?

- ❍ Your organization
- ❍ Transit authority

- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

---

8) Who is the lead in developing growth management plans?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

---

9) Who is the lead in developing community strategic land use plans?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

---

10) Who is the lead in developing short term neighbourhood or area plans?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

---

11) Who is the lead in developing site development applications?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

12) Who is the lead in developing environmental planning?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

13) Who is the lead in economic development?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

14) Who is the lead in securing funding sources for capital plans?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

15) Who is the lead in developing other types of planning applications?

- ❍ Your organization
- ❍ Transit authority
- ❍ Regional government
- ❍ Province / Territory
- ❍ Other (please specify)

If you selected other please specify:

16) Are the transportation planning forecasts and data that you described in Section 2 (planning methods and tools) and Section 3 (types of data collected) available to the public?

❍ All forecasts / data are available for public to access
❍ All forecasts / data are available upon request
❍ Only selected information is available upon request
❍ Project specific information is available
❍ Not normally disseminated to the public
❍ Other (please specify)

If you selected other please specify:

______________________________________________

17) Who usually conducts your transportation planning studies? Please select one.

❍ In-house staff conduct most studies
❍ Projects are often conducted by other local or regional governments or agencies
❍ Projects are often conducted by Provincial / Territorial government
❍ We rely mostly on consultants
❍ Other (please specify)

If you selected other please specify:

______________________________________________

18) What is the current number of transportation planning / traffic engineering technical staff at your agency? Please provide the number based on the professional designation of staff member(s).

Transportation Planners: ______________________

Road / Traffic Engineers: ______________________

Road / Traffic Technologists ______________________

Others: ______________________

19) Are the available in-house resources sufficient for your current or emerging needs? Please select one.

❍ Sufficient or more than sufficient
❍ Less than sufficient

20) If in-house resources are less than sufficient, please explain why; select all that apply.

❑ Lack of staff
❑ Lack of previous experience in an emerging area of emerging needs
❑ Not enough demand for topic area to warrant specialized training
❑ Conducted by others
❑ Loss of experience due to staff retirement
❑ Other (please specify)

If you selected other please specify:

______________________________________________________________

21) Are training programs or conferences funded to enable staff to become informed on the latest transportation planning practices and analytical tools? If so, how often?

❍ Yes, annually
❍ Yes, every two years
❍ Yes, every three to five years
❍ Yes, subject to program availability
❍ No

22) Which of the following traffic operations, signals or network micro-simulation methods do you use? Please select all that apply.

❑ Highway Capacity Software (HCS)
❑ Roadrunner
❑ Canadian Capacity Guide Software (CCG/CALC 2)
❑ Synchro
❑ SimTraffic
❑ PASSER
❑ TRANSYT-7F
❑ SIGNAL/TEAPAC
❑ Paramics
❑ VISSIM
❑ INTEGRATION
❑ CORSIM
❑ AIMSUN
❑ TransModeler
❑ Dynameq
❑ DynaSmart
❑ None
❑ Other (please specify)

If you selected other please specify:

______________________________________________________________

This concludes Section 4 of the survey. If you are satisfied with your responses, please press "Submit Survey" to be taken to the next Section.

# Best Practices for Technical Delivery of Long-Term Transportation Planning Projects-Section 5

### Section 5: Lessons learned

This section concludes the survey, by asking you to assess how well your existing tools, models and data meet your planning needs, and what improvements / additions you might want to see.

1) How well do your existing transportation planning methods and tools meet your needs (e.g., for transportation plan development, operational analysis, transit planning, planning for other modes, investment decision-making, etc.)? In what areas are they deficient?

______________________________________________________________________
______________________________________________________________________
________________________________________________________

2) Has your organization recently encountered increased public or political interest in issues highlighted below that could impose significant influence on the way the organization makes transportation decisions and receives financial support?

| | High on the public and political agenda; strong influence on planning practice | Strong interest voiced by special interest groups and/or public appreciation of the issue; moderate influence on planning practice. | Some interest expressed by individuals; weak influence on planning practice. | No noticeable interest, no influence |
|---|---|---|---|---|
| Climate change / transportation impact | ❍ | ❍ | ❍ | ❍ |
| Smart growth | ❍ | ❍ | ❍ | ❍ |
| Reduction in transportation generated noise and air pollution | ❍ | ❍ | ❍ | ❍ |
| Introduction of new “green” transportation system technologies such as hybrid vehicles used in municipal fleet | ❍ | ❍ | ❍ | ❍ |
| Introduction of “smart” technologies such as intelligent traffic controllers, Travel Information System, | ❍ | ❍ | ❍ | ❍ |

| | | | | |
|---|---|---|---|---|
| Carpool/Vanpool ride matching | | | | |
| Introduction or development of Transportation Demand Management (TDM) measures (e.g. carpooling, vanpooling, telecommuting) | ❍ | ❍ | ❍ | ❍ |
| Support for safe non-motorized travel such as walking or cycling | ❍ | ❍ | ❍ | ❍ |
| Support for better levels of service for transit | ❍ | ❍ | ❍ | ❍ |
| Cost of congestion to society and the economy | ❍ | ❍ | ❍ | ❍ |
| Influence of transportation on public and personal health | ❍ | ❍ | ❍ | ❍ |
| Preservation of agricultural land and natural areas | ❍ | ❍ | ❍ | ❍ |
| Preservation of historical significant and cultural-heritage buildings and districts | ❍ | ❍ | ❍ | ❍ |

3) In your view, is your organization prepared to tackle any of the emerging issues listed in Question 2 and selected by you as of interest to public and decision makers in terms of:

| | Well prepared | Somewhat prepared; sufficient | Unprepared / insufficient | Have not considered at this time |
|---|---|---|---|---|
| The overall planning process and supporting guiding policies | ❍ | ❍ | ❍ | ❍ |
| Structuring and conducting long-term transportation planning projects | ❍ | ❍ | ❍ | ❍ |
| Access to funding at the local level | ❍ | ❍ | ❍ | ❍ |
| Access to funding at the provincial level | ❍ | ❍ | ❍ | ❍ |
| Access to funding at the federal level | ❍ | ❍ | ❍ | ❍ |
| Analytical methods | ❍ | ❍ | ❍ | ❍ |
| Analytical tools | ❍ | ❍ | ❍ | ❍ |
| Data collection protocols | ❍ | ❍ | ❍ | ❍ |
| Depth of available data | ❍ | ❍ | ❍ | ❍ |
| Access to new technology | ❍ | ❍ | ❍ | ❍ |
| Access to information about new | ❍ | ❍ | ❍ | ❍ |

| | | | | |
|---|---|---|---|---|
| technology | | | | |
| Staff resources | ❍ | ❍ | ❍ | ❍ |
| Staff training and conference attendance | ❍ | ❍ | ❍ | ❍ |
| Access to consulting expertise | ❍ | ❍ | ❍ | ❍ |
| More information on best practices in emerging transportation issues and trends | ❍ | ❍ | ❍ | ❍ |

4) Which of the following TAC briefings or documents does/has your organization use/used in its transportation plans within the last 3 years? Please respond to all that apply. For more information, see www.tac-atc.ca.

| | Adopted as policy | Used as a reference or source | Have applied the principles or key points to our plans | Not used |
|---|---|---|---|---|
| Strategies for sustainable transportation planning | ❑ | ❑ | ❑ | ❑ |
| Guidelines for Project Management Development and Conduct | ❑ | ❑ | ❑ | ❑ |
| Urban Transportation Indicators Survey, Advancing the State of Information on Canada's Urban Areas | ❑ | ❑ | ❑ | ❑ |
| Urban Transportation and Air Quality | ❑ | ❑ | ❑ | ❑ |
| Innovations in Financing Urban Transportation | ❑ | ❑ | ❑ | ❑ |
| Measuring Progress, Toward the New Vision for Urban Transportation | ❑ | ❑ | ❑ | ❑ |
| Achieving Liveable Cities | ❑ | ❑ | ❑ | ❑ |
| A New Vision for Urban Transportation | ❑ | ❑ | ❑ | ❑ |
| A Primer on Urban Transportation and Global Climate Change | ❑ | ❑ | ❑ | ❑ |
| Guide to Integrating Environmental Management | ❑ | ❑ | ❑ | ❑ |
| Principles into Operating Codes of Practice | ❑ | ❑ | ❑ | ❑ |
| National Roadway Standards and Guidelines Program | ❑ | ❑ | ❑ | ❑ |
| New Vision for Canadian Transportation | ❑ | ❑ | ❑ | ❑ |
| Creating a Common Vision: the Urban Mobility Challenge | ❑ | ❑ | ❑ | ❑ |
| Environmental Policy and Code of Ethics | ❑ | ❑ | ❑ | ❑ |
| Other TAC documents | ❑ | ❑ | ❑ | ❑ |

5) Are you aware of the availability of these TAC briefings/documents?

Note: All documents are freely available from the TAC website at www.tac-atc.ca.

- ❍ Yes
- ❍ No

6) What **improvements to** your organization's **existing transportation planning methods and tools** would be needed to address any deficiencies or gaps?

______________________________________________________________________
______________________________________________________________________
________________________________________________________

7) What **improvements to** your organization's **existing data sources or data collection activities**, or new data, would be needed to address any deficiencies or gaps?

______________________________________________________________________
______________________________________________________________________
________________________________________________________

8) What existing **factors** contribute to the **success** of your transportation planning process?

______________________________________________________________________
______________________________________________________________________
________________________________________________________

9) What are the **main problems with existing processes** of planning, delivering and implementing the findings of transportation planning projects?

______________________________________________________________________
______________________________________________________________________
________________________________________________________

10) What **technical limitations** do you encounter in your transportation planning processes (e.g. staff expertise, consultant expertise, data availability)? How do you plan to address these issues in the future?

______________________________________________________________________
______________________________________________________________________
________________________________________________________

11) Other comments:

______________________________________________________________________

Thank you for taking the time to complete the TAC Best Practices for Technical Delivery of Long-term Transportation Planning Studies in Canada survey. Please remember to submit your survey by pressing the "Submit Survey" button once you are satisfied with your responses.

If you have any further comments or questions, please feel free to contact David Kriger, P.Eng., MCIP by telephone at (613) 722-6515 ext. 5612; or Elizabeth Szymanski at (toll-free) 1-888-860-1116 ext. 5340. You can also reach us by e-mail at: Best-practice@itransconsulting.com

**You have now completed the TAC Best Practices for Technical Delivery of Long-Term Transportation Planning Studies Survey.**

***Thank you for your participation!***

# Appendix B
# Survey Results

# B. APPENDIX B: SURVEY RESULTS

The sections below document the responses to the survey; and in order to serve as stand-alone document, some graphics from previous chapters are repeated. Classification of the responses follows the main five sections of the survey however, in some instances, the consultant cross-referenced questions from various parts of the survey.

## B.1 Statistics of Survey Respondents

**Exhibit B-1: Respondents by Organization Type and Population**

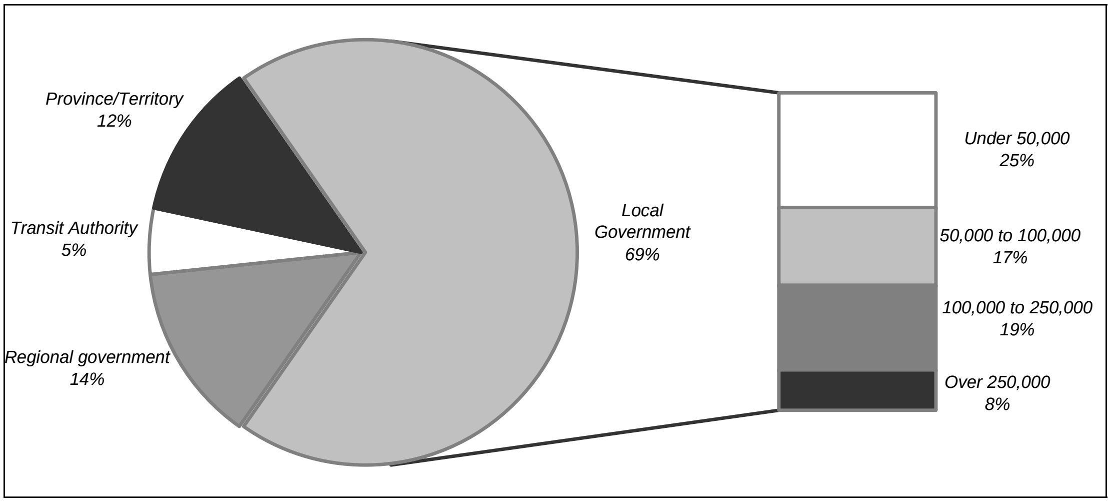


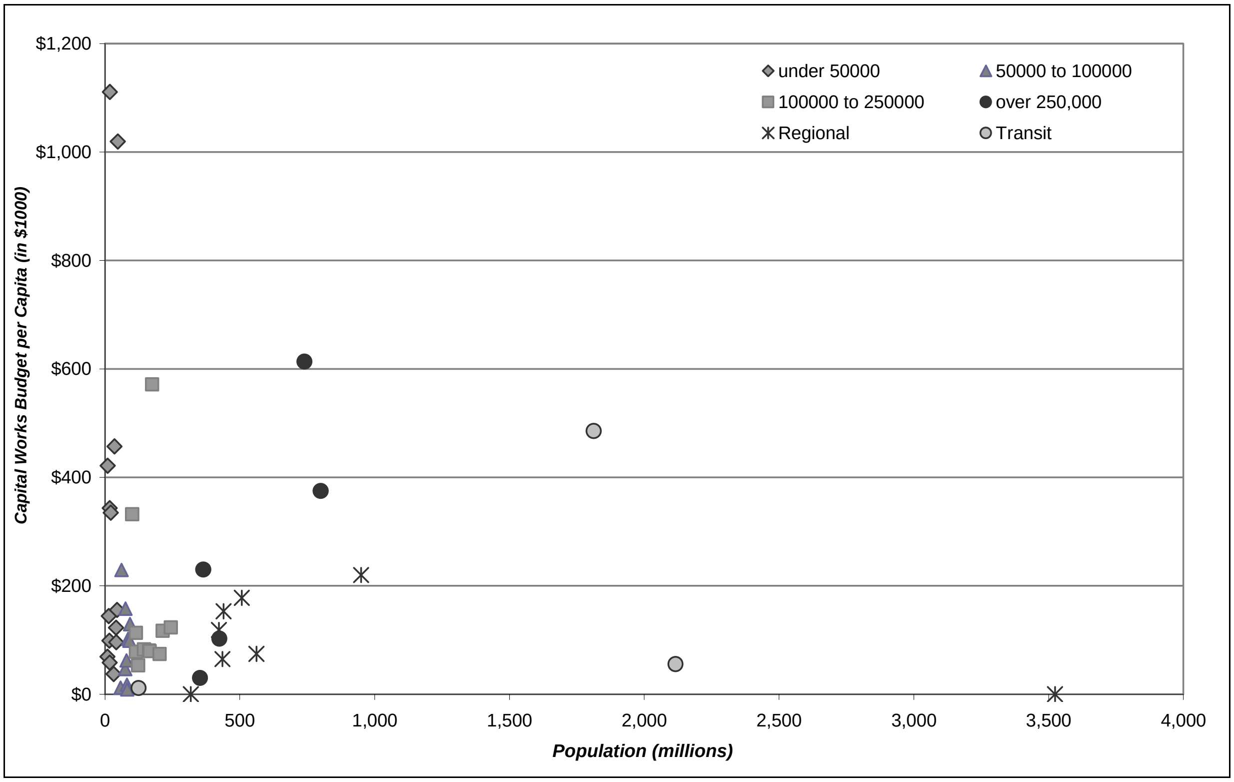

**Table B-1: Respondents by key indicators**

| Respondent | Number of respondents | Percentage of respondents |
|---|---|---|
| Western Canada (West of Ontario) | 27 | 46% |
| Ontario | 20 | 34% |
| Québec | 9 | 15% |
| Eastern Canada (East of Québec) | 3 | 5% |
| | | |
| 2007 transportation capital budget < $5,000,000 | 14 | 24% |
| 2007 transportation capital budget $5,000,000 to $9,999,999 | 10 | 17% |
| 2007 transportation capital budget $10,000,000 to $99,999,999 | 22 | 38% |
| 2007 transportation capital budget $100,000,000 and up | 12 | 21% |
| | | |
| Transit operated by organization | 31 | 53% |
| | | |
| Road-kilometres under jurisdiction (0-499) | 17 | 31% |
| Road-kilometres under jurisdiction (500-999) | 15 | 28% |
| Road-kilometres under jurisdiction (1000-9999) | 13 | 24% |
| Road-kilometres under jurisdiction (10000 and up) | 9 | 17% |

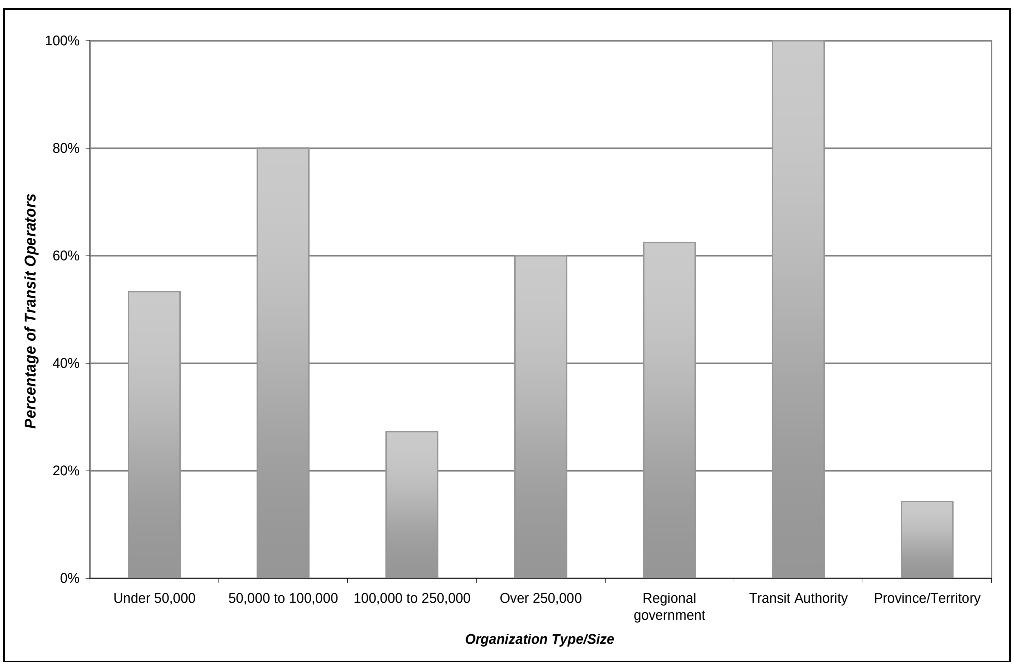
## Table B-2: Respondents by population size

| | Number of respondents | | | | | |
|---|---|---|---|---|---|---|
| **Respondent** | **Population under 50,000** | **Population 50,000 to 100,000** | **Population 100,000 to 250,000** | **Population over 250,000** | **Regions** | **Provinces /Territories** |
| Western Canada | 12 | 5 | 2 | 2 | 2 | 4 |
| Ontario | 3 | 3 | 6 | 2 | 6 | 1 |
| Québec | 0 | 1 | 3 | 1 | 2 | 1 |
| Eastern Canada | 0 | 1 | 1 | 0 | 0 | 1 |
| | | | | | | |
| Transport capital budget <$5m | 7 | 4 | 1 | 0 | 2 | 0 |
| Transport capital budget $5m to $10m | 5 | 3 | 2 | 0 | 0 | 0 |
| Transport capital budget $10m to $100m | 2 | 3 | 8 | 3 | 5 | 1 |
| Transport capital budget $100m and up | 0 | 0 | 1 | 2 | 3 | 6 |
| | | | | | | |
| Operates transit service | 8 | 8 | 4 | 3 | 7 | 1 |
| | | | | | | |
| Road km controlled (<500) | 10 | 2 | 3 | 0 | 2 | 0 |
| Road km controlled (500-999) | 1 | 7 | 4 | 0 | 3 | 0 |
| Road km controlled (1000-9999) | 2 | 1 | 3 | 3 | 3 | 1 |
| Road km controlled (10000 and up) | 0 | 0 | 0 | 2 | 1 | 6 |

