Canadian Transportation Demand Management Impact Measurement Guidelines

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ABSTRACT

Transportation demand management (TDM) has become an increasingly common component of transportation master plans, neighbourhood plans, and transportation studies for development approvals. It is an important tool in managing the effects of travel and a variety of TDM initiatives have been implemented by Canadian municipalities and organizations. However, to date, the evidence of the impacts and effectiveness of TDM initiatives has been poorly quantified. This means that cost-benefit analysis, program assessment and an understanding of who is using TDM and why all have been difficult to measure. The need for impact quantification is important because, as this field expands, approval and funding bodies will increasingly require that the impacts of TDM investment be measured.

The Transport Canada project *Development of Standard TDM Impact Measurement Guidelines* combined international best practices with an understanding of the needs of Canadian TDM practitioners. The project developed an evaluation system that provides a flexible framework in which to measure all types of TDM initiatives against their intended goals. The system provides guidance in measuring changes in attitudinal and awareness levels, as well as more concrete changes in travel patterns, congestion, emissions, and costs. The evaluation system recommends indicators and measurements for the various assessment levels and is supported by guidelines for data collection and calculations.

The Canadian TDM Impact Measurement Guidelines provide a standardized process for TDM impact measurement and guidance for TDM practitioners, municipalities, and funding bodies.

This paper provides a brief overview of the Guideline, including the evaluation process, assessment levels, indicators, data collection techniques, and evaluation procedures.

INTRODUCTION

Governments are under increasing pressure to provide sustainable transportation systems. One increasingly common strategy in these systems is Transportation Demand Management (TDM). TDM programs and initiatives influence transportation **demand**: these programs shift private automobile use to other modes, disperse travel from times or routes of peak demand, or eliminate travel all together. These types of programs have been implemented by regions, municipalities, transportation management associations (TMAs), businesses, and other organizations across Canada.

However, to date, the evidence of the impacts and effectiveness of TDM initiatives has been poorly quantified. This means that cost-benefit analysis, program assessment and an understanding of who is using TDM and why all have been difficult to measure. The need for impact quantification is important because, as this field expands, approval and funding bodies will increasingly require that the impacts of TDM investment be measured.

Transport Canada sponsored the development of *Canadian TDM Impact Measurement Guidelines* (the Guideline) to address this knowledge gap. The Guidelines provide a standardized process and accompanying methods to help organizations quantify the impacts of their TDM initiatives.

The full Guideline and supporting technical information can be found on the Transport Canada website (1, 2). This paper provides a brief overview of the Guideline, including the Guideline development, target audience, evaluation process, assessment levels, indicators, data collection techniques, and evaluation procedures. The remainder of the paper discusses how the Guideline is expected to be applied and how the application and assessment of TDM in Canada is expected to be influenced by the use of the Guideline. Finally, possible next steps are presented and the paper concludes.

DEFINITIONS

Following are a few key definitions for the discussion of TDM measurement.

Assessment Levels: Within the evaluation framework, a TDM initiative can be evaluated on a number of different levels, each of which involves its own indicators and measurements.

Mode Share, Mode Split, and Mode Shift
Mode share: The percentage of all travellers using a mode is the mode share.
Mode split: The ratio of travellers between two or more modes.
Mode shift: A change in travel patterns of a percentage of travellers from one mode to another over a given period of time.

Objectives, Indicators, and Measures
Objective: Overall goals of the program.
Indicators: The desired output or outcome based on the objectives set for the program. It describes an attribute of the program's performance.

Measures: the means used to quantify or qualify the indicator.

Outputs and Outcomes
Outputs: The activities and processes of the program itself.
Outcomes: The results of the program that will be measured against the overall goals.

Vehicle-kilometres travelled (VKT): A measure of vehicle activity or usage – for TDM, this is a measure of the activity in the use of personal vehicles. TDM can reduce or make more efficient the number of vehicle trips (the "V" in VKT), their usage ("the K" in VKT), or both. VKT measures the distance travelled by autos in a given time period in a given area or as used by a given group of travellers.

