Sampler of Commentaries on Methods and Techniques that Could be Used in Making Decisions about Identifying, Adopting, or Implementing Sustainable Transport Practices

RESEARCH REPORT 3

Transport Canada Project

Methodologies for Identifying and Ranking Sustainable Transport Practices in Urban Regions

Principal Investigator:

Barry Wellar, PhD, MCIP
Professor Emeritus, University of Ottawa
Principal, Wellar Consulting Inc.
wellarb@uottawa.ca
http://www.wellarconsulting.com/

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A. Report Context and Purpose

Research Report 1, Methods and Techniques that Could be Used in Making Decisions about Identifying, Adopting, or Implementing Sustainable Transport Practices (Wellar, 2008a), began by making explicit the three states of usage of methods and techniques which are pertinent to this project:

- The methods and techniques that *are used*.
- The methods and techniques that ***could be used*.**
- The methods and techniques that *should be used*.

After discussing the relationships between the states of *are used*, *could be used*, and *should be used*, Research Report 1 focused on the methods and techniques that ***could be used*** in making decisions to identify, adopt, or implement sustainable transport practices. Table 1 contains the methods and techniques selected from the literature on sustainable transport, and from the suggestions of experts, to illustrate the potential choices available to decision makers.

Table 1. Initial Selection of Methods and Techniques that *Could Be Used* in Making Decisions about Identifying, Adopting, and Implementing Sustainable Transport Practices

1. Anatomical Sourcing
2. Attitudinal Surveys
3. Authority
4. Brainstorming
5. Charrette
6. Committee Approach
7. Common Sense
8. Comparative Analysis
9. Copycat/Follow the Leader
10. Cost-Benefit Analysis
11. Cost-Effectiveness Analysis
12. Counterfoil Research
13. Cross-Impact Analysis
14. Econometric Analysis
15. Focus Groups
16. Follow the Money
17. Forecasting Delphi
18. Highest and Best Use
19. Impact Assessment
20. Indicators
21. Indexing
22. Life-Cycle Analysis
23. Modelling
24. Normative Delphi
25. NIMBY Strategy
26. Open House
27. Opinion Polls
28. Optimization
29. Panel Evaluation
30. Pilot Study
31. Policy Delphi
32. Pre-Test
33. Referenda
34. Roundtables
35. Scaling
36. Simulation
37. Squeaky Wheel
38. Surveys
39. Trial Run
40. Walking Security Index
41. Workshops
42. YIMBY Strategy

By way of a brief review, the process of selecting methods and techniques was then discussed, references to a number of texts on research methods and techniques were provided, and then Research Report 1 presented commentaries by the Principal Investigator on five of the items contained in Table 1:

- Anatomical Sourcing
- Cost-Benefit Analysis
- Life-Cycle Analysis
- Open House
- Walking Security Index.

The intent of Research Report 1 was to "…apprise Transport Canada of the methodological design of the project, report on project progress, and provide examples of commentaries for the information of experts who accept the invitation to contribute to the more detailed, forthcoming project report, *Commentaries on the Methods and Techniques that Could be Used in Making Decisions about Identifying, Adopting, or Implementing Sustainable Transport Practices."*

The terms of reference for the commentaries follow the advice expressed in Part A, of Research Report 1, that is, "… keep discussions about methods and techniques of decision making as brief, simple, and to-the-point as circumstances and skills permit." As shown, the commentaries are not longer than two pages of text in length, they are similar to the level of reading materials in undergraduate courses, and there is no writing space available to go off on much of a tangent.

Further, it was emphasized that "…these and future commentaries are not papers on their way to a refereed journal. Rather, the commentaries are standalone expressions of opinion, and they do not include references in the interests of brevity, keeping things simple, and staying on point for the respective method or technique."