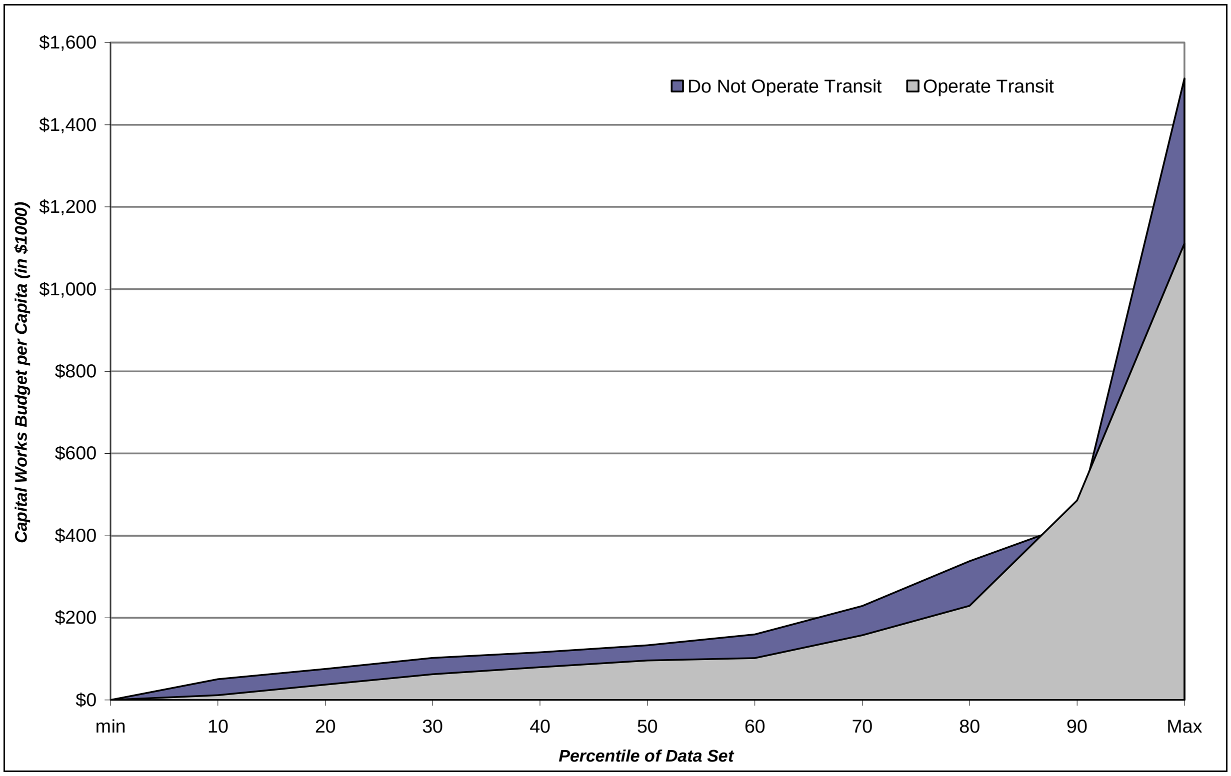
## Exhibit B-2: Capital Works Budget per Capita



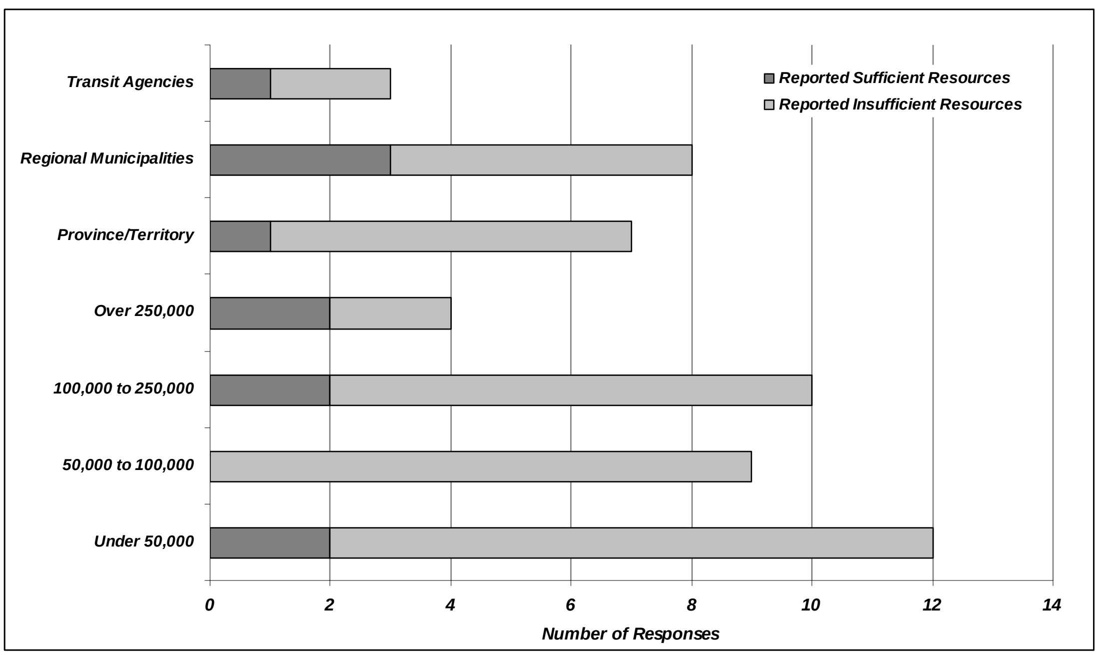

## Exhibit B-3: Proportion of Transit Operators



## Exhibit B-4: Transit and Non-Transit Operators by Capital Works Budget per Capita



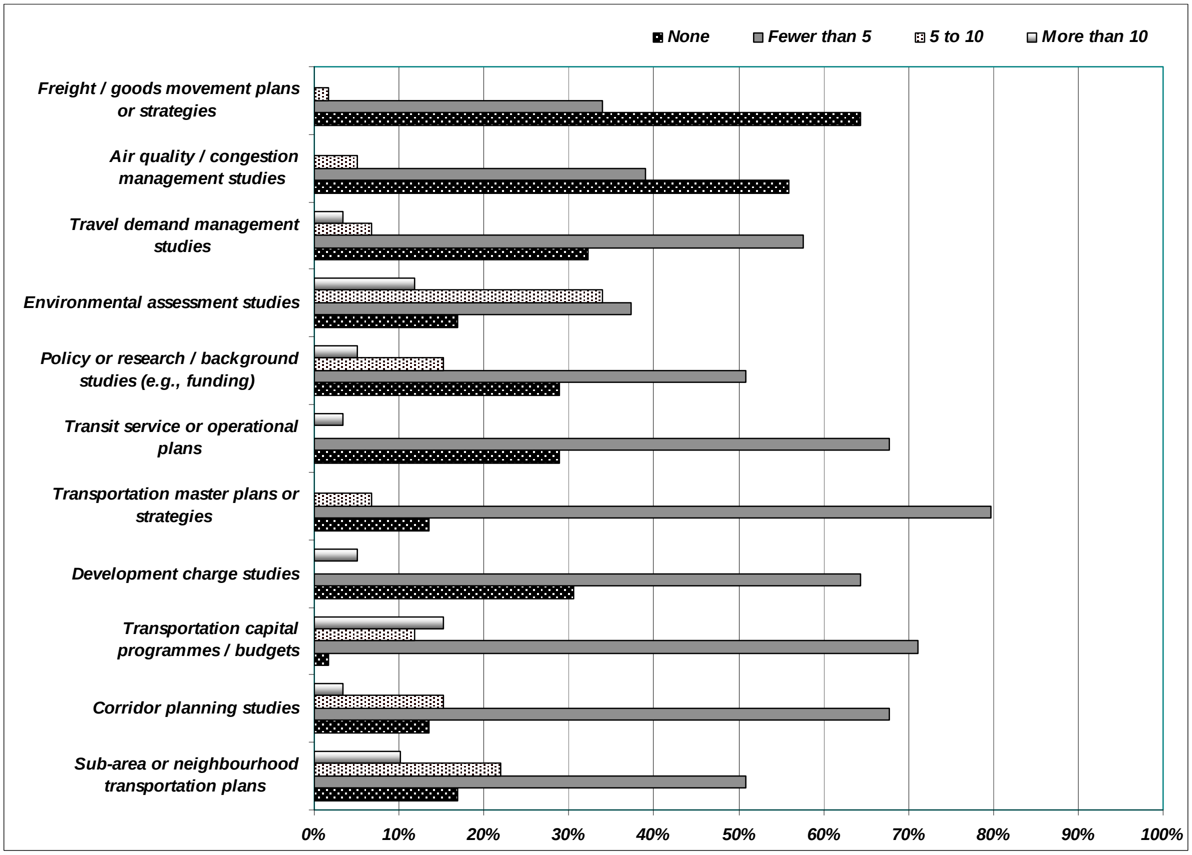

## Exhibit B-5: Report of Sufficient / Insufficient Resources by Organization Type / Size



## B.2 Planning Studies and Issues Addressed

| Planning Study Type | None | Fewer than 5 | 5 to 10 | More than 10 |
|---|---|---|---|---|
| Sub-area or neighbourhood transportation plans | 10 (17%) | 30 (51%) | 13 (22%) | 6 (10%) |
| Corridor planning studies | 8 (14%) | 40 (68%) | 9 (15%) | 2 (3%) |
| Transportation capital programmes / budgets | 1 (2%) | 42 (71%) | 7 (12%) | 9 (15%) |
| Development charge studies | 18 (31%) | 38 (64%) | 0 (0%) | 3 (5%) |
| Transportation master plans or strategies | 8 (14%) | 47 (80%) | 4 (7%) | 0 (0%) |
| Transit service or operational plans | 17 (29%) | 40 (68%) | 0 (0%) | 2 (3%) |
| Policy or research / background studies (e.g., funding) | 17 (29%) | 30 (51%) | 9 (15%) | 3 (5%) |
| Environmental assessment studies | 10 (17%) | 22 (37%) | 20 (34%) | 7 (12%) |
| Travel demand management studies | 19 (32%) | 34 (58%) | 4 (7%) | 2 (3%) |
| Air quality / congestion management studies | 33 (56%) | 23 (39%) | 3 (5%) | 0 (0%) |
| Freight / goods movement plans or strategies | 38 (64%) | 20 (34%) | 1 (2%) | 0 (0%) |

## Exhibit B-6: Distribution of Planning Study Types and Quantities of Studies Conducted




## Table B-3: Issues Addressed by Transportation Planning Study

| Transportation planning study issues | Absolute Number | Percentage |
|---|---|---|
| Adoption of a public policy by your organization's council or government | 46 | 78% |
| Input to public policy development at regional / provincial / territorial level | 33 | 56% |
| Funding approvals for implementation of a specific facility, service or program | 38 | 64% |
| Implementation staging of a specific facility, service or program | 39 | 66% |
| Budget preparation and approval | 46 | 78% |
| Development approvals | 34 | 58% |
| Input to funding, infrastructure staging and budgeting at regional or provincial / territorial level | 40 | 68% |
| Existing land use specifications | 37 | 63% |
| Preparation for a legal defence | 11 | 19% |

## Table B-4: Issues of Increased Interest and Influence

| Issues of Increased Interest & Influence | High | Moderate | Weak | None |
|---|---|---|---|---|
| Climate change / transportation impact | 11 (22%) | 15 (29%) | 20 (39%) | 5 (10%) |
| Smart growth | 13 (25%) | 17 (33%) | 18 (35%) | 3 (6%) |
| Reduction in transportation generated noise and air pollution | 7 (14%) | 17 (33%) | 21 (41%) | 6 (12%) |
| Introduction of new green transportation system technologies | 8 (16%) | 18 (35%) | 18 (35%) | 7 (14%) |
| Introduction of smart technologies | 5 (10%) | 15 (29%) | 22 (43%) | 9 (18%) |
| Introduction or development of TDM measures | 7 (14%) | 14 (27%) | 17 (33%) | 13 (25%) |
| Support for safe non-motorized travel | 11 22% | 24 (47%) | 13 (25%) | 3 (6%) |
| Support for better transit service | 16 (31%) | 21 (41%) | 10 (20%) | 4 (8%) |
| Economic/social cost of congestion | 7 (14%) | 18 (35%) | 12 (24%) | 14 (27%) |
| Influence of transportation on public and personal health | 6 (12%) | 18 (35%) | 14 (27%) | 13 (25%) |
| Preservation of agricultural land and natural areas | 14 (27%) | 15 (29%) | 14 (27%) | 8 (16%) |
| Preservation of heritage buildings and districts | 7 (14%) | 24 (47%) | 12 (24%) | 8 (16%) |

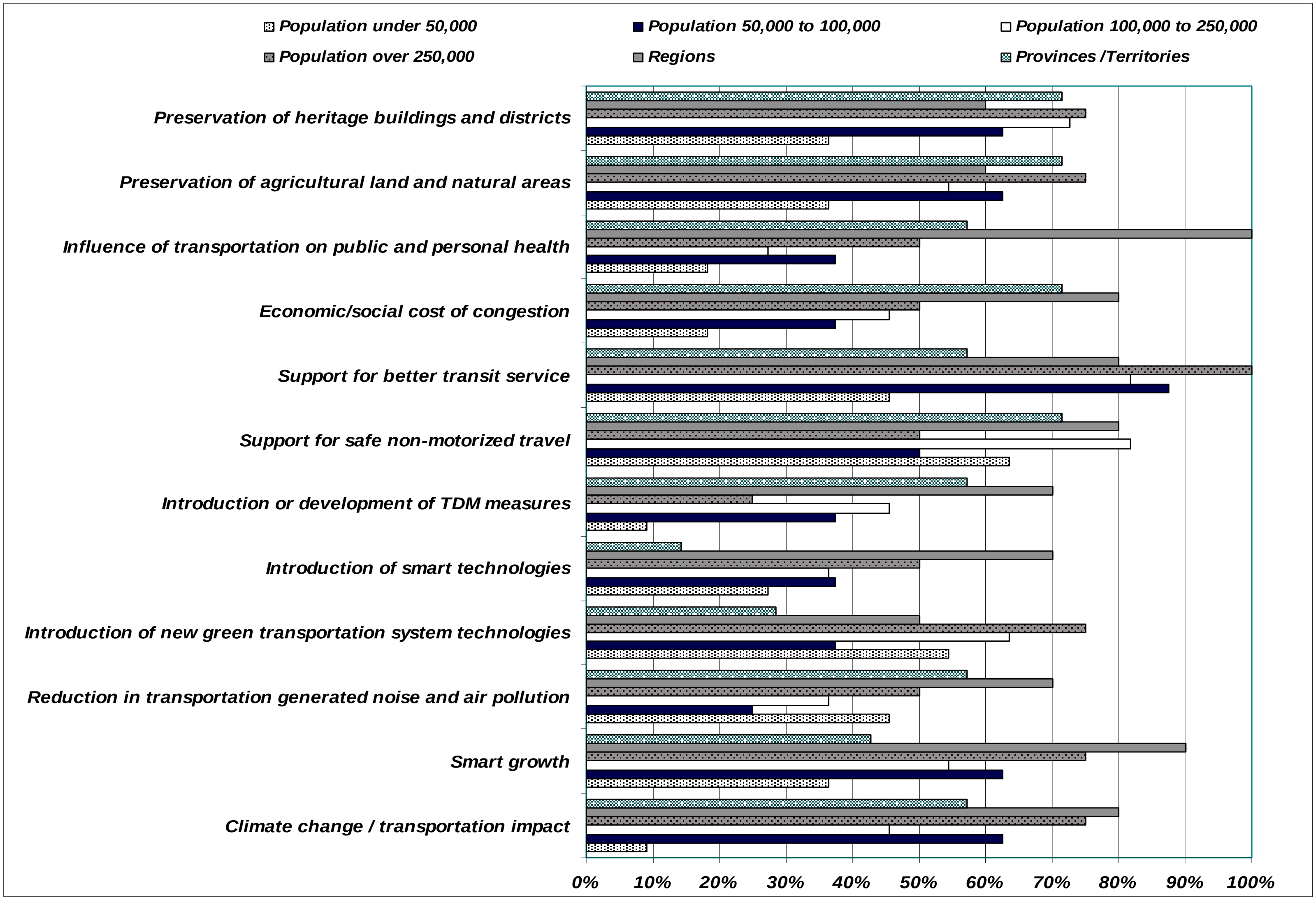
## Table B-5: Issues of Increased Interest and Influence (continued)

| Issues of Increased Interest & Influence | Considered highly or moderately significant by: | Percentage of respondents considered such by |
|---|---|---|
| Support for better transit service | 37 | 73% |
| Support for safe non-motorized travel | 35 | 69% |
| Preservation of heritage buildings and districts | 31 | 61% |
| Smart growth | 30 | 59% |
| Preservation of agricultural land and natural areas | 29 | 57% |
| Economic/social cost of congestion | 25 | 49% |
| Climate change / transportation impact | 26 | 51% |
| Introduction of new green transportation system technologies | 26 | 51% |
| Reduction in transportation generated noise and air pollution | 24 | 47% |
| Influence of transportation on public and personal health | 24 | 47% |
| Introduction or development of TDM measures | 21 | 41% |
| Introduction of smart technologies | 20 | 39% |