METHOD

The Guideline was developed as part of a Transport Canada project. They evolved from a literature review and consultation process that considered international best practices and the needs of Canadian TDM practitioners. Three major sources were used in the development of the Guideline:

1. Direct consultation (interviews) with Canadian and international TDM practitioners
2. Literature review of published and unpublished reports and guidelines
3. Online survey of Canadian TDM practitioners

The study team utilized the best of the applicable information gathered in the literature review and combined key pieces of different methods to create a complete set of guidelines. The literature was supplemented with well established best practices in data collection. Each piece was adjusted to meet the needs of Canadian practitioners based on the survey and consultation.

TARGET AUDIENCE

The Guideline was developed for people who are implementing TDM programs at organizations across Canada. TDM is being implemented by a wide variety of organizations: businesses, TMA, non profit groups, community and business associations, and all levels of government. The people tasked with implementing TDM come from different backgrounds: both technical and non-technical. Some are engineers or in other professions accustomed to quantification. Others may be social marketers, or from other background with limited prior experience with this type of measurement. The Guideline provides a standardized method for practitioners from all backgrounds.

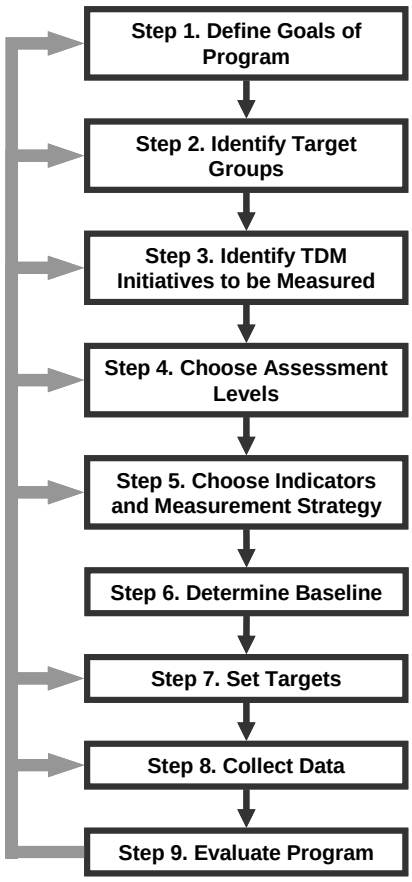
EVALUATION FRAMEWORK

The initial literature review led to two major types of best practices: measurements that are being developed and used in the United States and New Zealand; and evaluation frameworks that have been developed in Europe. Through consultation with Canadian practitioners, the study team quickly learnt that the Canadian Guideline needed to be more than a compilation of measurement techniques – that is, an evaluation framework to identify and organize the indicators and measures is necessary.

The resulting Guideline is built around an evaluation framework that meets the needs of Canadian TDM practitioners. The individuals who are responsible for TDM programs in Canada come from a wide variety of technical backgrounds, and not all have expertise in measurement. The framework gives these practitioners a strategy and makes the measurement process less overwhelming. It organizes the methods and measurement techniques found in the literature review into individual steps. This step by step program also provides a method for a measurement strategy to be incorporated into TDM program design at the first stages.

The evaluation framework provides TDM practitioners with nine steps to follow in the design and application of a TDM measurement program. The nine steps are shown in **Exhibit 1**. These steps are important because they give standard structure to the measurement process and ensure that every program is being measured against its own goals at a level that it is appropriate to the level of investment. The evaluation framework is based on similar frameworks provided by the MOST MET seven-step approach (3) and the SUMO process (4). The process has been adjusted to meet the needs of Canadian practitioners as deduced from the survey and consultation.

Exhibit 1: Evaluation Process



Source: adapted from Finke et al. (2001) and , Hyllenius, P. et. al (2004) in iTRANS, 2009

ASSSESSMENT LEVELS

Step four in the evaluation process is to choose an assessment level. There are two assessment levels: context and performance. *Context assessment* considers the environment (context) in which the initiative is being implemented. After implementation is complete and follow-up measurements are being done, the context assessment looks for environmental changes that may have influenced the initiative. *Performance assessment* considers changes that are attributable to the initiatives themselves, and can be further divided into three types: outputs (actions of the TDM practitioner or staff), outcomes (results of those actions), and effectiveness (value of the outcomes for the investment). The use of both assessments levels is well established in TDM applications. However, it should be noted that although the concept of performance assessment is common in the measurement of transportation initiatives generally, the concept of having measures for context assessment is somewhat uncommon in traditional transportation planning and evaluation.