In terms of the reasons for selecting the five methods and techniques to start the discourse, they are paraphrased as follows from the discussion in Research Report 1:

- Each method and technique (M&T) could be applicable to the decision-making process for any of the stages in achieving a practice (identifying, adopting, implementing), so they all have general applicability to the stages of the decision process;

- At least one M&T would likely be familiar to each of the groups involved in debates, discourse, deliberations, etc., involving decisions about sustainable transport practices, so the commentaries avoid the "ivory tower" label;

- One or more M&T would likely have been a subject of discussion in each of the disciplines noted in Table 1, Research Report 1, as having an interest in the topic of this project, which means that a wide net is cast in terms of potentially engaging different research perspectives in the current project;

- Municipal governments that have given consideration to one or more of the five methods and techniques selected for demonstration purposes would likely be at different stages of sophistication and application regarding their use, which means that one or more commentaries may bring something new to the attention of municipal governments;

- It is highly likely that one or more of the methods and techniques selected for a commentary is already receiving consideration in principle, and perhaps even in practice from several to many municipal governments, so using an M&T or two which is or are familiar to municipal governments should help to facilitate communications between the Principal Investigator and the survey respondents for the participating municipal government.

Those summary comments in Research Report 1 provided the context for Research Report 2 (Wellar, 2008b), which presented commentaries for five more methods and techniques. It was again emphasized, consistent with the purpose of Research Report 1 that the intent of this part of the project is to provide an indicative overview of the kinds of methods and techniques that ***could be used*** in making decisions about identifying, adopting, and implementing sustainable transport practices.

In terms of the overall research process, a number of experts who expressed interest in contributing to the project were invited to prepare commentaries on the existing Ms and Ts, and/or to propose new Ms and Ts to be added to the list, and provide the accompanying commentaries.

Research Report 2, containing ten commentaries, was made available as a preliminary document that responded to inquiries from municipal respondents, citizen groups, advocacy groups, members of the media, and graduate students. An additional nine commentaries have been completed, and they are now part of the bundle of 20 commentaries assembled for Research Report 3.

B. Organization of Research Report 3

This report builds directly on Research Report 2, and primarily involves adding commentaries for another nine methods and techniques, most of which are listed in Table 1. Section C contains a list of the methods and techniques selected for inclusion in Research Report 3, and the names of commentators. Section D

contains the commentaries, the summary is in section E, references are in section F, and Appendix 1 contains the names and affiliations of commentators, and their contact information.

C. Methods and Techniques, and Commentators

Table 2 contains the methods and techniques for which commentaries could be obtained within the time frame of the project's publication schedule.

The materials in Table 2 appear to be sufficient to meet the intention of Research Report 3, which is to provide an indicative overview of methods and techniques that ***could be used*** in making decisions about identifying, adopting, and implementing sustainable transport practices.

In addition, and as is shown in a number of the commentaries, many of the methods and techniques can be combined. As a result, there is considerably more content in Table 2 than may immediately meet the eye.

Table 2. Selection of Methods and Techniques that *Could Be Used* in Making Decisions about Identifying, Adopting, and Implementing Sustainable Transport Practices, and Names of Commentators

Name of Method or Technique	Commentator
1. Anatomical Sourcing	Barry Wellar
2. Benefit-Cost Analysis Cost-Benefit Analysis	Barry Wellar
3. Common Sense	Barry Wellar
4. Counterfoil Research	Barry Wellar
5. Cross-Impact Analysis	Victor Bañuls
7. Delphi Trend Forecasting	Murray Turoff
8. Dynamic Delphi	Connie White
9. Follow the Money	Barry Wellar
10. Forecasting Delphi	Murray Turoff
11. Impact Assessment (1)	William Garrison
12. Impact Assessment (2)	Barry Wellar
13. Indexing	Barry Wellar
14. Life-Cycle Analysis	Barry Wellar
15. Multi-Criteria Decision Making	Anjali Awasthi
16. Normative Delphi	Barry Wellar
17. Open House	Barry Wellar
18. Policy Delphi	Murray Turoff
19. Surveys	Jean Andrey
20. Walking Security Index	Barry Wellar

D. Commentaries on Methods and Techniques

The preamble to the commentaries was initially prepared for Research Report 2. It is repeated in the interests of report completeness, and the convenience of readers, and includes changes to the text to reflect the new information brought into the discourse on methods and techniques by adding nine more commentaries.

Several conditions or caveats associated with exploring the ***could be used*** aspect of employing methods and techniques in decision making were stated in Research Report 1, and are stated above in this report, so there should not be a need to repeat them again. However, it is my experience that it is advisable to err on the side of explicitness and over-statement when it comes to writing reports on non-trivial research methods and techniques, and particularly when the materials may be used in debates about transportation issues.