## Table B-6: Issues of Increased Interest and Influence by Population Size

| | Number of respondents by | | | | | |
|---|---|---|---|---|---|---|
| **Issues of Increased Interest & Influence** | **Population under 50,000** | **Population 50,000 to 100,000** | **Population 100,000 to 250,000** | **Population over 250,000** | **Regions** | **Provinces /Territories** |
| Climate change / transportation impact | 1 | 5 | 5 | 3 | 8 | 4 |
| Smart growth | 4 | 5 | 6 | 3 | 9 | 3 |
| Reduction in transportation generated noise and air pollution | 5 | 2 | 4 | 2 | 7 | 4 |
| Introduction of new green transportation system technologies | 6 | 3 | 7 | 3 | 5 | 2 |
| Introduction of smart technologies | 3 | 3 | 4 | 2 | 7 | 1 |
| Introduction or development of TDM measures | 1 | 3 | 5 | 1 | 7 | 4 |
| Support for safe non-motorized travel | 7 | 4 | 9 | 2 | 8 | 5 |
| Support for better transit service | 5 | 7 | 9 | 4 | 8 | 4 |
| Economic/social cost of congestion | 2 | 3 | 5 | 2 | 8 | 5 |
| Influence of transportation on public and personal health | 2 | 3 | 3 | 2 | 10 | 4 |
| Preservation of agricultural land and natural areas | 4 | 5 | 6 | 3 | 6 | 5 |
| Preservation of heritage buildings and districts | 4 | 5 | 8 | 3 | 6 | 5 |

# Exhibit B-7: Issues of Increased Interest and Influence by Population Size



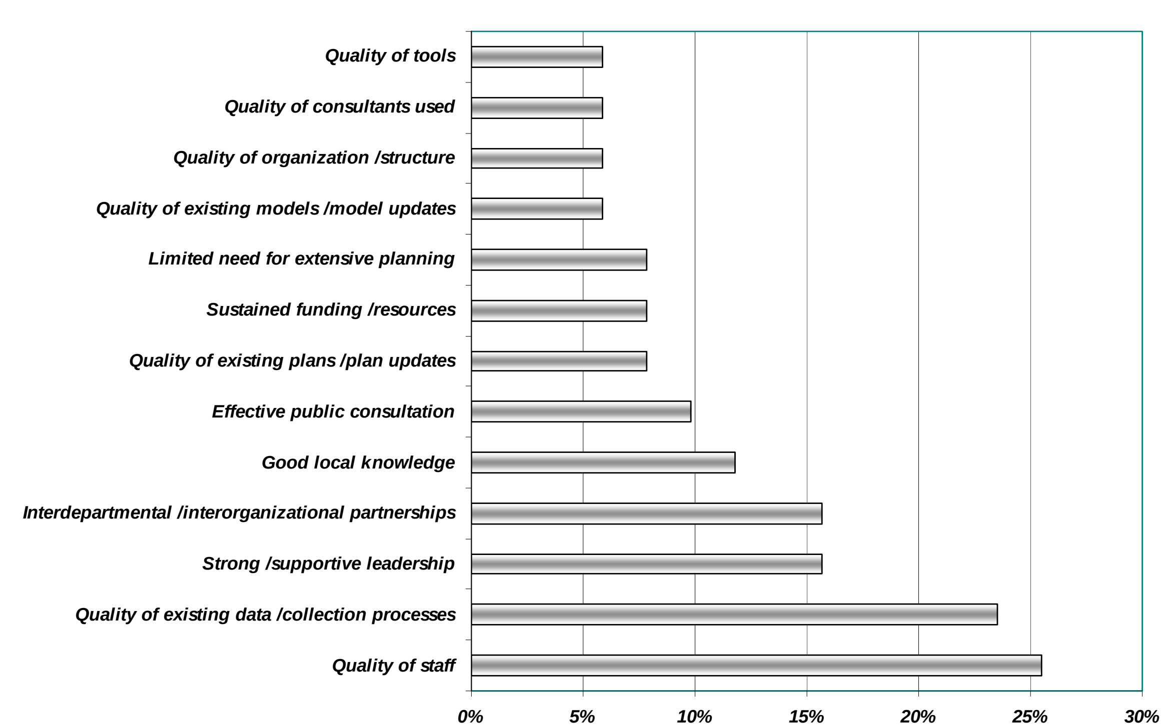
## Table B-7: Levels of Preparation to Meet the Emerging Issues

| | Good | Sufficient | Insufficient | Not considered |
|---|---|---|---|---|
| Overall planning process and guiding policies | 7 (14%) | 32 (63%) | 10 (20%) | 2 (4%) |
| Structuring /conducting long-term transportation planning projects | 9 (18%) | 33 (65%) | 8 (16%) | 1 (2%) |
| Access to local funding | 7 (14%) | 26 (51%) | 12 (24%) | 6 (12%) |
| Access to provincial funding | 8 (16%) | 27 (53%) | 12 (24%) | 4 (8%) |
| Access to federal funding | 5 (10%) | 24 (47%) | 17 (33%) | 5 (10%) |
| Analytical methods | 7 (14%) | 26 (51%) | 13 (25%) | 5 (10%) |
| Analytical tools | 7 (14%) | 25 (49%) | 15 (29%) | 4 (8%) |
| Data collection protocols | 9 (18%) | 29 (57%) | 10 (20%) | 3 (6%) |
| Depth of available data | 7 (14%) | 23 (45%) | 17 (33%) | 4 (8%) |
| Access to new technology | 8 (16%) | 28 (55%) | 12 (24%) | 3 (6%) |
| Access to information about new technology | 12 (24%) | 24 (47%) | 12 (24%) | 3 (6%) |
| Staff resources | 1 (2%) | 19 (37%) | 27 (53%) | 4 (8%) |
| Staff training and conference attendance | 3 (6%) | 30 (59%) | 16 (31%) | 2 (4%) |
| Access to consulting expertise | 12 (24%) | 32 (63%) | 6 (12%) | 1 (2%) |
| More information on best practices in emerging transportation issues and trends | 3 (6%) | 31 (61%) | 14 (27%) | 3 (6%) |

## Table B-8: Successful aspects of existing planning studies by category

| Category | Absolute Number | Percentage |
|---|---|---|
| Quality of staff | 13 | 25% |
| Quality of existing data /collection processes | 12 | 24% |
| Strong /supportive leadership | 8 | 16% |
| Interdepartmental /inter-organizational partnerships | 8 | 16% |
| Good local knowledge | 6 | 12% |
| Effective public consultation | 5 | 10% |
| Quality of existing plans /plan updates | 4 | 8% |
| Sustained funding /resources | 4 | 8% |
| Limited need for extensive planning | 4 | 8% |
| Quality of existing models /model updates | 3 | 6% |
| Quality of organization /structure | 3 | 6% |
| Quality of consultants used | 3 | 6% |
| Quality of tools | 3 | 6% |

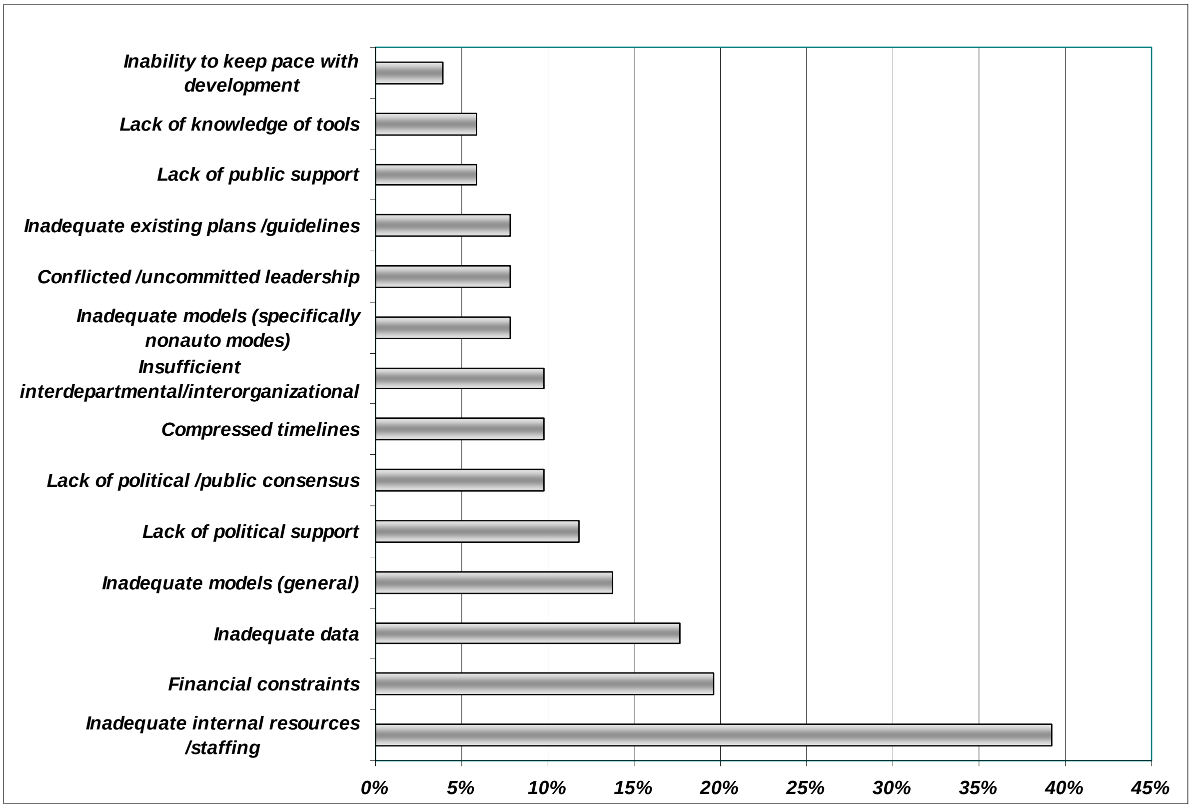
## Exhibit B-8: Aspects of successful planning studies




## Table B-9: Aspects of transportation planning studies needing improvement by category

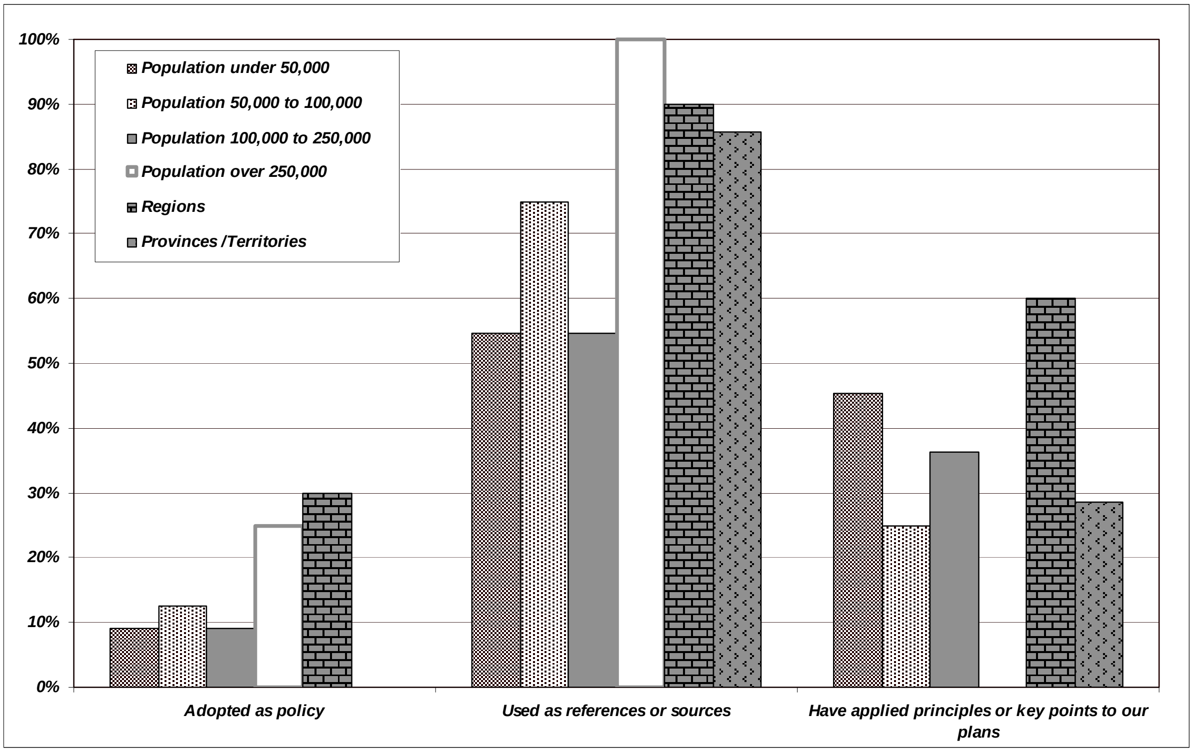
| Category | Absolute Number | Percentage |
|---|---|---|
| Inadequate internal resources /staffing | 20 | 39% |
| Financial constraints | 10 | 20% |
| Inadequate data | 9 | 18% |
| Inadequate models (general) | 7 | 14% |
| Lack of political support | 6 | 12% |
| Lack of political /public consensus | 5 | 10% |
| Compressed timelines | 5 | 10% |
| Insufficient interdepartmental/inter-organizational integration | 5 | 10% |
| Inadequate models (specifically nonauto modes) | 4 | 8% |
| Conflicted /uncommitted leadership | 4 | 8% |
| Inadequate existing plans /guidelines | 4 | 8% |
| Lack of public support | 3 | 6% |
| Lack of knowledge of tools | 3 | 6% |
| Inability to keep pace with development | 2 | 4% |

## Exhibit B-9: Aspects of transportation planning studies needing improvement by category



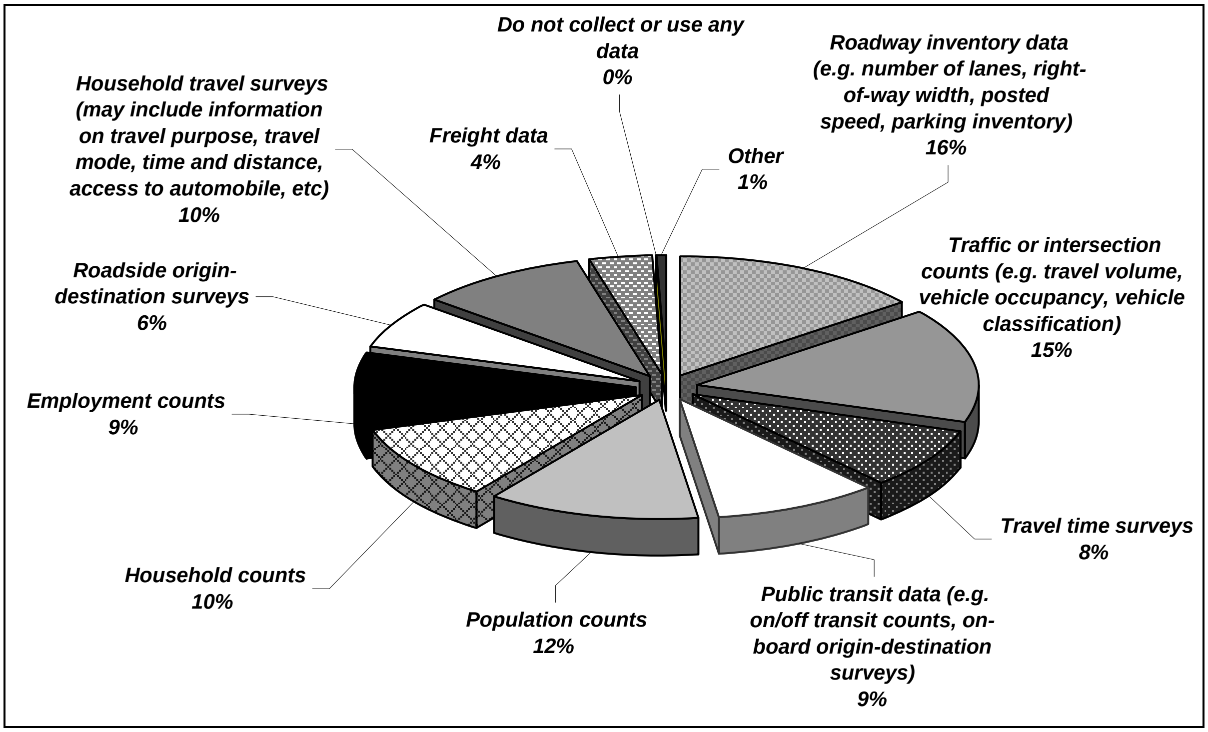
## B.3 TAC Briefings

### Exhibit B-10: Use of TAC Briefings



# B.4 Transportation Planning Data

### Exhibit B-11: Data Collection by Data Type




### Table B-10: Data found most useful

| Data type | Number of users | Percentage of respondents |
|---|---|---|
| Traffic or intersection counts | 51 | 94% |
| Roadway inventory data | 48 | 89% |
| Population counts | 41 | 76% |
| Household counts | 34 | 63% |
| Household travel surveys | 32 | 59% |
| Public transit data | 31 | 57% |
| Employment counts | 31 | 57% |
| Travel time surveys | 28 | 52% |
| Roadside origin-destination surveys | 21 | 39% |
| Freight Data | 12 | 22% |