Table 1: Assessment Levels

Assessment Level			Description
CONTEXT ASSESSMENT			
Context	S	System Conditions	Background conditions surrounding the implementation of the TDM program.
	P	Personal Information	Information about individual survey respondents that will allow them to be grouped. Also, information about the respondents' personal situation that may impact their response to TDM.
PERFORMANCE ASSESSMENT			
Outputs	A	Activities Undertaken	Activities undertaken by the TDM program team to accomplish the goals of the program.
	B	Customer Satisfaction	Customer reports of satisfaction concerning the TDM program or program activities.
Outcomes	C	Awareness	Level of awareness of the program among members of the target group.
	D	Participation	Level of participation among the target group.
	E	Short-term Change	The short-term impact of the initiatives, i.e. number of people who have tried a sustainable mode. This is equivalent to "experimental use" in other programs.
	F	Long-term Change	The long term (one year or greater) change to participants travel behaviour.
	G	Personal Impact	The direct impact to participants who have made a long-term or short-term change. This includes indicators such as time savings, mobility level, affordability, vehicle operating cost savings, personal health benefits, or other impacts for individuals. Can typically be represented as averages for population sub-groups, as individual impacts for all participants may be difficult or impossible to determine.
	H	System Impact	The aggregate impact of travel behaviour changes on the system. This could be impacts to transit ridership,

Table 1: Assessment Levels			
Assessment Level			**Description**
			congestion, GHG or CAC emissions, public health or some other goal for the system as a whole.
Effectiveness	I	Financial Effectiveness	The benefit of the system for the investment. This can be measured holistically as cost/ benefit or it could be a more finite cost per unit of change. Cost per unit of change reflects progress for investment for a certain goal, but neglects side benefits of the program. Full cost/benefit can encompass more impacts but can be more difficult to calculate.

Source: adapted from Finke et al. (2001) and , Hyllenius, P. et. al (2004) in iTRANS, 2009

Practitioners are not required to assess at every level, rather, the assessment levels to be used must be carefully chosen on an initiative by initiative basis. Assessment levels should be chosen based on their applicability to the program's goal, the type of initiative, the level of complexity, and the requirements of funding bodies.

INDICATORS

Indicators are the subject of measurement – what is actually to be measured at each assessment level. Step five in the evaluation framework includes choosing indicators. Like assessment levels, indicators must be chosen to suit the goals, type of initiative, complexity, and funding requirements. In addition, indicators should be measurable. Some indicators are required because they are a component in the calculation of another indicator that is desired for the evaluation. A list of sample indicators by assessment level is included in **Table 2**.

The measurement of indicators that fall under the *Level H* assessment is often required for funding. This level can be measured using indicators such as mode shift, VKT reduced, GHG emissions, health care costs, or number of collisions. Many of these indicators can be calculated using VKT as a base.

DATA

Data must be collected both **before** the initiative is implemented (Step 6 – Baseline) and one or more times **after** the initiative is in place (Step 8 – Collect Data). Only the data necessary for the direct measurement or calculation of indicators should be collected.

The Guideline identifies three tiers of data:

- **Tier 1: Direct Data** – Data that are collected through direct observation.
- **Tier 2: Reported Information** – Data that are reported by another party. This tier is further divided into **Surveys** and **Databases and Outside Sources**.
- **Tier 3: Model Outputs** – Data that can be derived from local or regional transportation models.

The data required to measure the impact of TDM can be labour-intensive to collect. Changes in travel behaviour resulting from TDM can be difficult to separate from changes attributable to

other sources (such as changes in gas prices, transit routes, etc.) and many of the desirable indicators require supplemental data for calculation. In addition to these challenges, practitioners often seek to understand changes in attitudes as well as changes in behaviour, which calls for different types of data collection. Because of this, data often must be collected from more than one tier.

For many TDM programs, origin-destination (OD) surveys or trip diaries are an important part of the data collection for TDM impact evaluation. These surveys are commonly used in transportation planning to provide important information about mode, travel patterns, travel frequency, and trip distance. OD surveys offer the advantage of providing a complete picture of travel patterns, where very little has to be assumed based on proxies or collected from other data sources. However, surveys can be subject to statistical errors (e.g. due to sampling) and can be expensive to conduct.

An alternative approach is to measure changes in behaviour with Tier 1 data locally and use proxy data from model outputs or other sources as required for calculation purposes.