I note by way of brief elaboration that the current discussions about stimulating the economies of countries around the world frequently include a reference to infrastructure, and to transportation infrastructure in particular. Moreover, much of the discussion seems to emphasize doing things first and justifying them later, which is along the lines of the "Ready, Fire, Aim" approach to acting on a decision. The commentaries assembled for this report are designed to contribute to informed deliberations, and the following comments are intended to minimize the extent to which the commentaries could be inadvertently misconstrued, or put to purposes for which they are not intended.

First, Table 2 contains some of the types, kinds, names, or other characterizations of methods and techniques that have appeared in the sustainable transport literature, or which have been proposed as candidates for inclusion among the array of selected methods or techniques developed for this report. These are not advanced as good, better or best methods and techniques; rather, they are a selection of methods and techniques that ***could be used*** because all of them have in fact been used in transportation decision-making situations, and/or have appeared in one or more of the bodies of literature which comprise the literature on sustainable transportation. Further, the matter of how many methods and techniques could be used is a different issue, as is the matter of which methods and techniques ***should be used***.

Second, the methods and techniques are listed in alphabetical order for convenience, and their order of appearance does not necessarily indicate their value, merit, utility, complexity, power, etc., as decision-assistance instruments.

Third, the terms of reference for the commentaries in Research Report 3 follow the advice expressed in Part A of Research Report 1, that is, "… keep discussions about methods and techniques of decision making as brief, simple, and to-the-point as circumstances and skills permit." Towards that end, the

commentaries are not longer than two pages of text in length, they are similar to the level of reading materials in undergraduate courses, and opportunities for commentaries to go off on tangents are limited.

However, a *caveat* is issued for those not familiar with a skill possessed by experienced researchers-writers, namely, they can make complex methods and techniques appear easy to understand and use, but in reality internalizing these procedures and relating them to each other can be very challenging. The reminder is given, therefore, that the commentaries are an easy overview of methods and techniques that ***could be used*** in making sustainable transport decisions. Textbooks provide the details.

Fourth, it is emphasized that these commentaries are not articles on their way to a refereed journal. Rather, the commentaries are standalone expressions of opinion, and they do not include references in the interests of brevity, keeping things simple, and staying on point for the respective method or technique. This approach is consistent with the objectives and research of the project, and leaves the "heavy lifting" of a more learned report to a future project.

Fifth, I am indebted to Jean Andrey, Anjali Awasthi, Victor Bañuls, and Connie White for their commentaries, and I am especially indebted to Murray Turoff for his commentaries, his assistance in obtaining other commentaries, and his support for the idea of preparing two-page, easy-to-read commentaries on subjects which are often topics of attention in 20-page papers, and even entire dissertations or textbooks.

I note in this regard that Dr. Turoff and I met in the early 1970s at a "mini-conference" in Ottawa on research methods and public policy at which he discussed the Delphi approach with an audience of federal civil servants doing policy research, program evaluation, and developmental planning. I am most pleased that he is once again sharing his expertise and enthusiasm for public policy research and decision making with Canadians.

Sixth, a special word of thanks goes to Dr. William Garrison, Distinguished Professor Emeritus, University of California, Berkeley. Dr. Garrison provided advice on various aspects of the project, including research design suggestions, information and references regarding pertinent prior studies, and comments about the pros and cons of many of the methods and techniques listed in Table 1. In addition, Dr. Garrison prepared a commentary on impact assessment, a field of transportation in which he conducted original, pioneering research more than fifty years ago. His contributions are most appreciated.

Finally, commentaries have been obtained for a total of 19 methods and techniques, which is sufficient for an indicative overview. Information about the commentators, including affiliations, email addresses and website urls is provided in Appendix 1 for readers interested in the commentators' credentials.

Anatomical Sourcing

Barry Wellar

The term “anatomical sourcing” is used here to refer to a method of making decisions that is one of the oldest and most informal means of arriving at a decision in politics or any other aspect of life.

Further, this approach to decision making is seemingly one of the most popular but least-admitted ways of arriving at a proposed solution to a problem.

Moreover, and despite the high frequency of times that the different ways of anatomical sourcing are mentioned in comments about how decisions are arrived at by municipal government committees, agencies, and councils, I have not encountered even two pages of text on this topic in the formal literature.