## Table B-11: Most useful data by population size

| | Number of respondents by | | | | | |
|---|---|---|---|---|---|---|
| **Data type** | **Population under 50,000** | **Population 50,000 to 100,000** | **Population 100,000 to 250,000** | **Population over 250,000** | **Regions** | **Provinces /Territories** |
| Roadway inventory data | 10 | 9 | 11 | 4 | 8 | 6 |
| Traffic or intersection counts | 12 | 8 | 12 | 4 | 8 | 7 |
| Travel time surveys | 1 | 5 | 8 | 4 | 6 | 4 |
| Public transit data | 8 | 5 | 6 | 3 | 7 | 2 |
| Population counts | 9 | 5 | 11 | 4 | 9 | 3 |
| Household counts | 5 | 5 | 9 | 4 | 8 | 3 |
| Employment counts | 4 | 3 | 9 | 4 | 8 | 3 |
| Roadside origin-destination surveys | 2 | 3 | 2 | 4 | 4 | 6 |
| Household travel surveys | 1 | 6 | 8 | 4 | 10 | 3 |
| Freight Data | 0 | 1 | 2 | 2 | 2 | 5 |
| | | | | | | |
| | **% responding by respondent category** | | | | | |
| Roadway inventory data | 83% | 100% | 92% | 100% | 80% | 86% |
| Traffic or intersection counts | 100% | 89% | 100% | 100% | 80% | 100% |
| Travel time surveys | 8% | 56% | 67% | 100% | 60% | 57% |
| Public transit data | 67% | 56% | 50% | 75% | 70% | 29% |
| Population counts | 75% | 56% | 92% | 100% | 90% | 43% |
| Household counts | 42% | 56% | 75% | 100% | 80% | 43% |
| Employment counts | 33% | 33% | 75% | 100% | 80% | 43% |
| Roadside origin-destination surveys | 17% | 33% | 17% | 100% | 40% | 86% |
| Household travel surveys | 8% | 67% | 67% | 100% | 100% | 43% |
| Freight Data | 0% | 11% | 17% | 50% | 20% | 71% |

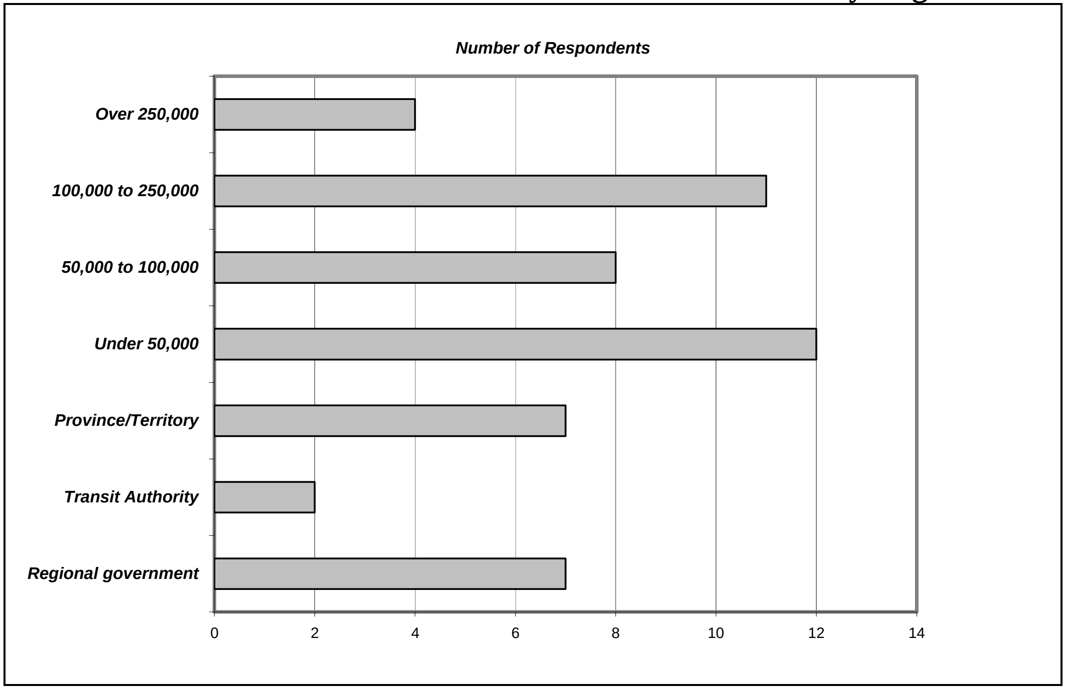
## Table B-12: Improvements sought for data collection process

| Name | Absolute Number | Percentage |
|---|---|---|
| Collect more data/more regular data | 7 | 14% |
| Increased funding/staff resources | 6 | 12% |
| Origin-Destination survey improvements | 5 | 10% |
| Traffic counting program improvements | 5 | 10% |
| Better sharing of data | 4 | 8% |
| Better freight data | 4 | 8% |
| Data organization improvement | 4 | 8% |
| Non-auto modes | 3 | 6% |
| GIS development | 3 | 6% |
| Improve validation | 3 | 6% |
| Travel-time surveys | 2 | 4% |
| New developments | 1 | 2% |
| Employment | 1 | 2% |
| Ramp counts | 1 | 2% |
| Transit users profile | 1 | 2% |
| Intersection camera data use | 1 | 2% |
| Occupancy surveys | 1 | 2% |

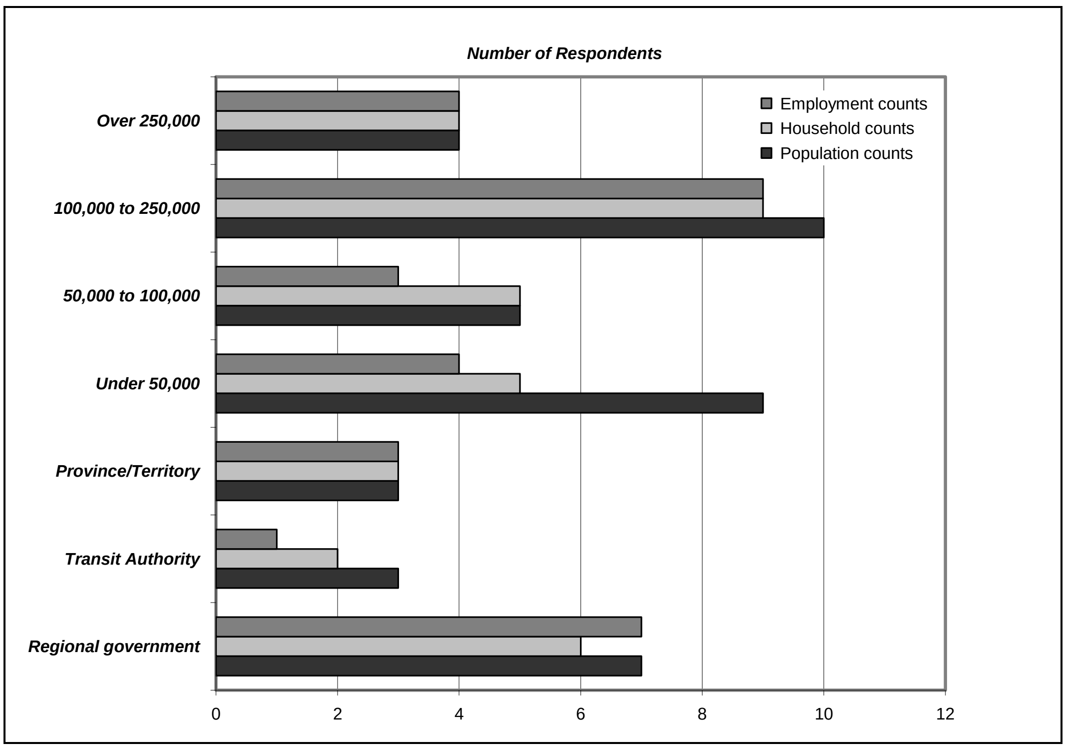
## Table B-13: Data storage tools

| Tool Name | Number of users | Percentage of respondents | Percentage of GIS users |
|---|---|---|---|
| ArcGIS/ArcView | 26 | 48% | 58% |
| Autodesk | 7 | 13% | 16% |
| MapInfo | 7 | 13% | 16% |
| TransCad | 6 | 11% | 13% |
| Intergraph | 5 | 9% | 11% |
| OracleSpatial | 3 | 6% | 7% |
| MapPoint | 1 | 2% | 2% |
| GeoTools | 1 | 2% | 2% |
| WebMap | 1 | 2% | 2% |
| Web-based open source GIS | 1 | 2% | 2% |
| Chameleon | 0 | 0% | 0% |

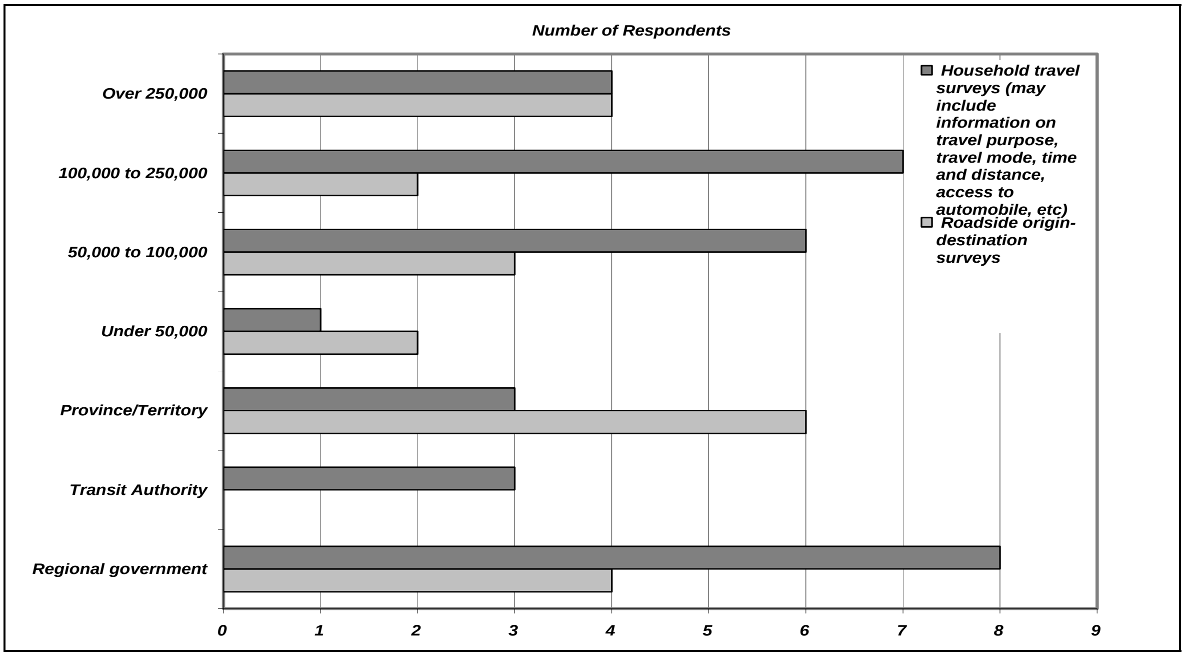
## Exhibit B-12 Traffic or Intersection Data Collection Efforts by Organization Category



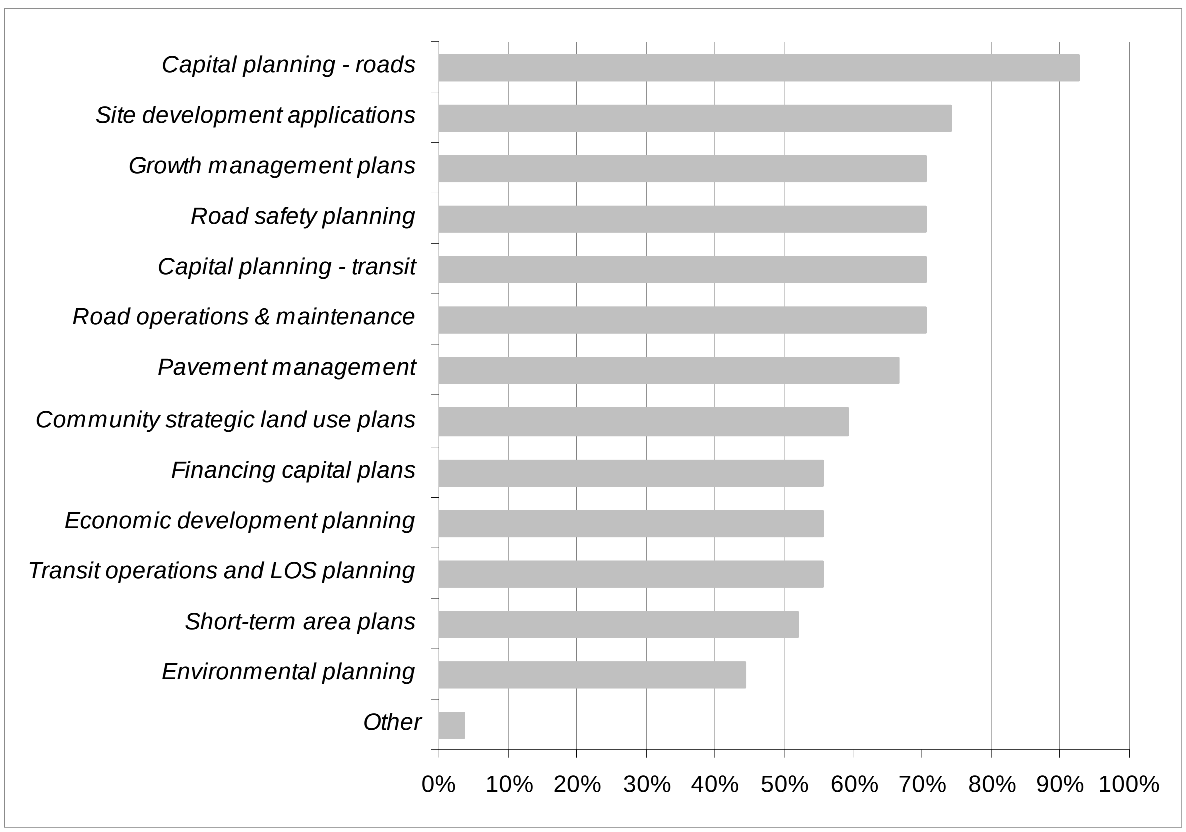

## Exhibit B-13: Land Use Data Collection Efforts by Organization Category



## Exhibit B-14 Survey Collection Efforts by Organization Category




## Exhibit B-15 Utilization of transportation planning data in ancillary applications



## B.5 Analytical Tools

**Exhibit B-16 Travel demand estimation methods**

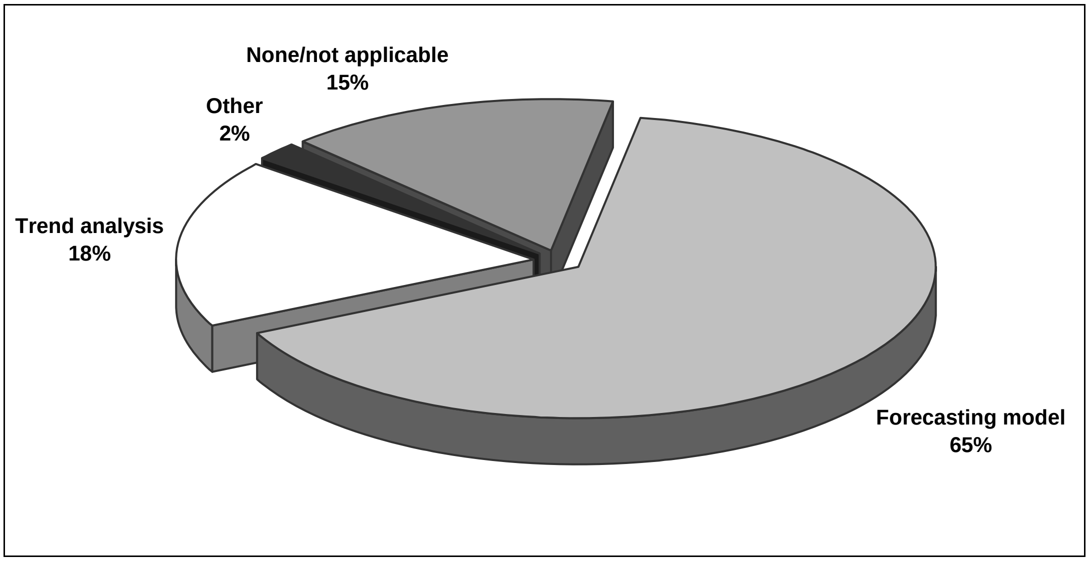
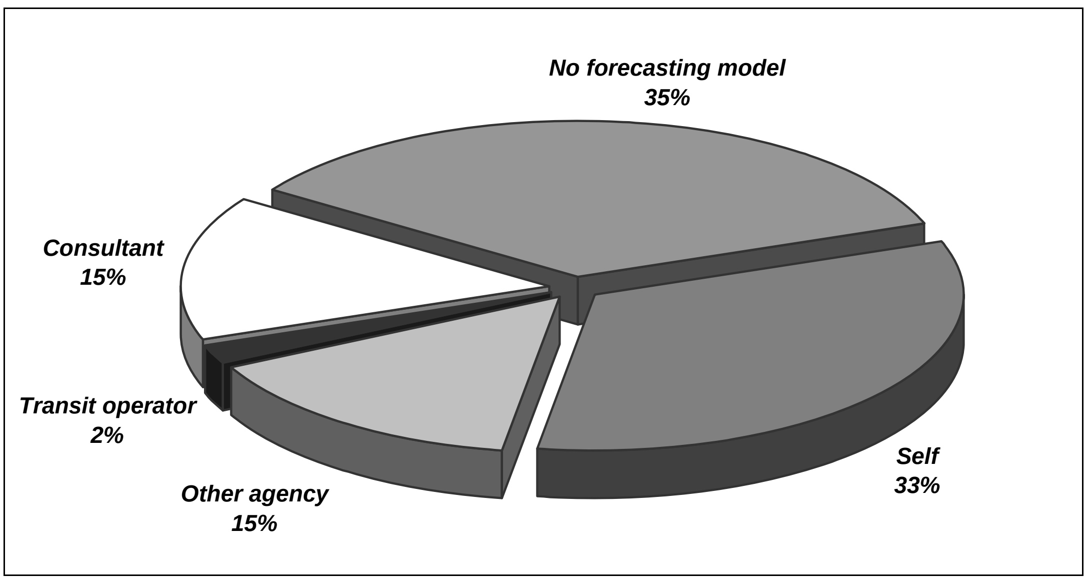