EVALUATION PROCEDURES

Indicators must be evaluated by comparing the before measurement with the after measurement. Some indicators are directly measurable using collected data. Others must be calculated using a combination of different data types and model outputs.

Some important indicators that can be evaluated directly from data include:

- Transit trips (ridership).
- Transit pass sales.
- Vehicle occupancy.
- Vehicle trips (generated, or past a set point).
- Pedestrian trips (generated, or past a set point).
- Awareness (knowledge of program's existence, purpose, how to access).
- Participation (number signed up for service, attending event, etc.).
- Parking utilization.
- Employee productivity.
- Employee retention.

Other indicators, like VKT, GHG, health care costs, collisions, and cost-benefit ratios, must be calculated using a combination of a number of direct data measures, and supplemental information and factors. **Exhibit 2** illustrates how indicators are related to each other. It shows that there can be multiple paths used to calculate a single indicator. One example of this is VKT, which can be calculated using information from O-D surveys or through a combination of outside information and traffic count data. The two paths are illustrated in **Exhibit 3**.

Central to TDM impact measurement is the measurement of changes in kilometres travelled (KT) for different modes. Many TDM programs aim for a reduction in VKT, whether to reduce congestion, GHG emissions, or as a goal in itself. TDM is also used to increase physical activity,

especially in school applications. This can be measured by calculating changes in active kilometres travelled (AKT).

The calculation of changes in KT indicators due to TDM presents some specific challenges. The basic components of KT indicators are the number of trips (for given mode) and the trip distance. Trip distance must be determined by mode, because different modes can have very different average trip lengths. Care must also be taken to accurately represent the number of trips shifted between modes or reduced over the measurement period.

KT indicators can be used to calculate other indicators. VKT, for example, can be used in combination with emissions factors to calculate Criteria Air Contaminant and GHG emissions. The factors may be derived from local, Provincial/Territorial, or national sources. AKT can be used to calculate changes in the minutes of physical activity per day.

The most complex indicator is the cost-benefit ratio. Cost-benefit ratios can be extremely complicated for TDM initiatives because the impacts of TDM are varied and are often not well understood. As more TDM impact assessment data are collected, and the attribution of the impacts becomes better understood, the inputs and calculations needed for cost-benefit analysis will become easier to identify.

APPLICATION OF THE GUIDELINE

The Guideline was designed to be used by a wide cross-section of TDM practitioners. Social marketers, planners, and engineers can be found among the professionals who are involved in the TDM community. The Guideline had to provide sound technical guidance, but also had to be readable and applicable for the non-technical practitioner.

The consultation and survey showed that many Canadian practitioners have not attempted to measure the impacts of their TDM initiatives because of lack of knowledge and resources. The Guideline provides a step-by-step approach to measurement. It also provides a national standard baseline for measurement that may encourage funding bodies to require (and fund) measurement activities.

Measuring TDM impact using the Guideline has advantages both for individual organizations and for the transportation industry. Following are the major benefits for individual organizations:

- Following the Guideline may fulfill the requirements of funding agencies, such as Transport Canada. Where a measurement program is required, but no specific program is cited, the Guideline provides a nationally recognized, defensible strategy.
- Defensible reporting of progress against goals and value of investment for politicians, the public, and private partners. “Telling the story” in terms that stakeholders understand is important for acceptance and buy-in.
- Maximization of the value of test or pilot initiatives in shaping the design or business case of more extensive programs.

These benefits are important – they are the motivators for practitioners to implement the Guideline. Beyond these benefits for program evaluation and reporting, widespread

implementation of the Guideline could have significant benefits in improving understanding of the actual benefits of TDM initiatives.

As more organizations engage in meaningful measurement, the actual benefits of TDM initiatives can be better understood. This provides four types of benefits:

1. Refinement of implementation: understanding what works and what doesn't will allow practitioners to refine the application of TDM in Canada.
2. Promotion of TDM: measurable results will allow practitioners to promote TDM initiatives that work to the public, politicians, and private partners. This, in turn, will increase support and funding for the initiatives that have been shown to accomplish goals.
3. Improving resources and knowledge: the build-up of data and of practical tools promotes organizational capacity building and the sharing of knowledge among practitioners. This has the further benefit of reducing measurement costs.
4. Development of forecasting tools: results of initiatives can be aggregated on a national scale for use in forecasting tools. The literature review and interviews found that a number of TDM impact forecasting tools is available in the United States, but none has been developed specifically for the Canadian context. These tools, which are intended to be more precise and detailed than the (limited) treatment of TDM in regional travel demand forecasting models, could build on the 'before-and-after' measurements to provide a predictive capability for planning purposes. However, the availability of appropriate data are essential for the development of predictive models.