However, aspects of anatomical sourcing have been mentioned for decades in newspaper stories, radio talk shows, television news broadcasts, and more recently as highly visible listserve topics involving communications critical of how decisions are reached by elected and appointed officials in local governments.

There are a number of aspects to anatomical sourcing, but comments on three of them should be sufficient to illustrate where this approach fits in the spectrum of methodologically-designed research.

Top-of-the-Head

Users of this approach make decisions that are seemingly devoid of any sign of formal thinking, there is no apparent evidence to support positions taken, and the associated question at a public meeting could be,

> “Did that answer come right off the top of your head? It sure doesn’t seem like you thought about the issue very much, very deeply, or very clearly. Have you actually read the report?”

Gut Feeling

It is likely that every reader of this document has heard an elected official make the following statement or a variation thereof at a public meeting:

> “I really do not understand what is going on; it is all so complicated with the charts and different points of view, and a lot of math, a whole lot of math, plus all those maps with routes going in different directions, so I am going to have to go with my gut on this one. I vote yes to spend the money and hope for the best.”

Knee-Jerk Reaction

The knee-jerk reaction is commonly associated with sitting on the edge of an examining table, and the doctor whacks you below the knee with a little rubber-tipped hammer to check out whether your foot moves in response to the whack.

The associated situation in decision making is to respond instinctively to a button being pushed on some issue: there is no thinking, no evidence is considered, but rather there is a conditioned response to a word, a phrase, a proposition, etc. An illustrative question posed by a journalist to a municipal councillor could be,

> "Why is it that every time a road widening proposal is presented to committee you immediately and invariably react by signifying that you are in favour, and every time a spending item comes up that involves walkways for pedestrians or facilities for cyclists, you immediately and invariably react by saying that there are other, higher priorities?"

In each of the examples of anatomical sourcing the decision-making process is easy and inexpensive, in that there is minimal to no thinking, and no evidence is collected or processed.

Under certain circumstances this kind of approach could be fully appropriate, such as replying to the very familiar and trivial question, "One sugar or two?" However, questions about identifying, adopting, or implementing sustainable transport practices are hardly ever trivial, so on its face this seemingly popular anatomical sourcing method is seriously flawed when it comes to using it in this decision environment.

As for methodologically-designed research flaws, the following limitations indicate the weaknesses of the anatomical sourcing method.

1. The likelihood of specifying the data, relationships, and tests to support top-of-the-head impressions, unthinking knee-jerk reactions, gut feelings, or similar non-scientific ways of deciding, appears to be extremely low.

2. The likelihood of contributing to information or knowledge about how to make more rational decisions in the processes of identifying, adopting or implementing sustainable transport practices appears to be extremely low.

3. The likelihood of logically explaining decisions (about sustainable transport practices) that are based on top-of-the-head impressions or musings, knee-jerk reactions, or gut feelings appears to be extremely low.

4. The anatomical sourcing method fails the tests of reproducibility, verifiability, representativeness, and other fundamental features of methodologically designed research.

Benefit-Cost Analysis/Cost-Benefit Analysis

Barry Wellar

There is a long history to benefit-cost analysis (BCA) and cost-benefit analysis (CBA). While they have different objectives and emphases, conceptually they share procedures which are fundamentally straightforward in both function and structure. For a project, or for competing or alternative projects (or plans or other matters), calculate the benefits to be derived from the project(s), calculate the costs to undertake the project(s), and then compare the totals to learn whether costs exceed benefits, or benefits exceed costs, and by how much.

In terms of appeal, BCA/CBA have much to offer if all the benefits and costs (Bs and Cs) are known, all the Bs and Cs are measurable and quantifiable, all the Bs and Cs can be expressed in monetary terms or in some other pertinent metric, and the temporal and spatial aspects of the cost and benefit items that comprise a project can be totally attributed to that project.

Conversely, BCA/CBA lose their appeal as a direct function of the unknowns, immeasurables, and uncertainties associated with the items comprising the list of costs and benefits or benefits and costs as the case may be. And they lose further appeal if other confounding features are introduced into the calculations of benefits and costs, such as differences in the time spans or geographic areas over which costs are incurred and benefits are realized.