**Exhibit B-17 Forecasting Model Ownership**



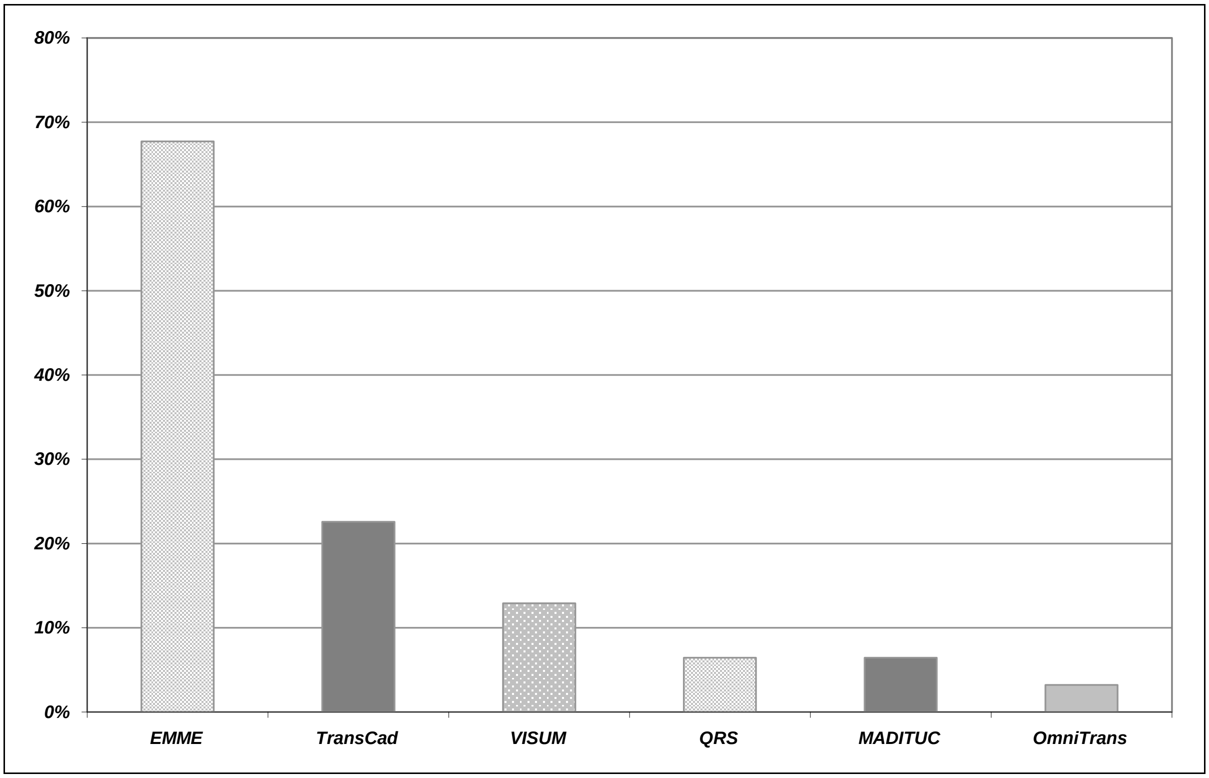
## Table B-14: Travel Demand Modelling Tools by Usage

| Tool Name | Number of users | Percentage of model users |
|---|---|---|
| EMME | 21 | 78% |
| TransCAD | 7 | 26% |
| VISUM | 4 | 15% |
| QRS | 2 | 7% |
| MADITUC | 2 | 7% |
| OmniTrans | 1 | 4% |

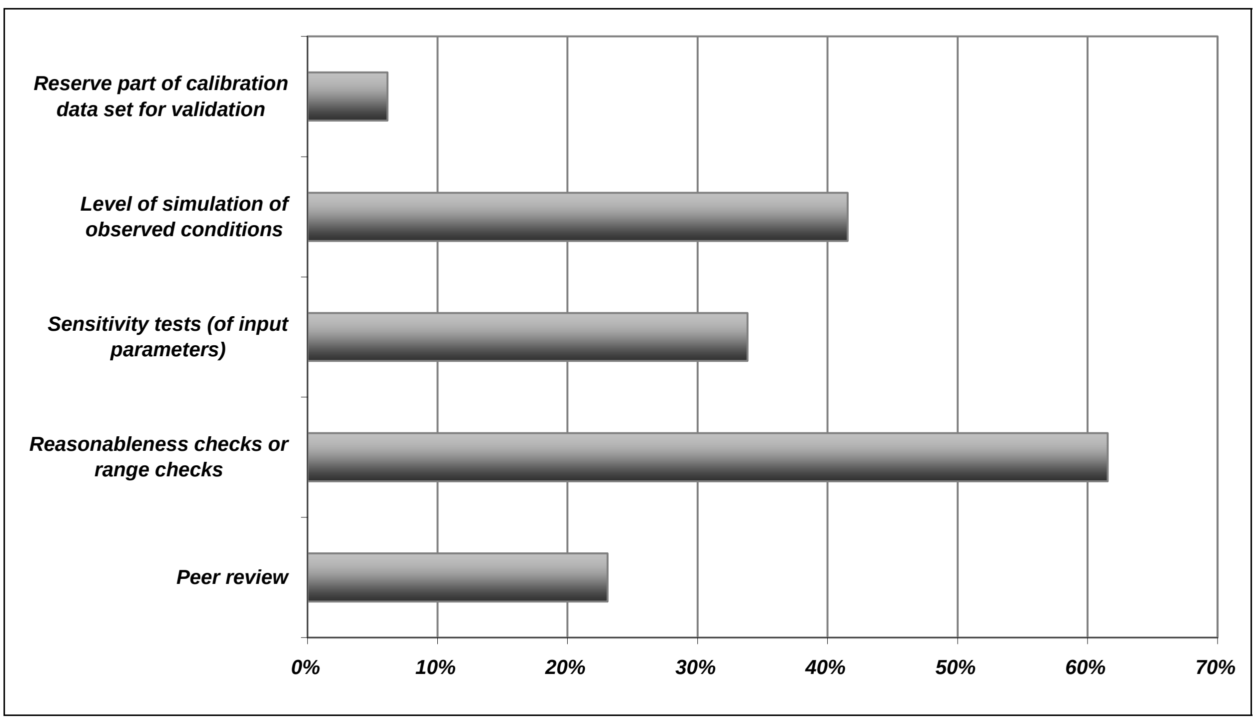
## Table B-15: Travel demand modelling tools by population size

| | Number of model users used by | | | | | |
|---|---|---|---|---|---|---|
| Tool Name | Population under 50,000 | Population 50,000 to 100,000 | Population 100,000 to 250,000 | Population over 250,000 | Regions | Provinces /Territories |
| EMME | 0 | 4 | 5 | 5 | 4 | 3 |
| VISUM | 0 | 1 | 0 | 1 | 0 | 1 |
| TransCAD | 0 | 0 | 1 | 0 | 3 | 1 |
| QRS | 0 | 0 | 1 | 0 | 0 | 0 |
| MADITUC | 0 | 0 | 0 | 0 | 1 | 1 |
| OmniTrans | 0 | 0 | 0 | 1 | 0 | 0 |
| | | | | | | |
| | % responding by respondent category | | | | | |
| EMME | 0% | 57% | 71% | 100% | 57% | 100% |
| VISUM | 0% | 14% | 0% | 20% | 0% | 33% |
| TransCAD | 0% | 0% | 14% | 0% | 43% | 33% |
| QRS | 0% | 0% | 14% | 0% | 0% | 0% |
| MADITUC | 0% | 0% | 0% | 0% | 14% | 33% |
| OmniTrans | 0% | 0% | 0% | 20% | 0% | 0% |

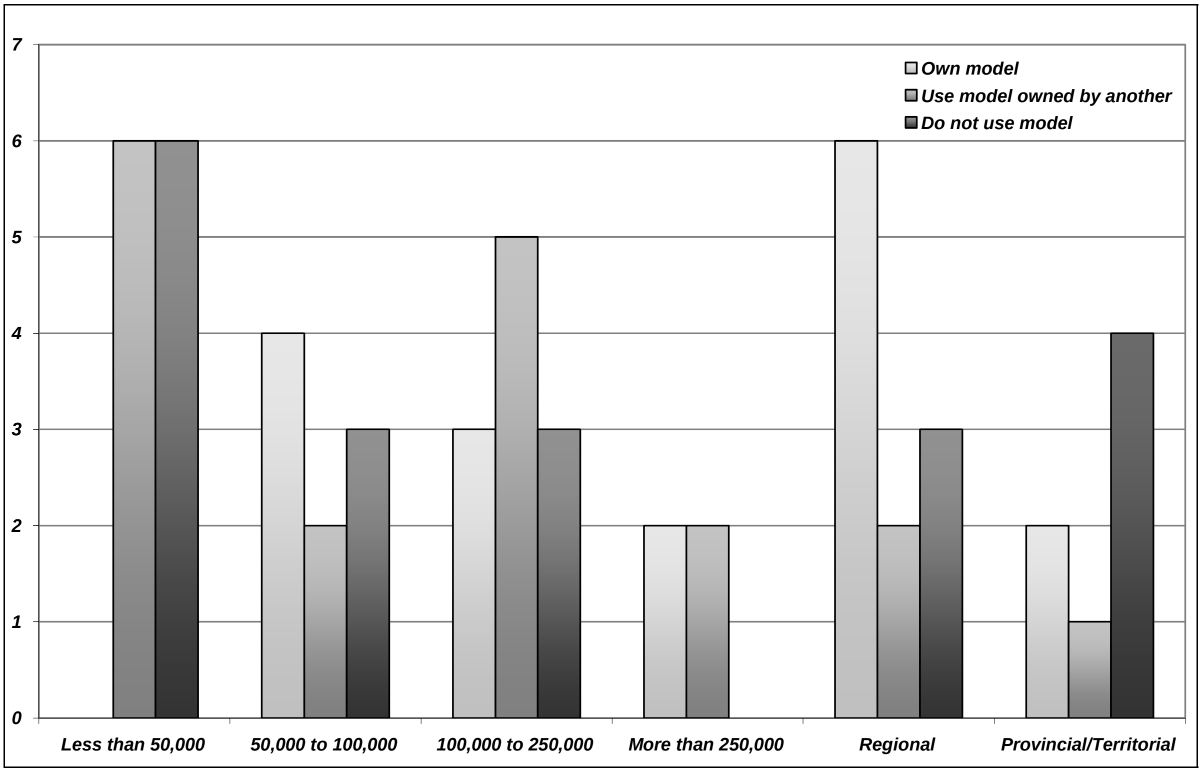
## Exhibit B-18: Travel demand modelling by usage



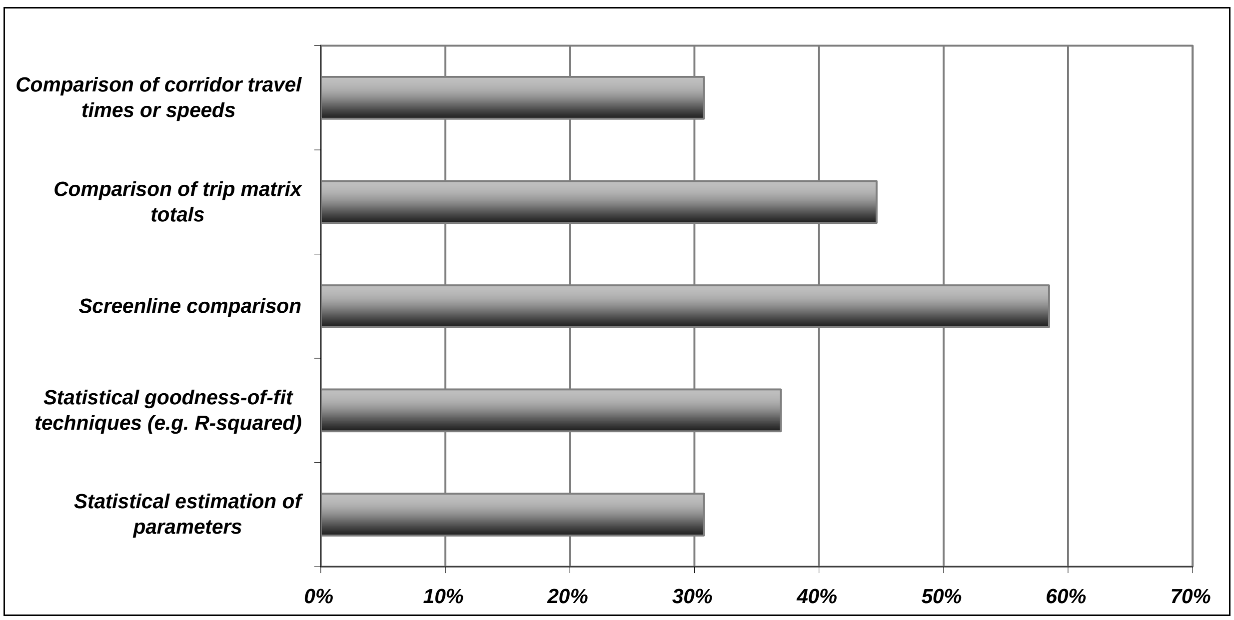

## Exhibit B-19 Model Validation Methods



## Exhibit B-20 Model Validation Methods by Type and Population Size



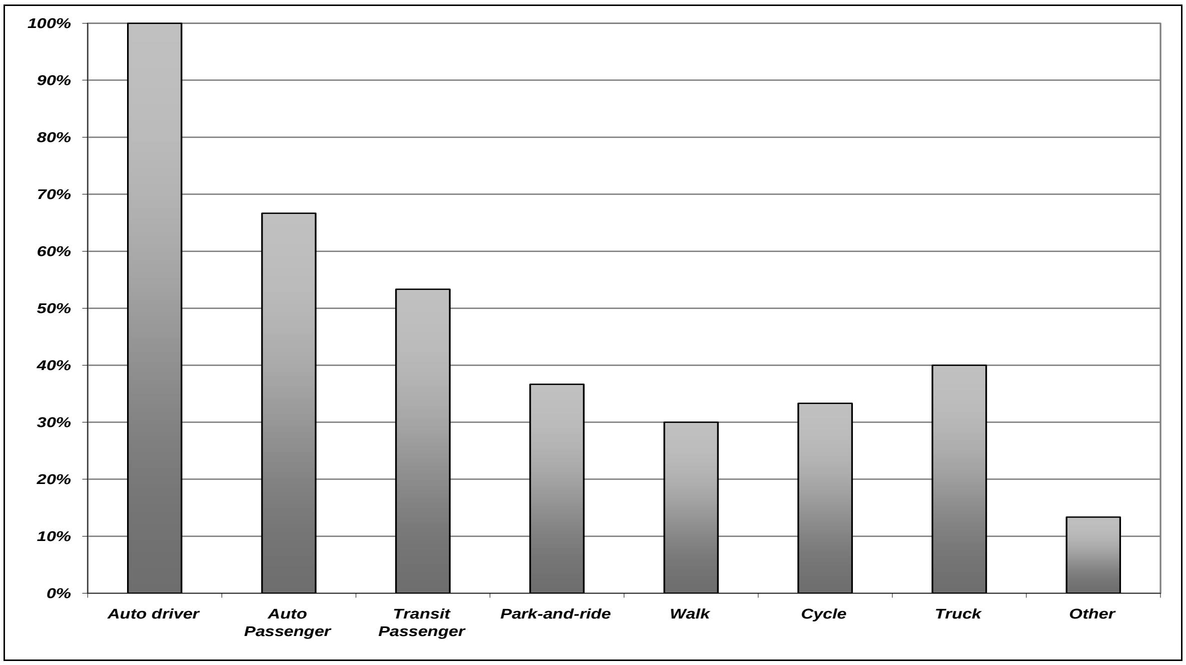

## Exhibit B-21 Model Calibration Methods



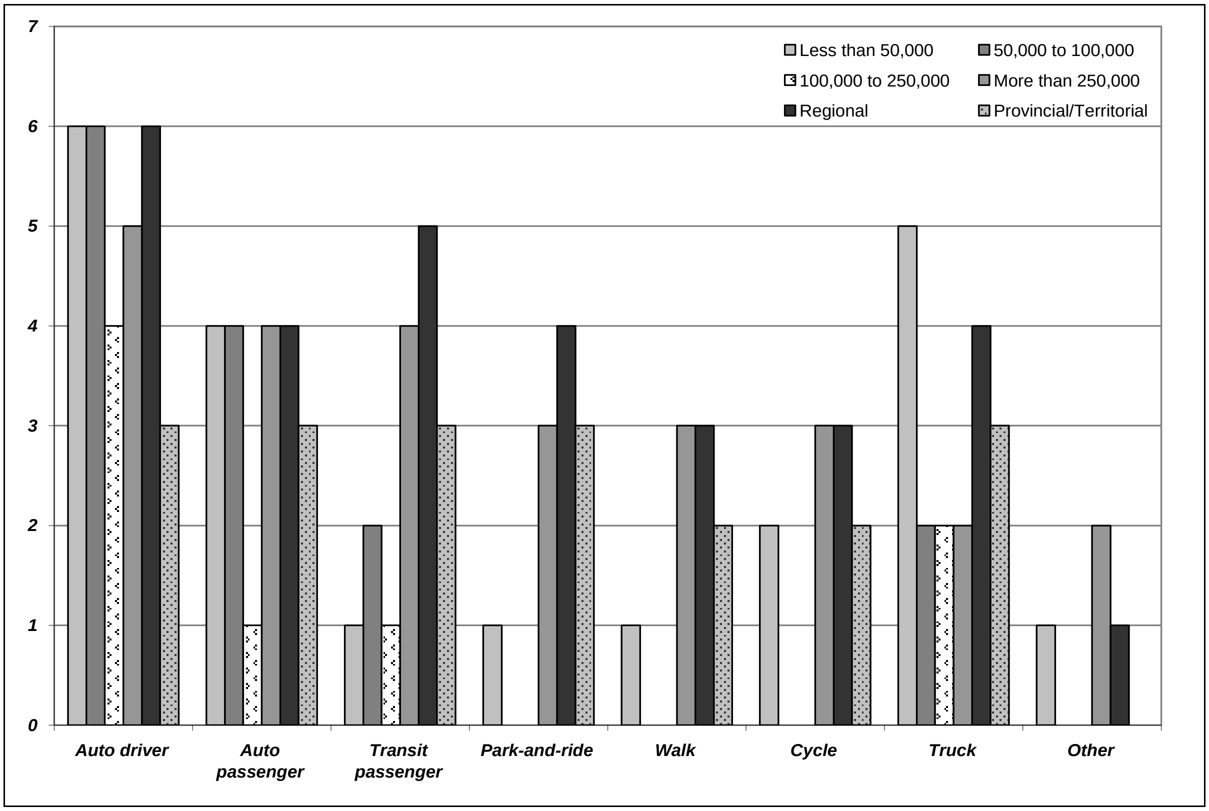
## Table B-16: Model updates, types and frequency

| Type of model update | Percentage | Number |
|---|---|---|
| Updates or changes in software | 8% | 3 |
| Expansion of coverage area | 6% | 2 |
| Increased zone detailing/density | 14% | 5 |
| Upgrades to auto and/or transit networks | 11% | 4 |
| Increased complexity of model | 17% | 6 |
| Recalibration/use of new land use data | 28% | 10 |
| Development of new horizon years | 6% | 2 |