POSSIBLE NEXT STEPS

TDM practitioners could benefit from the development and dissemination of additional tools and information sources that could increase the accuracy and decrease the cost of TDM impact measurement, for example:

- More detailed trip information available nationally, especially trip distance by mode and community.
- Nationally available standard TDM OD or trip diary survey instruments that can be integrated with existing GIS systems and adjusted to meet local requirements. GIS allows practitioners a more accurate and efficient way of determining trip distance and routing. Many municipalities and regions have existing GIS based mapping systems. Integrating into existing systems would save resources, while producing more accurate results. Data collected as part of TDM measurement could also be integrated with other types of data for other purposes, as required by the operating agency.

In order to realize the benefits listed above, the following next steps are suggested:

- Consensus on a small number of TDM indicators that that can be regularly measured nationally by agencies delivering TDM programs. As noted above, every program will have different goals, resources, and needs and therefore different indicators; however a small "shortlist" of indicators would enable benchmarking, aggregation of results, and development of forecasting tools.
- Information sharing of the indicators being measured, the associated measurement and the underlying data. Results could be stored in a centralized database so that they can be used in future studies and forecasting model development.

These next steps require the support of TDM practitioners, the transportation community, funding bodies, employers, and governments at all levels.

CONCLUSION

The Guideline provides a framework and procedures to guide TDM practitioners in the measurement of the impact of their programs and initiatives. While researching and developing the Guideline, the authors concluded the following:

1. The survey and consultation conducted during the project found that there is a lot of agreement among Canadian practitioners that we need a tool to quantify TDM. Thus far, there are few standardized processes and the effectiveness of TDM is not well understood in a quantifiable way. The Guideline responds to this need.
2. The target audience for the Guideline is a wide range of TDM practitioners, including people who come from social marketing and other non-engineering / non-planning backgrounds. The Guideline was designed to address all these communities.
3. The authors realized quickly that the need for a guideline was not just about measurement: first practitioners needed to have an evaluation framework in order to organize indicators and measures.
4. TDM is unusual, in transportation planning circles anyway, in that measurements of public knowledge and attitude (awareness, education, participation, etc.) are key components; whereas most other transportation planning indicators focus on more concrete outcome and outputs. Transit incorporates some of the prior type of assessment, but that often is considered separately as part of marketing, rather than being integrated with planning. The Guideline had to cover both to ensure applicability to the TDM community – the Guideline may be a model for the inclusion of this type of assessment in other transportation planning exercises.
5. To make the Guideline as practical as possible, it was built upon existing data sources and methods. In some cases this involves the extrapolation of existing concepts (notably, extending the “KT” concept to modes other than the personal vehicle). In other cases, there is a need for specific new data.

Wide application of the strategies presented in the Guideline has benefits for individual practitioners and also for the transportation industry, as discussed. Development of new tools and national data will further promote TDM impact analysis in Canada and allow practitioners to utilize of aggregate resources and information.

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- Claude d’Anjou, Directrice Générale, Mobiligo
- Catherine Habel, Senior Program Advisor, TDM, Metrolinx
- Sharon Lewinson, President, Commuting Solutions
- Sabine Schweiger, Environmental Coordinator, City of Whitehorse

The views expressed in this paper do not necessarily represent the views of the Government of Canada or the members of the Peer Advisory Committee.