As for the term 'analysis', if the projects, plans, operations, or other matters simply involve adding up the columns of costs and benefits, then all that is needed to conduct the BCA/CBA is knowing how to do arithmetic, or entering the numbers in a basic calculator, spread sheet, etc.

Conversely, if the BCA/CBA involves unknowns, immeasurables, uncertainties, and differences in temporal and spatial units, then the BCA/CBA could entail using a variety of estimation, interpolation, extrapolation, statistical, forecasting, fuzzy logic, and other techniques to generate the cost and benefit figures, and perform the cost and benefit comparisons.

Some of the issues in using BCA/CBA to assist in identifying, adopting, and implementing sustainable transport practices are outlined as follows.

CBA and Identifying Sustainable Transport (ST) Practices

This is the stage at which naming sustainable transport (ST) practices begins. That is, the concept of sustainable transport is unbundled and is represented by individual variables and combinations of variables which represent the different ways that ST may be achieved. During the transform process of moving from ST activities into identifying ST practices (by individuals, corporations, governments), the BCA/CBA approach assigns benefits and costs to the respective practices.

It is during this phase of the identify-adopt-implement process when it is learned whether the BCA/CBA approach is going to be relatively easy or relatively difficult to apply, and whether the degree of difficulty is going to apply equally or differentially to the modes for moving people (walking, cycling, public transit (bus, rail), private motor vehicle), freight (private motor vehicle, rail), and data (text, graphics, voice, etc.) in urban regions.

Finally, for reasons of changes in the field of sustainable transport, and in urban regions, as well as in the methodology of BCA/CBA, the use of BCA/CBA by decision makers in identifying ST practices can be an ongoing exercise.

BCA/CBA and Adopting Sustainable Transport Practices

As the identify phase proceeds it provides the BCA/CBA results for individual, competing or alternative projects, and moves the decision process into the adoption phase. That is, decision makers say “Aye” (adopt) or “Nay” (do not adopt), and part of that deliberation can include declaring whether the BCA/CBA results are sufficient, or necessary but not sufficient, or not pertinent.

If the BCA/CBA results are necessary but not sufficient for making the adopt-do not adopt decision, the BCA/CBA can be extended by incorporating new parameters, conditions, constraints etc., in the calculations. By way of illustration, full life-cycle costing could be introduced or relaxed as the case may be, different financing arrangements could be introduced, as could new population estimates, new modal split assumptions, etc.

BCA/CBA and Implementing Sustainable Transport Practices

In addition to critical questions about whether some or all costs are too high, some or all benefits are too low, or the benefit/cost ratio is not compelling, other key decision concerns about implementing sustainable transport practices involve where and when issues. That is,

- Where should one or more projects or parts of projects be located?
- In what temporal order should they be built, installed, modified, etc.?
- What are the implications of making changes in regard to where and when ST practices are implemented?

This is the important legacy issue (Garrison, 2007) that would likely have been assessed during the adoption phase, but this key feature of transportation system planning may warrant a separate BCA/CBA as one of the final checks on the completeness of the implementation phase.

As discussed above, with that foundation in place the BCA/CBA can be extended by taking into account unanticipated consequences that sometimes become apparent only after the implementation phase has been initiated.

Common Sense

Barry Wellar

It is frequently the case in society, including governments, that things are done or not done in the name of "common sense". This commentary discusses how common sense ***could be used*** in decisions about identifying, adopting, and implementing sustainable transport practices.

The common sense way of knowing is based on **everyday experience**, that is, the things that an individual does on a day-to-day basis -- sees, hears, tastes, smells, touches, reads, eats, walks, rides, drives, shovels snow, sleeps, talks, etc., -- as he/she proceeds through life. Further, the sense aspect of common sense refers to what our brains make of those experiences, and what they put into our memory banks about those everyday experiences. Consequently, every sentient human being with the mental capacity to form a thought around an everyday experience has some degree of so-called "common sense". As a result, since everyone has some common sense, it has the potential to be a useful method of decision making. However, three issues serve to illustrate the need to be prudent about relying on common sense as a decision-making method.