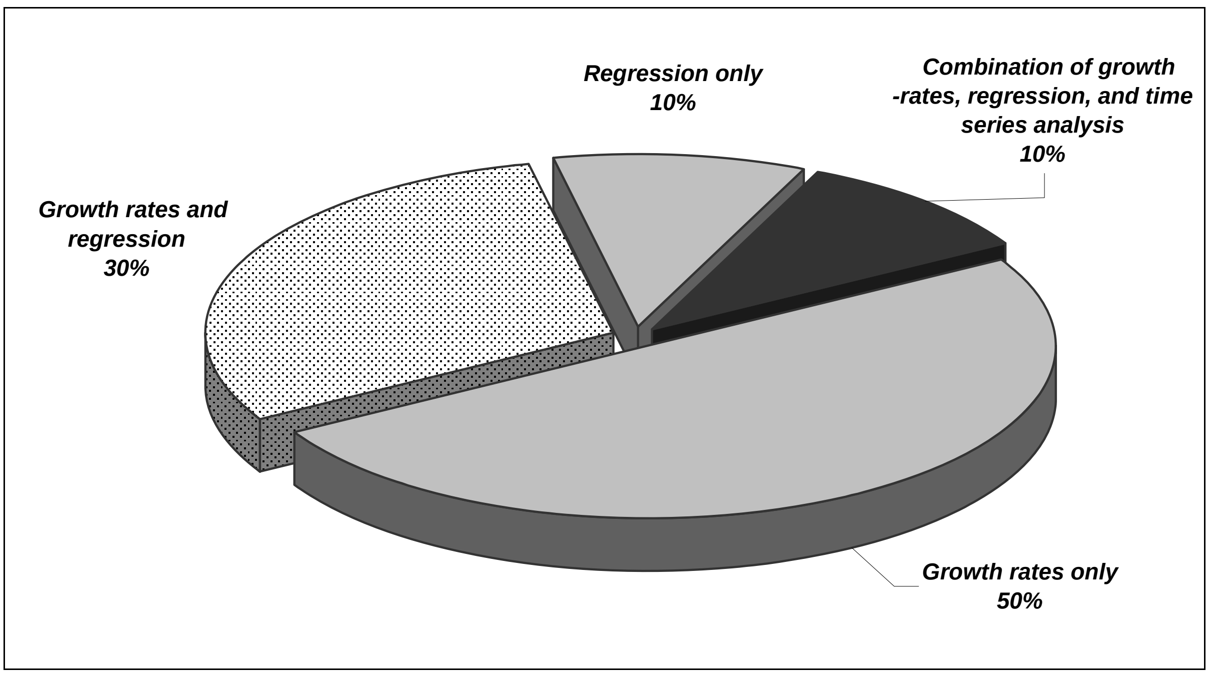
## Exhibit B-22 Modes Forecasted in Models



## Exhibit B-23 Modes Forecast by Type and Population Size




## Exhibit B-24 Trend Analysis Methods



## Table B-17: Operations/Signals/Micro-simulation tools by usage

| Tool Name | Number of users | Percentage of respondents |
|---|---|---|
| Synchro | 28 | 53% |
| Highway Capacity Software (HCS) | 19 | 36% |
| None | 17 | 32% |
| SimTraffic | 15 | 28% |
| Canadian Capacity Guide Software (CCG/CALC 2) | 9 | 17% |
| TRANSYT-7F | 7 | 13% |
| VISSIM | 6 | 11% |
| PASSER | 3 | 6% |
| CORSIM | 3 | 6% |
| Dynameq | 3 | 6% |
| Paramics | 2 | 4% |
| AIMSUN | 1 | 2% |
| SCOOT | 1 | 2% |

**Table B-18: Operations/Signals/Micro-simulation tools by population size**

| | Number of respondents used by | | | | | |
|---|---|---|---|---|---|---|
| **Tool Name** | **Population under 50,000** | **Population 50,000 to 100,000** | **Population 100,000 to 250,000** | **Population over 250,000** | **Regions** | **Provinces /Territories** |
| Synchro | 3 | 6 | 7 | 4 | 6 | 2 |
| Highway Capacity Software (HCS) | 1 | 3 | 5 | 3 | 3 | 4 |
| SimTraffic | 3 | 4 | 5 | 2 | 0 | 1 |
| Canadian Capacity Guide Software (CCG/CALC 2) | 0 | 2 | 1 | 2 | 3 | 1 |
| TRANSYT-7F | 0 | 2 | 1 | 2 | 1 | 1 |
| VISSIM | 1 | 1 | 2 | 2 | 0 | 0 |
| PASSER | 0 | 2 | 0 | 1 | 0 | 0 |
| CORSIM | 0 | 1 | 2 | 0 | 0 | 0 |
| Dynameq | 0 | 0 | 0 | 1 | 1 | 1 |
| Paramics | 0 | 0 | 0 | 2 | 0 | 0 |
| AIMSUN | 0 | 0 | 0 | 0 | 0 | 1 |
| SCOOT | 0 | 1 | 0 | 0 | 0 | 0 |
| None | 8 | 3 | 2 | 1 | 1 | 2 |
| | | | | | | |
| Synchro | 27% | 67% | 64% | 67% | 86% | 33% |
| Highway Capacity Software (HCS) | 9% | 33% | 45% | 50% | 43% | 67% |
| SimTraffic | 27% | 44% | 45% | 33% | 0% | 17% |
| Canadian Capacity Guide Software (CCG/CALC 2) | 0% | 22% | 9% | 33% | 43% | 17% |
| TRANSYT-7F | 0% | 22% | 9% | 33% | 14% | 17% |
| VISSIM | 9% | 11% | 18% | 33% | 0% | 0% |
| PASSER | 0% | 22% | 0% | 17% | 0% | 0% |
| CORSIM | 0% | 11% | 18% | 0% | 0% | 0% |
| Dynameq | 0% | 0% | 0% | 17% | 14% | 17% |
| Paramics | 0% | 0% | 0% | 33% | 0% | 0% |
| AIMSUN | 0% | 0% | 0% | 0% | 0% | 17% |
| SCOOT | 0% | 11% | 0% | 0% | 0% | 0% |
| None | 73% | 33% | 18% | 17% | 14% | 33% |

**Exhibit B-25: Operations/Signals/Micro-simulation tools by usage**

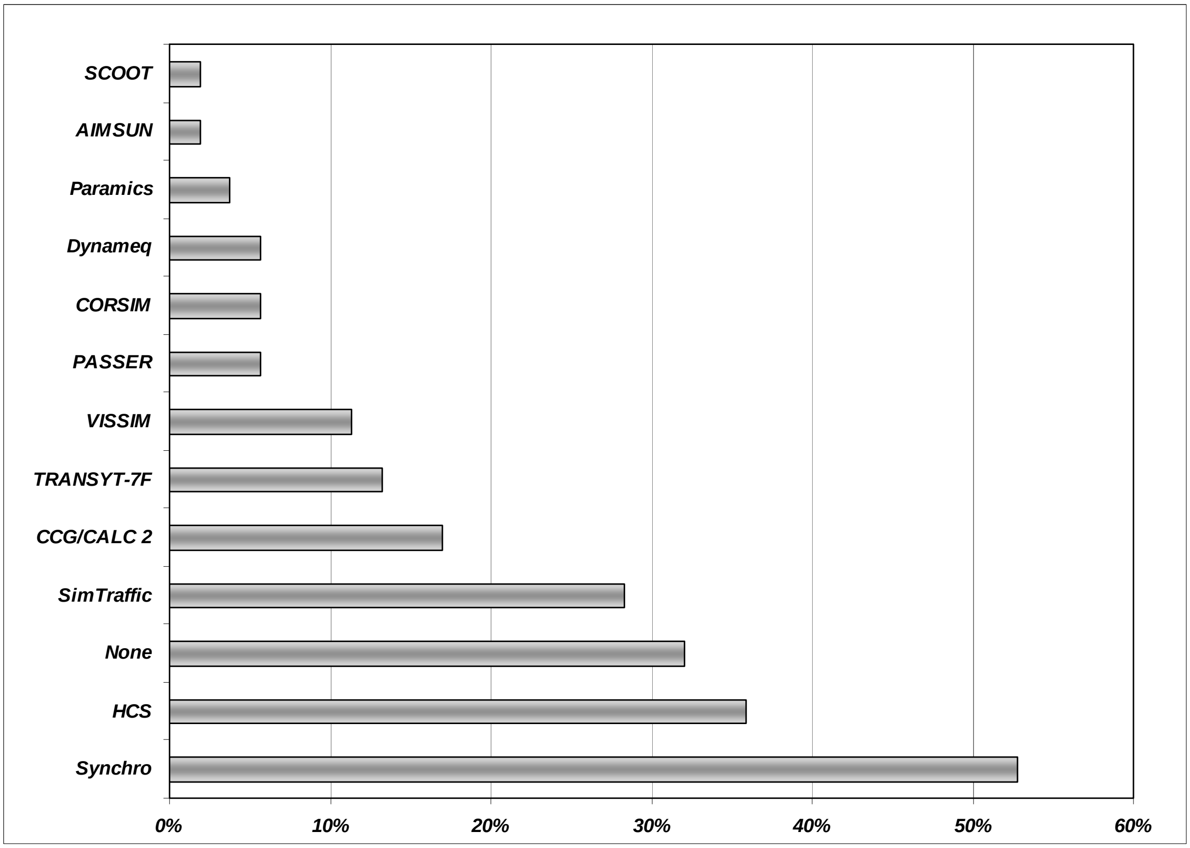


**Table B-19: Comments from the Practitioners, Survey Section 5**

| Agency | | Necessary improvements to methods and tools | Necessary improvements to data sources/collection | Contributing factors to success of process | Main problems with existing process | Technical limitations encountered |
|---|---|---|---|---|---|---|
| 1 | A reactive environment, very little proactive measures as a result of staff resources available and financial considerations. | Additional experienced staff with the purchase of specific software related to traffic. | See above | Knowledge of the City and various influences that affect traffic issues. | Financial considerations and political acceptance of changes. | Technical experience, qualifications, lack of current data. |
| 2 | Reasonably well | Need to be updated to reflect current issues. | Better sharing and collection of data. Better data on freight transportation. | Good defendable data Good public input and consultation process. | Inadequate funding and resources. Political acceptance. | Data availability Funding to hire experts. |
| 3 | Reasonably satisfied. Difficulty in getting the resources to run the program when required. | More available staff and/or consultants | More funds | Continual upgrading to the Transportation master Plan. | Funding availability | Insufficient staff level with the necessary experience. need to increase the salary grid levels to make this happen. |
| 4 | Deficient in modelling | Dedicated staff to planning, not stretched between planning, design and operations | Additional technical support staff | passionate staff, knowledgeable staff, engaged public | Staff have other responsibilities | Need modelling |
| 5 | Not meeting our needs for the following reasons: 1. Significant population and development proposals and plans outside City boundary need to be incorporated into City Transportation Plan Model. 2) Rapid developments and plan updates within City boundary demand model update. 3) Significant planned annexation areas around current City boundary need properly programmed development, zoning, utility and transportation plans. 4) Transportation demand management, transit, bicycle, walking and other alternative transportation mode usage in City need to be incorporated in Transportation Plan. 5) Freight traffic needs to be considered. 6) An integrated parking, transit, bicycle/walking trail, freight, and automobile transportation plan need to be conducted. These are conducted separately at present. 7) City needs to take control of the transportation planning model and provide ongoing model update in response to rapid development changes and overlapping development traffic influences. 8) City needs to develop / calibrate. | See comments in Section 5 Question 1 | See comments in Section 5 Question 1 | 1. Existence of a VISSIM transportation planning model that was created for the City for many years by our consultants; and the existence of well-prepared transportation plans every 5-7 year periods. 2. The existence of historical Transit Master Plan, Bicycle Trail Master Plans, Parking Master Plans, Major Area Structure Plans and Neighbourhood Area Structure Plans. 2. There is an established planning process among different city departments. 3. There is a reasonably extensive and consistent historical database on development, population, household, traffic etc. | See comments in Section 5 Question 1 | 1. Staff expertise needs to be developed to address the issues outlined in comments in Section 5 Question 1. 2. Consultant expertise is in high demand to meet the need of the rapid growth in Alberta. 3. The City is incrementally working through the issues outlined in comments in Section 5 Question 1. a) Acquired planning software models. b) Hiring and developing in house staff expertise. c) Incrementally developing, analyzing, surveying and expanding local traffic planning parameters and characteristics data. d) Incrementally assembling transportation planning data available from various sources for areas in the Central Alberta region. |
| 6 | Not well - need to develop strategic transportation plan over the next couple of years to get proper policies and methods in place. | Best practices from other organisations - tailored to our needs | Focus on performance of non-auto modes. | Strong administrative leadership | Alignment of staff, council, and public vision. | Funding |
| 7 | More integration with local municipal planning efforts would benefit - consideration for development impacts is required | Research and study of available information - further training and staffing | Migration towards GIS | Knowledgeable and experienced staff - supportive senior administration | Day to day workload influences on planning projects | Data integrity and delays in receipt of data from sources |
| 8 | Proactive transportation planning at the county/regional level is a fairly new role. We are still trying to determine the most efficient means of gathering, maintaining and utilizing transportation information. | More experienced staff. Transportation forecast model/software | | | There is a lack of existing polices/standards/guidelines to sufficiently and defensibly address the challenges that we face with various development proposals. | |

**Table B-19: Comments from the Practitioners, Survey Section 5**

| Agency | | Necessary improvements to methods and tools | Necessary improvements to data sources/collection | Contributing factors to success of process | Main problems with existing process | Technical limitations encountered |
|---|---|---|---|---|---|---|
| 9 | Our tools are reasonably adequate for the level of sophistication (or lack of it) of our system. An asset management system would be of great benefit. | Commitment at decision level to accept and act on plan results and to support long term planning. | Integration of existing asset management systems and addition of data for assets not now covered. | A small jurisdiction requires few planning resources as the volume of data is not large. Experienced staff with local knowledge. | Lack of commitment by decision makers. | There are no specific limitations. |
| 10 | The Durham Regional Transportation Planning Model (DRTPM) broadly meets needs for the development and monitoring of broad, strategic transportation initiatives such as the Transportation Master Plan and Community Strategic Plan. The Region is working to address additional needs that are currently deficient, such as simulating transit, preparing 5 and 15-year forecasts (i.e., 2011 and 2016) to help identify timing of infrastructure needs, and the ability to model alternative modes and goods movement. The Region would like to have the ability to improve trip assignment capabilities on the network, improve volume-delay functions, improve zone definitions as part of the Places to Grow conformity exercise, and bridge the gap between traffic operations and long-range planning through microsimulation capability. | - Enhancements to Durham Regional Transportation Planning Model (DRTPM) - Micro-simulation capability Travel time surveys for improving volume/delay Functions - Long-range modelling for transit | - Employment inventory - Goods movement survey - Updates to transportation zone definitions - Enhanced land use and network data in GIS; can be used to improve model As well - Improved access to Works traffic data for long-rang | - In-house, dedicated modelling staff - Good working relationships with other departments and sections (Works Department design, traffic, infrastructure staff, Durham Region Transit, Current and Policy Planning branches) - Regional transit | - Some projects are split between Works and Planning departments; even with good ongoing communication it is tricky coordinating findings amongst all staff involved - Funding/budgeting process in prioritizing projects is an Important factor that ca | - Data availability in terms of goods movement, more detailed transit ridership data, network data in GIS - we continue to investigate opportunities to improve our data sources through new projects and funding - Data sharing between departments is |
| 11 | They are meeting our needs, but the consulting community sometimes needs more assistance and guidance than felt should be required. | | Incorporate interchange ramp counts into the annual programs. | Sustained commitment of resources on given projects (ie. not bouncing around to the hot spots). | Committing resources to the completion of corridor preservation for medium/long term corridors/improvements identified in the studies. | Staff and consultant expertise. Training of staff is needed. Not sure on the consultant side. |
| 12 | The tools and methods are there. It is the data required that is lacking. | We require a long range strategic plan for planning methods and tools to be effective. | Origin Destination data | We have not yet reached the level of congestion which would drive a more rigorous planning regime. Also funding is there. | The rising cost of implementation | Technical limitations are being addressed by the evolution of projects into more complex undertakings thus the business case for improvements in expertise and availability can be presented and action taken. |
| 13 | Fairly well; deficiencies more to do with lack of understanding of tool limitations. | Stronger, more rigorous tools. | More funding for data collection, more staff dedicated to data collection. | Linked to regional growth strategy, comprehensive approach, standard evaluation process, consultation processes. | Compressed timelines, lack of resources. | Lack of staff resources, too many demands on existing staff. |
| 14 | Long-term planning forecasting and infrastructure are meeting needs. There are challenges to short-term turning movement forecasting for operational analysis. We do not have the ability to forecast alternative modes easily. | Increase ability to use micro-simulation for short term planning. Manage supply and demand to encourage model shift. Clear identification of modal priorities. | Improve OD data for external/internal trips. Update trip making information for all modes. | A Transportation Master Plan that has been embraced by staff, politicians and the community. An integrated organizational structure that breaks down silos. Successful forecasting that does not cause over design of infrastructure. | Diverse opinions on priorities on a project specific basis. Lack of staff resources. | Data availability is an issue...we are performing Transit OD survey in the fall and we are waiting for the release of the TTS data. Consultant expertise...we are experiencing issues with quality control. |
| 15 | No deficiencies at this time | Funding | Unknown | Partnerships, data collection | Rigorous planning process and public input | None |
| 16 | Well enough. | None | Additional resources to evaluate data. | Historical community knowledge. Sound City Council leadership. | Funding from senior levels of government. | None |