TABLES

Table 2: Indicators and Measures for Context Assessment

Possible Indicator	Measure
Level S-System Conditions Background conditions surrounding the implementation of the TDM program	
Population statistics (target/other groups)	Number of people
Parking data (on-site, off-site, availability, utilization, cost)	Number of spots, peak utilization (% used at peak time)
Existing travel subsidies	$ available and used, target population, target population size
Details of work times	Number of shifts, start time, end time, number of hours
Existing telework, flex time, compressed workweek	Days available per week, number of people participating, days participated per week for average participant
Carpool, carshare, company car information	Number of carpools, number of carpoolers, preferential parking availability, number of company cars or carshare, utilization, % used at peak time
Public transit - mode to transit, frequency, connectivity, pricing, special offers	Walk distance, transit type, vehicles per hour, price
Cycling facilities	Distance (km), directness of route, pavement quality, safety, km of routes, showers per person (employees / students / etc), secure bicycle parking per person (site users)
HOV network	Km of HOV lane
Sidewalk coverage	% of given roadway classification (one side or two sides)
Average travel time (by mode)	Minutes (convert to hours for calculations)
Average travel distance (by mode)	Km
Average travel speed (by mode)	km/h
Level P-Personal Information Information about individual survey respondents that will allow them to be grouped and information about the respondents' personal situation that may impact their response to TDM	
Age	Years of age
Gender	M/F
Job type	Hours worked per week, job descriptor (office-based, off-site, shift, manufacturing, retail)
Place of residence	Postal code / GIS
Place of work/school/etc	Postal code / GIS
Travel days per week	Days traveled to / from site per week
Trips per week	Trips to / from site per week
Time of travel	Start / end time of trips to site
Travel time	Total travel time for one trip
Travel distance	Total travel distance for one trip
Transport mode	Mode (or combination of modes) used to travel
For carpool - Number of people sharing mode and same/different household	For carpool – number of people in carpool, household, origin location (postal code)
Travel route	NA
Public transit pass	Pass type, usage in days
Car availability	% of time that a car is available for this trip

Source: iTRANS (2009

Table 3: Performance Indicators and Measures for Each Assessment Level

Possible Indicator	Measure
Level A-Activities Undertaken Activities undertaken by the TDM program team to accomplish the goals of the program	
Related jobs completed by staff / volunteers / etc.	Flyers distributed, calls made, calls answered, requests filled, events organized, promotional materials distributed
Level B-Customer Satisfaction Customer reports of satisfaction concerning the TDM program or program activities	
Participant satisfaction	% of participants satisfied with service
Administration satisfaction	Satisfaction rating of site administration with services provided
Level C-Awareness Level of awareness of the program among members of the target group	
Awareness of program / initiative existence	% of target group aware of initiative
Knowledge of role / purpose	% of target group able to describe role / purpose
Ability to contact / get information (if applicable)	% of target group able to describe how to get information (website location, phone number) or contact office / coordinator, number of website hits
Level D-Participation Level of participation among the target group	
Number of people using the service / initiative / participating in event	Number of calls, number of requests, number of participants at event, number of people registered, number of people using system
Level E-Short-term Change The short-term impact of the initiatives, i.e. number of people who have tried a sustainable mode. This is equivalent to “experimental use” in other programs	
One time try of alternative / new mode / reduced travel	Number of people who attempted
Experimental changes in travel patterns	Change type, number of people who made change, duration of change, days per week of change
Satisfaction with short-term change	% of people who made change that are satisfied with change
Level F-Long-term Change The long term (one year or greater) change to participants travel behaviour	
Aggregate mode share change type	% mode shift from each mode to each mode
Average duration	Average length of change at time of measurement
Average frequency	Average days of week used for each mode
Level G-Personal Impact The direct impact to participants who have made a long-term or short-term change. This includes indicators such as time savings, mobility level, affordability, vehicle operating cost savings, personal health benefits, or other impacts for individuals. Can typically be represented as averages for population sub-groups, as individual impacts for all participants may be difficult or impossible to determine	
Fuel consumption	Litres
Active time	Active minutes per day
Active kilometres travelled (AKT)	Km
Personal cost of travel (user cost)	Cost $ per km
Time savings (or cost)	Minutes per trip, or $ per trip