First, very few people are likely to share exactly the same everyday experiences, in the same places, at the same times, under the same circumstances for a day, much less a week, a month, a year, or a decade. As a result, **it is inappropriate to assume that everyday experiences are widely shared, or shared in the same way.** To illustrate, the everyday transport experience of a car driver is not the same as that of a pedestrian, which is not the same as that of a transit rider, which is not the same as that of a scooter user. Further, the everyday transport experiences of individual pedestrians, cyclists, transit riders, and car drivers are a function of routes taken, times of travel, and other mode users, so even generalizing about common sense notions by mode of travel can be risky.

The overriding message, therefore, is that people's everyday experiences involving even seemingly similar matters can be very different, which in turn makes them difficult to measure; as a result, establishing the amount of common sense that exists in support of a particular initiative can be very challenging.

Second, as a result of differences in intelligence, education, training, disposition, attitude, family life, community life, age, travel, life skills, etc., **people may perceive everyday experiences differently.** By way of illustration, some drivers may regard it as common sense to slow down when weather conditions turn nasty, whereas others may disagree and drive at or above the posted speed; some transit riders may think it common sense to give up a seat to an older person, and others may think it is common sense for the person who got there first to keep the seat; and, some pedestrians may think it is common sense to cross as soon as a walk signal appears, and others may think it common sense

to wait until there are no moving vehicles approaching. In cases where opinions collide the question arises: "Whose common sense do we believe?"

Third, **everyday experience is by definition an historical phenomenon**, that is, a record of things that have already occurred. As a result, individuals who have fallen on an icy sidewalk or seen others fall have a memory of the experience(s), and may share a "common sense" solution based on what they experienced on previous occasions. That is, they may believe that the municipality should have responded to weather reports and cleared the snow in a timely fashion, scraped the sidewalks bare of ice, and applied grit and salt as needed to prevent slipping.

However, the common sense situation is different for someone who has no previous experience with icy sidewalks. This person has no basis (experience) for appreciating the slip-and-fall risks, and no basis (experience) for expecting or suggesting the same kind of solution that occurs to others who have shared the experience, and have a perception of how it can be dealt with (avoided) in future.

In the case of sustainable transport practice in an urban region, the amount and quality of common sense that a person has accumulated in regard to this topic depends upon his/her experience with the different modes (e.g., the walk, cycle, scooter, transit, and private motor vehicle modes of people transport; the rail, private motor vehicle, and bike courier modes of freight transport, as well as all the data movement modes), the temporal nature of this experience (e.g., used one, some, or all modes every day over the past six months or the past 20 years, or just occasionally), and used one, several, or all modes in one, several, or many neighbourhoods throughout the urban region.

The key point is that what is generally referred to as "common sense" is a direct reflection of each individual's everyday (common) experience (sense). As a result, the more that the same experiences are shared, the more those individuals have a common basis for decisions. And, the more those individuals perceive (sense) things in the same way, the more those individuals have a shared basis for decision making. Clearly, a mayor and council with a lot of common sense (in the manner described above) are well-placed to achieve convergence in making sustainable transport practice decisions. And, conversely, the less everyday experience they share, the smaller the basis they have for finding common ground as a basis for arriving at informed decisions.

In closing, it is emphasized that **common sense only applies to matters that are already part of everyday experience**. If decisions about some sustainable transport practices involve new issues, new events, etc., that cannot be related to prior, everyday experience, then there is no common sense to bring to bear on these decisions. As a result, other methods or techniques must be used as the primary basis for the identifying, adopting, and implementing practices, but common sense could potentially be used to evaluate the decisions.

Cross-Impact Analysis

Victor A. Bañuls

The cross-impact analysis (CIA) method is a powerful analysis tool for taking a set of binary future events and examining the potential causal impacts the expectation or occurrence of the event may have on the others in the set. The CIA was designed to calculate the basic impact of a political, social or technological event on the occurrence probability of other events in the set.

Nowadays, several of the most recognized methodologies to generate scenarios are based on the CIA. The use of scenarios to study the future is well known as an approach to studying situations that can lead to extreme change, as well as situations for which it is difficult to create explicit relationships between events.

Examples are the merger of two companies, extreme disaster or risk situations, major political happenings, and/or the long-term impacts of new or changing regulations or policies. All the events in the set are of a binary nature: a merger will or will not occur; a specific new policy will be established or not; a company will or will not go bankrupt; a given technological breakthrough will occur or not; and so on.