**Table B-19: Comments from the Practitioners, Survey Section 5**

| Agency | | Necessary improvements to methods and tools | Necessary improvements to data sources/collection | Contributing factors to success of process | Main problems with existing process | Technical limitations encountered |
|---|---|---|---|---|---|---|
| 17 | Our tools are currently deficient in transit operations analysis and planning, park-n-ride activities, household structure-based trip generation, trip chaining and distribution, mode choice between transit modes, non-motorized modes, commercial / truck trips, external travel. | Overhaul of the travel forecasting model (under way); increased knowledge of available methods, tools, practices | Data sources and collection OK. | Increased richness of data available, improvement to analytical tools | Knowledge of and about the analytical tools available | Locally-restrained staff and consultant expertise |
| 18 | Currently they meet our needs and we are able to us consultants to assist us in overcoming our deficiencies | More staff | More staff | Experience and knowledge of the community | More staff is required | As we grow the need for additional staff and organizational restructuring will be needed |
| 19 | Staff resources so that instead of responding to complaints and reviewing studies, we can be more proactive in identifying areas where we can initiate emerging ideas. | Staff resources and capital funding | Improvements to the operation of our database and integration with the collision data | Support from Council and CAO | Time and Resources | Data and in particular the analysis and the streamlining of how each municipality within the Region interprets the data, e.g. collision data |
| 20 | Some | Call | Call | Many | People | Expertise |
| 21 | For the size of Moose Jaw, the current practices work well for transportation planning, we could do more planning and more detailed planning, which would assist but is not necessary. | Additional staff to manage the transportation planning, we are currently very reactionary. | Collect new data that is not currently collected. | Small size of the transportation network has been in our favour with the limited staff. | Not enough resources to do it properly. | Staff and resources availability. |
| 22 | | | | | | |
| 23 | Have met needs quite well. New TransCAD platform will resolve issues related to GIS integration with transportation modelling. Looking at developing a mesoscopic micro-simulation capacities for major corridor and land use developments. This would probably be purchase of TransModeler two or three years from now. | Inter-Municipal and inter-Agency integration good. Currently working with Municipalities and other Regional agencies to enhance integration | More centralized and rationalization of data collection by Municipalities and regional transit agency. Currently working with staffs on this initiative. | Good relations with staff from Municipalities and other Regional Agencies and good communication. | No major problems | Data availability for studies to address public demand for information. Currently working with staff from Municipalities and other Regional agencies to integrate data. |
| 24 | Current methods / tools work well. In longer term may need to develop additional models to account for land use planning / transportation planning interaction. | Ongoing need to upgrade tools to keep up with state of the art. increasing focus on micro-simulation of individual / vehicle travel. | Major surveys only conducted every 10 years or so. there is a lack of guaranteed funding / timing for future surveys. network performance as measured by actual travel times experienced by public an increasingly emergent issue. | Adequate resources provided to do the job; plus strong leadership shown within organization for importance of good planning. | Difficulties in co-ordinating administration efforts wit changing political priorities. lack of funding to implement identified needs. | Attracting / retaining qualified staff an issue. organization needs to be seen as a worthwhile place to work. |
| 25 | Deficient in details regarding transit usage on a stop by stop or zone basis. Deficient in the in-house ability to update or modify Transportation Model. | dedicated staff to transportation planning | Co-ordination of data and accessibility to others | All under one city...no region | Lack of political will to examine changes in technology. | Staff expertise and data availability |
| 26 | A consultant completed a transportation study for us in 2003. Since that time, we've just been able to maintain traffic counting programs. We plan on fully updating the Study every 5-10 years. Its okay for now, but we dont have as much data as we'd like. | Establishment of a firm traffic counting program that covers every area of the City in a reasonable amount of time. | More analytical and design guides. | 2003 Transportation Study, previous data. | Nothing is really organized; traffic counts not done nearly often enough. | Staff expertise, data availability |
| 27 | Fair transportation master plan not complete | Funding | Updated road needs study | Experience of staff | Workload | None |

**Table B-19: Comments from the Practitioners, Survey Section 5**

| Agency | | Necessary improvements to methods and tools | Necessary improvements to data sources/collection | Contributing factors to success of process | Main problems with existing process | Technical limitations encountered |
|---|---|---|---|---|---|---|
| 28 | Our planning methods are more operational driven. The Region does more master planning. | Need for modelling at the local level | | Tend to be smaller community based | Can't program larger city wide reviews | Staff expertise |
| 29 | Transportation planning has not happened in the past. We are in the process of reorganizing the Transportation Engineering Section to provide these services, however, it will be another 2 to 3 years before staff resources, training and systems are all in place. In the mean time, we rely on Waterloo Region. | Recruitment of new manager (vacant position) with education and experience in trans planning, addition of future FTE in 2010 for trans modelling, etc., purchase of software and systems, training, revisions to OP to include transportation issues, etc. | More data as funding permits. | Buy in by council and other stakeholders. Comprehensive approach on a city wide basis. | Limited tools. | GIS is very advance. We use TES to store traffic and collision data, which directly interfaces with the GIS. |
| 30 | Analyse d'opérations bsé sur une recherche locale. | Analyse et étude des circuits de transport permettant de maximiser le nombre d'utilisateur. | Étude sur le niveau économique de la population qui utilise le transport en commun. | Le nombre d'heure de service des circuits. | La détermination optimale des circuits de transport | Expertise locale manquante. |
| 31 | For the most part our existing transportation planning methods and tools meet our needs. Consultants are used in complex situations. | I believe that their is a need to address the demographics and the fact that the department will be losing a number of staff through retirement. This will lead to a loss of knowledge and therefore training opportunities will be needed into the future. | No gaps. | The major factor is collaboration with stakeholders. Technical abilities of the planners Availability of data Manipulation and presentation of data | time to consult with all stakeholders. | No major problems to date, however with the demographics of the staff, knowledge will be lost through retirements. Rigorous learning plan will be developed for all staff to ensure this "problem" is mitigated. |
| 32 | Reasonable, improvement could be made in investment decision making | | | involving public and council | special interest groups | |
| 33 | Scale 1(bad) - 10 (excellent) : 6 Data collection | | Better data collection | Staff expertise Help from provincial and federal agencies | Lack of funding and political issues. | Data availability Updated hardware and software systems. Don't know |
| 34 | Only work when Council agrees and commits to the plan recommendations | Regular updates of studies, | Regular collection of information | Council willing to buy in to consultant's recommendations. | Short range vision | Consultants do not listen to local input |
| 35 | For most needs the transportation planning tool and methods are sufficient. However better travel survey information is needed and for transit planning better methods of collecting on board ridership especially for buses is needed | As previously noted | None | A transportation plan with strong support from Council | Don't know | Very few technical limitations. |
| 36 | Current tools are sufficient for our needs. | | Additional information on trip origin/destination, household travel info would be useful. | Staff with historical knowledge of area. New staff trained in most recent methods. | Importance between transportation and planning not fully recognized. Need transportation to be involved from very beginning of any process. | |
| 37 | Most of the transportation planning is currently contracted out to consultants with the final decision - making being done in house, this process has worked well for us. We do traffic count collection in house and use the data to address specific problems. | Further data collection | Fully utilize data from camera controlled intersections. | | | |
| 38 | Inadequate qualification or lack of experience of staff makes advancement in techniques and tools difficult. Increasing sophistication of public enquiries require more resources. | More training and qualified staff. | Consistent methods and better validation of collected data. | Flexible and adaptable to emerging issues. | Political realities and development pressures do not always align with community desires. | Staff expertise, consultant expertise and data availability. Better process for hiring, procurement and data collection and dissemination. |

**Table B-19: Comments from the Practitioners, Survey Section 5**

| | Agency | Necessary improvements to methods and tools | Necessary improvements to data sources/collection | Contributing factors to success of process | Main problems with existing process | Technical limitations encountered |
|---|---|---|---|---|---|---|
| 39 | They are good. | More Staff and tools | More staff | Good design | Fast development | Staff |
| 40 | Adequate, but limited staffing prevents a more proactive and innovative approach | Staffing expertise | More detailed collection | Staff dedication | Need for higher level support for longer term transportation planning | Staff expertise Consultant expertise |
| 41 | MODEL DEVELOPMENT IS MAINLY DONE BY CONSULTANTS OFF SIGHT. THIS MAKES IN-HOUSE EXPERTISE TOUGH TO ACQUIRE. WORKLOAD IS SO HEAVY THAT WORK IS FARMED OUT DUE TO SHORT TIMELINES. | | | | TOO MUCH CONSULTANT INPUT | MORE TRAINING SESSIONS, AND ABLE TO HIRE ADDITIONAL STAFF AS CORPORATION GROWS |
| 42 | notre méthode de travail est bien développé,toutefois plusieurs outils sont à développer afin d'améliorer notre planification à long terme | compteurs permanents | relevé de circulation en permanence | personnel qualifié et des données à jour | données à jour | données à jour |
| 43 | There is a need to provide forecast traffic volume and growth information at a more detailed level of analysis. | possibly investing in a micro simulation transportation model | Better integration of traffic data and our GIS system. | | | |
| 44 | Travel demand forecast helps in defining long term plans. | Operational analysis require further sophistication by using car following theory techniques. | Occupancy Surveys, Roadside OD Surveys | Data availability, proper travel demand and performance measurement tools | Disconnection of TDF from some of the capital plans - Not enough software tools to simulate future conditions | Limitation in number of staff members |
| 45 | Our transportation planning methods meet our needs as a municipality and some instances have been used to meet the needs of the region as a whole. | N/C | Would like to have the funding to have more complete traffic count information collected on a regular basis. | Good staff and knowledgeable consultants | Council support | Data availability...... plans to address have included annual requests for addition operational funding for count programs. |
| 46 | Insuffisance majeure pour le volet des déplacements commerciaux (camionnage, biens et services) car il n'existe pas d'enquêtes O-D;, Limitations majeures des modèles statiques dans le traitement des conditions de congestion.<br><br>*Major insufficiency in commercial trips (trucking, goods and services) due to a lack of OD surveys. Major limitations in static models in the treatment of congested conditions.* | Nécessité de prendre en compte les déplacements commerciaux: requiert enquêtes spéciales., Prise en compte dynamique de la congestion et de l'étalement des heures de pointe.,<br><br>*It is necessary to take into account commercial trips: these require special [OD] surveys. Take into account a dynamic [analysis] of congestion and peak spreading.* | Besoin de plans de comptages systématiques et classifiés dans les régions urbaines (approche de lignes-écran avec comptage de tous les déplacements véhicules et personnes)., Besoin de relevés de temps de parcours systématiques., Données de génération des déplacements aux sites industriels et commerciaux.<br><br>*Need for systematic plans for classification counts in urban regions (at screenlines, counting all vehicles and occupants). Need for systematic travel time surveys. [Need for] trip generation data at industrial and commercial sites.* | La richesse de nos Enquêtes O-D (ménages) permet des analyses très robustes. Elles constituent la pierre angulaire de notre processus.<br><br>*The richness of our household OD surveys permits very robust analyses. These constitute the cornerstone of our processes.* | Difficulté d'obtenir des consensus sur les hypothèses d'aménagement entre tous les intervenants dans une région., Difficulté de prévoir l'évolution de l'emploi. , Difficulté d'obtenir des données de comptage assez complètes pour bien valider les modèles.,<br><br>*Difficulty in obtaining consensus on processes(?) among all the interests in a region. [referring to government agencies] Difficult to predict the evolution of employment [of the economy]. Difficult to obtain count data that are complete, in order to valid well the models.* | Le manque de données, le manque de temps et les limites dans les ressources humaines et financières obligent souvent à limiter la portée des études techniques. , Une des limites importantes concerne le manque de données pour les déplacements autres que ceux des personnes; les données de déplacements commerciaux sont rares et souvent incohérentes (i.e. modes camion, train, maritime et aérien). ,<br><br>*The lack of data, lack of time and limitations on human and financial resources in turn limit the ability to do technical studies. One of the important limitations concerns the lack of data on trips other than trips by persons; commercial trip data are rare and are often inconsistent [i.e., data for different modes are inconsistent with each other].* |

**Table B-19: Comments from the Practitioners, Survey Section 5**

| Agency | | Necessary improvements to methods and tools | Necessary improvements to data sources/collection | Contributing factors to success of process | Main problems with existing process | Technical limitations encountered |
|---|---|---|---|---|---|---|
| 47 | Les outils nous permettent de faire beaucoup de choses mais il reste encore du travail à faire en ce sens pour obtenir plus de précisions. Il reste certains programmes de suivit des nouveaux projets à mettre en place pour une meilleure évaluation des retombées de ces projets, selon le type de projets.<br>*The tools permit us to do many things, but more work is needed to obtain more precise results. Certain new projects must be put in place to [allow us to] obtain a better [means of evaluating projects, i.e. using the results of these tools], according to the type of project.* | Nous aimerions pouvoir planifier pour les périodes hors pointe avec notre logiciel de modélisation.<br>*We would like to be able to plan for off-peak hours with our model.* | Nous sommes en train de préparer l'enquête OD 2008 et la collecte de données sera très certainement améliorée car elle l'est à chaque enquête OD. Je n'ai pas encore les améliorations précises qui devront être apportées par contre. Mais le plus de données nous aurons et la meilleure planification nous pourrons faire.<br>*We are in the process of preparing a 2008 OD survey, and the data will be improved, as it is with each [successive] OD survey. I cannot identify any specific needs. But the more data we have, the better the planning we can do.* | Nous utilisons une enquête totallement désagrégée, c'est à dire qu'elle est précise au code postal ce qui nous donne beaucoup de détails et de précisions. Nous avons des personnes très compétentes dans la planification du transport et dans les bases de données, ainsi que des gens qui connaissent très bien le réseau montréalais. Le travail d'équipe multidisciplinaire aide aussi beaucoup en jumelant des gens plus analytiques à des personnes plus opérationnelles.<br>*We use a totally disaggregated survey; that is, at the [individual] postal code, which gives us much detail and precision. We have very competent [staff] in transport planning and in databases, as well as people who know well the Montreal transportation network. The multidisciplinary work team also helps a lot in twinning analytical staff with operational staff.* | Nous avons une méconnaissance des différents projets de développement à Montréal et nous ne sommes pas encore assez impliqué dans ces processus pour développer le transport en commun dans de nouveaux endroits à Montréal. De plus, nous avons un manque de disponibilité d'autobus qui nous empêche de mettre en oeuvre de nouveaux services aux heures de pointe.<br>*We have a lack of awareness of different [transit?] development projects in Montreal, and we aren't involved any longer in the processes used to develop public transport in Montreal. As well, we lack the buses that we need to implement new peak period transit service.* | Pour les projets de développement nous allons instaurer un processus avec la ville de montréal, qui impliquera la STM dans les différents projets. Pour des projets de réseau prioritaire ou de voies réservées, il nous manque de l'expertise en circulation que nous devons aller chercher chez des consultants. Le manque de ressources devrait aussi diminuer par l'embauche de plusieurs personnes cet automne.<br>*For [transit?] development projects, we have a implemented a process with [staff at] the City of Montreal which then involves the transit authority (STM) in different projects. For priority treatment projects or reserved [bus] lanes, we lack expertise in traffic [operations or engineering] that we must find with consultants. This lack of resources will diminish this autumn (2007) with the hiring of new people.* |
| 48 | Manque de données, mise à jour périodiquement,manque de personnel expérimenté pour EMME-3.<br>*Lack of data, updated periodically, lack of staff who have experience with EMME-3 [newest version of EMME/2].* | Manque de données, de personnel qualifié et de connaissance EMME-3<br>*Lack of data; lack of staff qualified in understanding EMME-3.* | Besoin de constance dans nos collectes de données (mise à jour).<br>*Need for "constant" in our data collection (updates) [i.e., the data collection programme is ad hoc; need to have a regular, ongoing and commitment data collection & update programme].* | Collaboration avec les partenaires.<br>*Collaboration with [our] partners* | Disponiobilités financières.<br>*Financial [funding] availability.* | Disponnibilité de données., Données EMME - 3.<br>*Availability of data, and of EMME-3 data.* |
| 49 | Répondent assez bien (80%).<br>*Pretty good (80%)* | Sera analysé suit à la planification stratégique actuellement en cours de réalisation<br>*Will be analyzed after[a] strategic planning [exercise] now underway. [Not sure if this refers to a TMP or to a data plan, or to some other strategic plan. – I think TMP.]* | Améliorer la fiabilité des données<br>*Improve the reliability of the data* | Qualité des consultants<br>*Quality of consultants* | Manque de ressources internes<br>*Lack of internal resources* | Disponibilité des données, il n'est pas toujours facile de les rassembler.<br>*Availability of data, it's never easy to assemble [these data].* |

**Table B-19: Comments from the Practitioners, Survey Section 5**

| Agency | | Necessary improvements to methods and tools | Necessary improvements to data sources/collection | Contributing factors to success of process | Main problems with existing process | Technical limitations encountered |
|---|---|---|---|---|---|---|
| 50 | satisfaits mais enquêtes OD devraient être plus fréquentes, plus de budget serait requis pour installation d'appareils de mesure de volume ou vitesse ou de comptages de passagers (GPS)<br><br>*Satisfactory, but OD surveys must be more frequent; more budget is needed to install equipment that measures volume, or speed or passenger counts (GPS).* | outils apparaissent satisfaisants, mais leur fréquente d'utilisation pourrait être plus importante<br><br>*Tools appear satisfactory, but [increasing] the frequency of their use [i.e., of the use of the existing tools] might be more important* | avoir des postes de comptage permanents, régularité dans l'obtention des données, avoir plus accès aux STI dans nos projets<br><br>*Have permanent counting stations; regularity in the [frequency] of obtaining data; have more access to ITS [?] in our projects [i.e., to data that can be gathered from ITS]* | accès à peu de données, mais fiables et relativement récentes (enquête OD), échange de bonnes pratiques entre les organismes de tc, recours à des consultats qualifiés,, bases de données pertinentes et performantes telles l'enquête OD,, plusieurs politiques et systèmes de gestion contribuant à une planification rigoureuse,, systèmes de pointage pour prioriser les projets de transport (sécurité)<br><br>*Access to few data but data that are reliable and relatively recent (OD survey), exchange of good practices among public transport organizations, recourse to qualified consultants, data bases that are pertinent to [the analytical / retrieval needs of] and capable of [handling] OD surveys, more policies and management systems contribute to a rigorous planning process, checklist to prioritize transport projects (security [???])* | budgets insuffisants, manque de ressources humaines outils plus performants pour analyse des données<br><br>*Insufficient budgets, lack of human resources, tools that perform better to analyze data.* | difficulté de recueillir toutes les données pertinentes et nécessaires pour en faire une juste synthèse afin de remplir les objectifs souhaités de planification à long terme (la plus optimale possible)<br><br>*Difficulty in gathering all the pertinent and necessary data to do a just synthesis in order to meet the desired long-term planning objectives (the most optimal possible).* |
| 51 | La CMM ne fait pas encore de planification des transport à long terme. Ce rôle est présentement partagé entre le ministère des Transports, l'AMT et les sociétés de transport. La CMM compte faire de la planification intégrée des transports et de l'aménagement du territoire à l'échelle de son territoire. Nous devrons alors estimer si les outils de planification actuels peuvent répondre à nos objectifs, à nos besoins. Aucun constat d'insuffisance à ce jour.<br><br>*The CMM (respondent : I believe is the Montreal metropolitan community; not sure – please confirm) no longer does long-range transportation planning. The role currently is divided among the MTQ, the AMT [Metropolitan Transportation Agency in Montreal: similar to TransLink but without as many powers], and the transit operators. The CMM does integrated transportation and land use planning at the scale of its own territory [i.e., within its own boundaries]. We must accordingly determine whether the actual planning tools can meet our objectives and needs.*<br>*No official report [i.e., position] on insufficiencies currently.* | Accroître nos connaissances des outils de planification intégrée des transports et de l'aménagement du territoire.<br><br>*Increase our knowledge of tools that integrate transportation and land use planning.* | nous n'avons pas encore abordé cette question<br><br>*We have not yet got into this issue* | n/a<br><br>*n/a* | n/a<br><br>*n/a* | n/a<br><br>*n/a* |