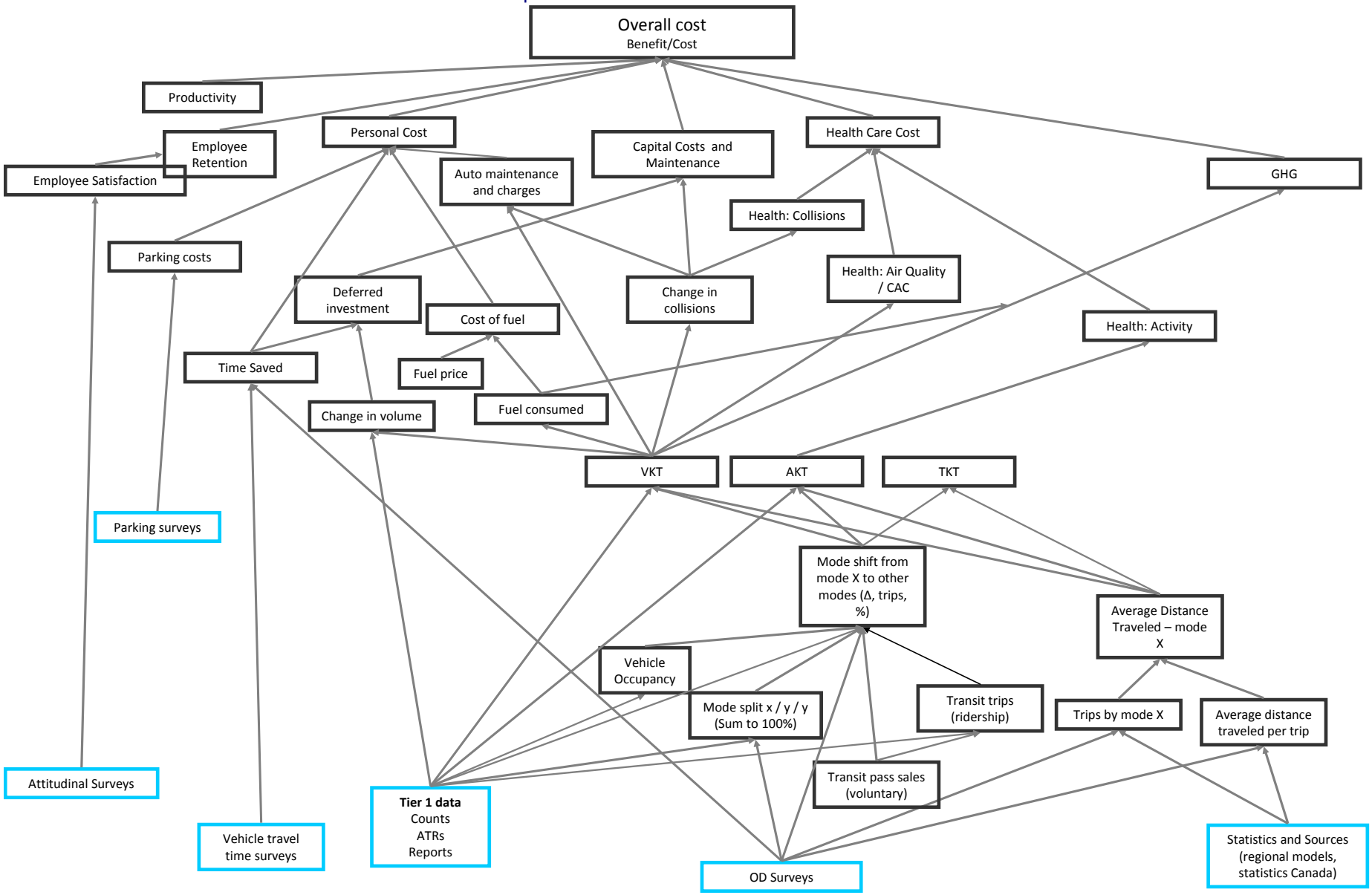
Table 3: Performance Indicators and Measures for Each Assessment Level

Possible Indicator	Measure
Level H-System Impact The aggregate impact of travel behaviour changes on the system. This could be impacts to transit ridership, congestion, GHG or CAC emissions, public health or some other goal for the system as a whole.	
Trip generation – transit	Number of transit users
Trip generation – private car	Number of auto users
Trip generation – car pool	Number of car pool participants
Trip generation – cyclist	Number of cyclists
Trip generation – pedestrian	Number of pedestrians
Mode shift	Change in number and % of auto users to sustainable modes, decrease in auto mode share
VKT reduced	Total decrease in kilometres traveled by users as result of mode shift
Transit kilometres travelled (TKT)	Km
GHG/CAC reduced	Tonnes or tonnes per person (target group or total population
Health care cost	Cost savings resulting from GHG reduction
Lost time due to congestion	Vehicle hours travelled (VHT) under congestion.
Number accidents	Number / year
Number of accidents per capita	Number of accidents per person (target group or entire population)
Number of accidents per VKT	Number of accidents / km
Economic cost of accidents	Cost of accidents
Average fuel usage	Litres
Relative growth (decline) in traffic volumes	% change in volumes / % change in population
Level I-Financial Effectiveness The benefit of the system for the investment. This can be measured holistically as cost/ benefit or it could be a more finite cost per unit of change. Cost per unit of change reflects progress for investment for a certain goal, but neglects side benefits of the program. Full cost/benefit can encompass more impacts but can be more difficult to calculate	
Investment per tonne CO_2 reduced	Dollars / tonne
Cost-benefit	Ratio (dollars (cost) / dollars (benefit))