The basic concept of CIA is “structural modeling”, where professionals who are knowledgeable about at least some portion of the event set can estimate subjective probabilities which allow the computer to establish a consistent model for one individual, or for a group of individuals. The success of the approach is mainly due to it being a flexible methodology that can be combined with other approaches, such as the Delphi or multicriteria methods, to allow true collaborative model building and scenario creation by groups.

CIA Basics

The CIA is based on the principle that the occurrence of events is not independent of one another. An individual or a group must come up with a set of interrelated events that might occur in the future. It needs to be a balanced set, in that the interrelated subset of events that influence one another are often matched by a subset of external events that are largely not influenced by the interrelated set. Often the analysis itself determines which events the group judges to be external. A pure brain storming or simple Delphi approach might be used to generate candidates (events) for the model. Actual uses of the model range from tasks such as determining which events may turn out to be more or less relevant than others, to creating a final scenario or set determination in an iterative process.

There are several different structural model versions of CIA approaches. The basic steps in the approach are:

1. Take the events that have been chosen and ask the professionals and/or or other participants (estimators) to estimate the subjective probability that each event will occur in some future time frame, such as five years. Then perturb their judgments a maximum amount.
    a. For events that have a probability of less than .5 ask the estimators to assume it will occur, and to re-estimate the probability of the other events occurring under this hypothesis.
    b. For events that have a probability of .5 or more, ask the estimators to assume that event will not occur and to re-estimate the probability of the other events to occur.
2. Once this set of n(n-1) estimates have been made for the n events, the computer can generate a complete working structural model that may now be used.
3. If a working model is available to each participant, it is desirable to let participants use the model to reach consistency among their individual estimates. It is then possible to use the data to carry out a more consistent averaging process to reach a collaborative result for a version of the model.
4. If the event set spans many different professional areas, then users are more likely to want to estimate probabilities only for those events and event interactions they are more familiar with, and that has to be done as a facilitated process such as in a Delphi.

Once a model has been established for the group or for an individual, it is possible to vary the initial probabilities for individual events and see the degree of influence that change has on the occurrence of the other events.

There are also internal measures that express quantifiably to what degree a given event is controlled external to the set, which indicates either that an event is truly external or that events might be missing that should have been included. One can also quickly list which events have the most influence on which other events.

Due to the nature of the model it is possible to build subsets of multi- event, mini-scenarios of which two, three, or four events always seem to happen or not happen in a combination. One can then create a new event set made up of compound events, and in fact reduce the complexity of the problem from n different events to a much smaller number of multi-event scenarios, including the extreme result of one scenario made up of all the events. However, this should be done with the help of someone who knows the internal workings of the CIA model well enough to be able to use the internal parameters to present a sensitivity analysis for the user group as a whole.

Since probabilities are highly non-linear variables, it follows that understanding of the consequences of the model and the estimations comes easier for those with a good understanding of the mathematical properties of the CIA method. Where

that understanding is not present, it is our experience that some guidance is required for most user groups, and especially the first time that they go though the process of using the model as an input to planning.

The most powerful benefit of CIA in the long run, is to reduce very complex situations to simpler ones by developing summary scenarios that express the most likely futures based upon some of the decision options and actions that are contained in the initial event set.

An excellent example of this is that of identifying sustainable transport practices for a large urban area or a nation as a whole. The first matter of complexity is the uncertainty of what is entailed in ranking different alternatives in a future time horizon. The second problem is caused by the diversity of stakeholders involved in the process. This multiplicity of interests, together with the uncertainty related to the forecasted results, can be solved by using CIA to:

(1) Build descriptions of possible futures for alternative transportation modes, systems, configurations, etc.
(2) Aggregate the estimations and the priorities of the diverse stakeholders involved in the process.

Based on these future visions given by the CIA, policy makers should be able to explore different courses of action in regard to identifying, adopting, and implementing sustainable transport practices which best support achieving sustainable transport policies.

Using the results of CIA, decision makers have a set of alternatives and a probability of occurrence for the outcomes associated with the alternatives. Moreover, the fact that CIA is based on the principle that the occurrence of events is not independent, may help in analyzing interactions between events and detecting key drivers in the future of transportation. The likelihood that these key drivers will be markedly different from what is prevalent today further underscores the utility of the CIA method as a means for estimating the potential causal impacts associated with changes in existing transport modes, or the addition of alternatives.