# Appendix C
# Survey Contact List

| Organization Name | Location | Province |
|---|---|---|
| Municipal District of Smoky River No. 130 | Smoky River | AB |
| Alberta Infrastructure and Transportation | Alberta | AB |
| Alberta Infrastructure and Transportation | Alberta | AB |
| Alberta Infrastructure and Transportation | Alberta | AB |
| Alberta Infrastructure and Transportation | Alberta | AB |
| The City of Calgary | Calgary | AB |
| City of Edmonton | Edmonton | AB |
| The City of Red Deer | Red Deer | AB |
| Strathcona County | Strathcona County | AB |
| City of Lethbridge | Lethbridge | AB |
| City of Medicine Hat | Medicine Hat | AB |
| Regional Municipality of Wood Buffalo | Wood Buffalo | AB |
| City of Grande Prairie | Grande Prairie | AB |
| Municipal District of Rocky View | Rocky View | AB |
| Parkland County | Parkland County | AB |
| City of Airdrie | Airdrie | AB |
| City of Spruce Grove | Spruce Grove | AB |
| Red Deer County | Red Deer County | AB |
| Town of Okotoks | Okotoks | AB |
| City of Leduc | Leduc | AB |
| City of Lloydminster | Lloydminster | AB |
| City of Camrose | Camrose | AB |
| City of Fort Saskatchewan | Fort Saskatchewan | AB |
| Town of Cochrane | Cochrane | AB |
| Leduc County | Leduc County | AB |
| Town of Canmore | Canmore | AB |
| City of Cold Lake | Cold Lake | AB |
| Town of Lacombe | Lacombe | AB |
| County of Lethbridge | Lethbridge County | AB |
| Yellowhead County | Yellowhead County | AB |
| British Columbia Ministry of Transportation | British Columbia | BC |
| Greater Vancouver Regional District | Greater Vancouver Regional District (GVRD) | BC |
| Greater Vancouver Transportation Authority (Translink) | Vancouver, Greater Region | BC |
| City of Vancouver | Vancouver | BC |
| City of Surrey | Surrey | BC |
| City of Burnaby | Burnaby | BC |
| City of Richmond | Richmond | BC |
| City of Abbotsford | Abbotsford | BC |
| City of Coquitlam | Coquitlam | BC |
| Corporation of the District of Saanich | Saanich | BC |
| City of Kelowna | Kelowna | BC |
| Corporation of Delta | Delta | BC |
| Township of Langley | Langley | BC |
| District of North Vancouver | North Vancouver | BC |
| City of Kamloops | Kamloops | BC |
| City of Nanaimo | Nanaimo | BC |
| Capital Regional District | Victoria | BC |
| City of Prince George | Prince George | BC |
| City of Chilliwack | Chilliwack | BC |
| Fraser Valley Regional District | Chilliwack | BC |
| District of Maple Ridge | Maple Ridge | BC |
| City of New Westminster | New Westminster | BC |
| City of Port Coquitlam | Port Coquitlam | BC |
| Corporation of the City of North Vancouver | North Vancouver City | BC |

| | | |
|---|---|---|
| District of West Vancouver | West Vancouver | BC |
| Corporation of the City of Vernon | Vernon | BC |
| District of Mission | Mission | BC |
| City of Penticton | Penticton | BC |
| City of Campbell River | Campbell River | BC |
| City of Port Moody | Port Moody | BC |
| City of Langley | Langley City | BC |
| City of Langford | Langford | BC |
| Corporation of the District of Oak Bay | Oak Bay | BC |
| City of Port Alberni | Port Alberni | BC |
| City of Fort St. John | Fort St. John | BC |
| District of Salmon Arm | Salmon Arm | BC |
| District of Powell River | Powell River | BC |
| Town of Sidney | Sidney | BC |
| City of Dawson Creek | Dawson Creek | BC |
| City of Parksville | Parksville | BC |
| The Corporation of the District of Summerland | Summerland | BC |
| District of North Saanich | North Saanich | BC |
| Manitoba Department of Transportation and Government Services | Manitoba | MB |
| City of Winnipeg | Winnipeg | MB |
| City of Brandon | Brandon | MB |
| Municipality of Springfield | Springfield | MB |
| New Brunswick Department of Transportation | New Brunswick | NB |
| City of Saint John | Saint John | NB |
| Saint John Transit Commission | Saint John | NB |
| City of Moncton | Moncton | NB |
| Coidac Transit Commission (Moncton) | Moncton | NB |
| City of Fredericton | Fredericton | NB |
| Fredericton Transit | Fredericton | NB |
| Ville de Dieppe | Dieppe | NB |
| Town of Riverview | Riverview | NB |
| Ville d'Edmundston | Edmundston | NB |
| Town of Quispamsis | Quispamsis | NB |
| City of Bathurst | Bathurst | NB |
| Town of Rothesay | Rothesay | NB |
| Newfoundland Works, Services and Transportation | Newfoundland and Labrador | NL |
| Newfoundland Works, Services and Transportation | Newfoundland and Labrador | NL |
| Newfoundland Works, Services and Transportation | Newfoundland and Labrador | NL |
| Newfoundland Works, Services and Transportation | Newfoundland and Labrador | NL |
| City of St. John's | St. John's | NL |
| City of Mount Pearl | Mount Pearl | NL |
| City of Corner Brook | Corner Brook | NL |
| Corner Brook Transit | Corner Brook | NL |
| Town of Paradise | Paradise | NL |
| Nova Scotia Department of Transportation and Public Works | Nova Scotia | NS |
| Halifax Regional Municipality | Halifax | NS |
| Cape Breton Regional Municipality | Cape Breton | NS |
| Municipality of the County of Kings | Kings County | NS |
| Municipality of the County of Colchester | Colchester County | NS |
| Municipality of Pictou County | Pictou County | NS |
| Municipality of Lunenburg | Lunenburg | NS |
| Municipality of Annapolis County | Annapolis County | NS |
| Town of Truro | Truro | NS |
| Region of Queens Municipality | Queens | NS |
| Town of Yarmouth | Yarmouth | NS |

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| Northwest Territories Department of Transportation | Northwest Territories | NT |
| City of Yellowknife | Yellowknife | NT |
| Nunavut Department of Economic Development and Transportation | Nunavut | NU |
| Ministry of Transportation, Ontario | Ontario | ON |
| City of Toronto | Toronto | ON |
| Regional Municipality of Peel | Peel | ON |
| The Regional Municipality of York | York | ON |
| City of Ottawa | Ottawa | ON |
| City of Mississauga | Mississauga | ON |
| Regional Municipality of Durham | Durham | ON |
| Regional Municipality of Waterloo | Waterloo, Region | ON |
| City of Hamilton | Hamilton City | ON |
| City of Brampton | Brampton | ON |
| Regional Municipality of Niagara | Niagara | ON |
| County of Simcoe | Simcoe County | ON |
| Regional Municipality of Halton | Halton | ON |
| City of London | London | ON |
| Town of Markham | Markham | ON |
| City of Vaughan | Vaughan | ON |
| Corporation of the City of Windsor | Windsor | ON |
| City of Kitchener | Kitchener | ON |
| Corporation of the Town of Oakville | Oakville | ON |
| City of Burlington | Burlington | ON |
| Town of Richmond Hill | Richmond Hill | ON |
| City of Greater Sudbury | Greater Sudbury | ON |
| Corporation of the City of Oshawa | Oshawa | ON |
| City of St. Catharines | St. Catharines | ON |
| City of Barrie | Barrie | ON |
| Corporation of the County of Lambton | Lambton | ON |
| County of Peterborough | Peterborough County | ON |
| Corporation of the City of Cambridge | Cambridge | ON |
| Corporation of the City of Kingston | Kingston | ON |
| City of Guelph | Guelph | ON |
| Town of Whitby | Whitby | ON |
| City of Thunder Bay | Thunder Bay | ON |
| Municipality of Chatham-Kent | Chatham-Kent | ON |
| County of Oxford | Oxford | ON |
| The City of Waterloo | Waterloo | ON |
| Corporation of the City of Brantford | Brantford | ON |
| County of Grey | Grey | ON |
| Corporation of the County of Wellington | Wellington | ON |
| County of Renfrew | Renfrew, County | ON |
| City of Niagara Falls | Niagara Falls | ON |
| Northumberland County | Northumberland | ON |
| City of Peterborough | Peterborough | ON |
| City of Kawartha Lakes | Kawartha Lakes | ON |
| Town of Newmarket | Newmarket | ON |
| Corporation of the City of Sarnia | Sarnia | ON |
| United Counties of Stormont, Dundas and Glengarry | SD&G | ON |
| Town of Caledon | Caledon | ON |
| Town of Halton Hills | Halton Hills | ON |
| The Corporation of the Town of Milton | Milton | ON |
| Corporation of the City of Welland | Welland | ON |
| City of Belleville | Belleville | ON |
| Corporation of the Town of Aurora | Aurora | ON |

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| City of Cornwall | Cornwall | ON |
| Haldimand County | Haldimand County | ON |
| City of Quinte West | Quinte West | ON |
| County of Brant | Brant | ON |
| City of Orillia | Orillia | ON |
| The Corporation of the Town of Fort Erie | Fort Erie | ON |
| Town of Tecumseh | Tecumseh | ON |
| The Corporation of the Town of Grimsby | Grimsby | ON |
| The Corporation of the City of Owen Sound | Owen Sound | ON |
| Town of Lincoln | Lincoln | ON |
| County of Essex | Essex | ON |
| Township of Woolwich | Woolwich | ON |
| Corporation of the Town of Cobourg | Cobourg | ON |
| United Counties of Prescott & Russell | Prescott & Russell | ON |
| Municipality of Port Hope | Port Hope | ON |
| Town of Greater Napanee | Greater Napanee | ON |
| Corporation of the City of Kenora | Kenora | ON |
| County of Haliburton | Haliburton | ON |
| Loyalist Township | Loyalist | ON |
| The Town of Tillsonburg | Tillsonburg | ON |
| Municipalité de Russell Township | Russell | ON |
| Township of South Glengarry | South Glengarry | ON |
| Town of Ingersoll | Ingersoll | ON |
| The Corporation of the Town of Mississippi Mills | Mississippi Mills | ON |
| Township of North Glengarry | North Glengarry | ON |
| Municipality of Brighton | Brighton | ON |
| Prince Edward Island Department of Public Works and Transportation | Prince Edward Island | PE |
| City of Charlottetown | Charlottetown | PE |
| City of Summerside | Summerside | PE |
| Agence métropolitaine de transport | Montréal Region | QC |
| Ministère des transports du Québec | Jonquière | QC |
| Communauté métropolitaine de Montréal (CMM) | Montréal | QC |
| Communauté métropolitaine de Montréal (CMM) | Montréal | QC |
| Ministère des transports du Québec | Montréal | QC |
| Ville de Montréal | Montréal | QC |
| Communauté métropolitaine de Québec (CMQ) | Québec | QC |
| Communauté métropolitaine de Québec (CMQ) | Québec | QC |
| Ministère des transports du Québec | Québec | QC |
| Ville de Québec | Québec | QC |
| Réseau de transport de la capiatle (RTC - Quebec) | Québec | QC |
| STL - Société de transport de Laval | Laval | QC |
| Ministère des transports du Québec | Gatineau | QC |
| STO - Société de transport de l'Outaouais | Gatineau | QC |
| Ville de Gatineau | Gatineau | QC |
| Ville de Gatineau | Gatineau | QC |
| Ville de Gatineau | Gatineau | QC |
| Réseau de transport de Longueuil - RTL | Longueuil | QC |
| Ministère des transports du Québec | Sherbrooke | QC |
| STS - Société de Transport de Sherbrooke | Sherbrooke | QC |
| Ville de Sherbrooke | Sherbrooke | QC |
| Ville de Sherbrooke | Sherbrooke | QC |
| Société de transport du Saguenay | Saguenay | QC |
| Ville de Saguenay | Saguenay | QC |
| Ville de Saguenay | Saguenay | QC |
| Ville de Lévis | Lévis | QC |

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| Ministère des transports du Québec | Trois-Rivières | QC |
| Ville de Trois-Rivières | Trois-Rivières | QC |
| Ville de Terrebonne | Terrebonne | QC |
| Ville de Saint-Jean-sur-Richelieu | Saint-Jean-sur-Richelieu | QC |
| Ville de Repentigny | Repentigny | QC |
| Ville de Brossard | Brossard | QC |
| Ville de Drummondville | Drummondville | QC |
| Ville de Saint-Jérôme | Saint-Jérôme | QC |
| Ville de Granby | Granby | QC |
| Ville de Saint-Hyacinthe | Saint-Hyacinthe | QC |
| Ville de Shawinigan | Shawinigan | QC |
| Ville de Dollard-des-Ormeaux | Dollard-des-Ormeaux | QC |
| Ville de Blainville | Blainville | QC |
| Ville de Châteauguay | Châteauguay | QC |
| Ville de Saint-Eustache | Saint-Eustache | QC |
| Ville de Rimouski | Rimouski | QC |
| Ville de Victoriaville | Victoriaville | QC |
| Ville de Salaberry-de-Valleyfield | Salaberry-de-Valleyfield | QC |
| Ville de Rouyn-Noranda | Rouyn-Noranda | QC |
| Ville de Boucherville | Boucherville | QC |
| Ville de Sorel-Tracy | Sorel-Tracy | QC |
| Ville de Mascouche | Mascouche | QC |
| Ville de Mirabel | Mirabel | QC |
| Ville de Val-d'Or | Val-d'Or | QC |
| Ville de Côte-Saint-Luc | Côte-Saint-Luc | QC |
| Ville de Pointe-Claire | Pointe-Claire | QC |
| Ville de Alma | Alma | QC |
| Ville de Saint-Georges | Saint-Georges | QC |
| Ville de Sainte-Julie | Sainte-Julie | QC |
| Ville de Boisbriand | Boisbriand | QC |
| Ville de Thetford Mines | Thetford Mines | QC |
| Ville de Sept-Îles | Sept-Îles | QC |
| Ville de Sainte-Thérèse | Sainte-Thérèse | QC |
| Ville de Saint-Constant | Saint-Constant | QC |
| Ville de Vaudreuil-Dorion | Vaudreuil-Dorion | QC |
| Ville de Saint-Bruno-de-Montarville | Saint-Bruno-de-Montarville | QC |
| Ville de Magog | Magog | QC |
| Ville de Baie-Comeau | Baie-Comeau | QC |
| Ville de Chambly | Chambly | QC |
| Ville de Saint-Lambert | Saint-Lambert | QC |
| Ville de Kirkland | Kirkland | QC |
| Ville de La Prairie | La Prairie | QC |
| Ville de Varennes | Varennes | QC |
| Ville de Beaconsfield | Beaconsfield | QC |
| Ville de Westmount | Westmount | QC |
| Ville de Beloeil | Beloeil | QC |
| Ville de Mont-Royal | Mont-Royal | QC |
| Ville de Joliette | Joliette | QC |
| Ville de Rivière-du-Loup | Rivière-du-Loup | QC |
| Ville de Dorval | Dorval | QC |
| Ville de Deux-Montagnes | Deux-Montagnes | QC |
| Ville de Saint-Augustin-de-Desmaures | Saint-Augustin-de-Desmaures | QC |
| Ville de L'Assomption | L'Assomption | QC |
| Ville de Sainte-Catherine | Sainte-Catherine | QC |
| Ville de L'Ancienne-Lorette | L'Ancienne-Lorette | QC |

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| Ville de Saint-Lazare | Saint-Lazare | QC |
| Ville de Mont-Saint-Hilaire | Mont-Saint-Hilaire | QC |
| Ville de Saint-Basile-le-Grand | Saint-Basile-le-Grand | QC |
| Ville de Candiac | Candiac | QC |
| Ville de Matane | Matane | QC |
| Ville de Gaspé | Gaspé | QC |
| Ville de Dolbeau-Mistassini | Dolbeau-Mistassini | QC |
| Ville de Rosemère | Rosemère | QC |
| Ville de Saint-Lin--Laurentides | Saint-Lin--Laurentides | QC |
| Ville de Sainte-Anne-des-Plaines | Sainte-Anne-des-Plaines | QC |
| Ville de Mont-Laurier | Mont-Laurier | QC |
| Ville de Amos | Amos | QC |
| Municipalité de Les Îles-de-la-Madeleine | Les Îles-de-la-Madeleine | QC |
| Ville de Cowansville | Cowansville | QC |
| Ville de Lavaltrie | Lavaltrie | QC |
| Ville de La Tuque | La Tuque | QC |
| Municipalité de Saint-Charles-Borromée | Saint-Charles-Borromée | QC |
| Ville de Beauharnois | Beauharnois | QC |
| Ville de Lachute | Lachute | QC |
| Ville de Sainte-Marie | Sainte-Marie | QC |
| Ville de Montmagny | Montmagny | QC |
| Ville de Bécancour | Bécancour | QC |
| Ville de Pincourt | Pincourt | QC |
| Municipalité de Sainte-Sophie | Sainte-Sophie | QC |
| Ville de Roberval | Roberval | QC |
| Ville de Sainte-Adèle | Sainte-Adèle | QC |
| Ville de Sainte-Marthe-sur-le-Lac | Sainte-Marthe-sur-le-Lac | QC |
| Ville de Saint-Félicien | Saint-Félicien | QC |
| Ville de Mercier | Mercier | QC |
| Ville de L'Île-Perrot | L'Île-Perrot | QC |
| Saskatchewan Highways and Transportation | Saskatchewan | SK |
| Saskatchewan Highways and Transportation | Saskatchewan | SK |
| Saskatchewan Highways and Transportation | Saskatchewan | SK |
| City of Saskatoon | Saskatoon | SK |
| City of Regina | Regina | SK |
| City of Prince Albert | Prince Albert | SK |
| City of Moose Jaw | Moose Jaw | SK |
| City of Swift Current | Swift Current | SK |
| City of North Battleford | North Battleford | SK |
| City of Estevan | Estevan | SK |
| Yukon Department of Highways and Public Works | Yukon | YT |
| City of Whitehorse | Whitehorse | YT |
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