Source: iTRANS (2009)

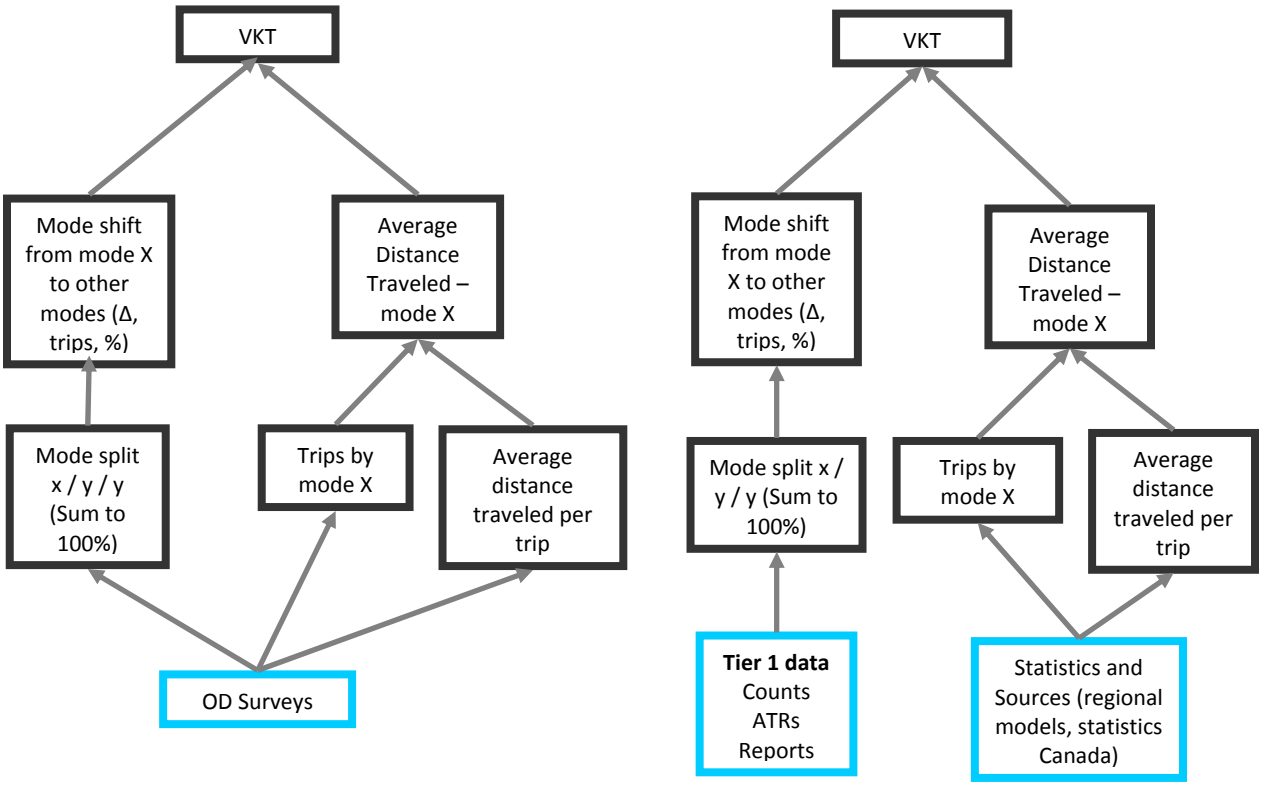
FIGURES

Exhibit 2: Illustration of Indicator Relationships



Source: iTRANS (2009)

Exhibit 3: Two methods to calculate VKT



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