Both the dynamic Delphi method and the Delphi trend forecasting method can be used to generate potential candidate events for a CIA study, and those doing a CIA model should be able to capture event possibilities from other related planning efforts. Once again the model can be set up as a continuous one, which directly serves the purpose of planning or other functions which operate, or should operate, as continuous processes. Finally, multi-criteria decision-making methods would be integrated in CIA analysis in order to support the scenario-based, decision-making process, and help decision makers choose the most desirable scenario.

Counterfoil Research

Barry Wellar

Among its many features, counterfoil research (CR) **challenges** conventional wisdom, **confronts** the bandwagon effect, **ensures** that opposing alternatives are explicitly recognized, substitutes **evidence** for unfounded enthusiasm, and emphasizes that the **right way to do things** is to provide a full and fair hearing for different and opposing points of view. While this may be seen as a contrarian procedure, it is not; rather, it is another means of improving the validity, reliability, reproducibility, and credibility of research processes and decision outcomes, which in point of fact is the essence of methodologically-designed research.

(**Note:** The CR line of thinking began for me while in graduate studies at Northwestern University in the 1960s, was expanded while I was at the Ministry of State for Urban Affairs, 1972-1979, and has been ever-present during my involvement in community affairs in a number of cities in Canada, the U.S., and abroad over the past 40 years. Any seeming reference to particular municipal councils, or municipal officials, is purely coincidental.)

It is my impression that few municipal governments in Canada have formally adopted counterfoil research (CR) as a practice to incorporate in decision making, so this commentary is written at the "Methods 101" level. Readers who want more depth can find it in textbooks and by searching the Internet.

To introduce the counterfoil research method, I first briefly characterize the thinking among officials sitting at "the comfortable committee table" at city hall.

Comfortable Committee Table

Around this table the following thoughts, and admonitions-to-self, arise when the presentation on a complex and controversial sustainable transport issue concludes, and **all eyes are on the committee members** as they begin to deliberate the report's findings, recommendations, and implications:

- Don't rock the boat! Don't make waves!
- Where is the path of least resistance on this one?
- Remember: You get along by going along.
- Ask no questions if you won't understand the answers.
- Damn, is that woman from the community newspaper here again?
- Better to look wise and say nothing, than to ask a question and get an answer that makes people in the public gallery snicker.
- These consultants and city staff could be in my ward next, so what happens if I disagree with their report?
- Is this a good time to suggest another study?
- This situation is dragging and dragging, is there no way to move it off the table and away from the media?

- Will I be seen as a trouble-maker if I disagree with the basic premise behind the study?
- Why don't we just do things the way we always have?

It is my experience in government, and in communication with others in government, that **many elected officials and staff opt to "go with the flow"** whenever the opportunity presents itself. Rarely do they rouse themselves to take serious, protracted, informed issue with such fundamental research concerns as assumptions, premises, quality of data, representativeness of data, methods of research design, logic of hypotheses, biases, powers of techniques of analysis, theoretical underpinnings of empirical "findings", the robustness of interpretations, or the soundness of generalizations.

Enlightening Committee Table

In city halls where elected officials and staff are **conscientious** about public issues, they sit around what might be called "the enlightening committee table". These are some of the thoughts they have, and public statements they make:

- I'm from Missouri on this notion, and I do not accept the recommendation.
- I am totally skeptical about those findings. What methods were used, and why, to make the predictions?
- I'd have to suspend disbelief to buy that reasoning. The time series run for 30 years, why did you only use the last 30 months?
- Is there any substantive evidence to support that recommendation?
- How hard did you try to find an alternative explanation?
- Does everyone believe, with certainty, that this is the best way to go?
- We have only heard from transportation experts who want to build roads. When do we hear the transportation experts opposed to road-building?
- For years staff argued to go north-south with LRT, and now they are arguing to go east-west with BRT. This research process is illogical.
- Staff agreed with the consultants when they bent one way, and now they agree with them when they bend the other way? What is going on?
- The consultants got a lot of money to produce that LRT plan, and even more to defend it. How much was spent to challenge it from premises and assumptions through analysis to interpretations and findings?

Counterfoil research could be pertinent to any situations or circumstances involving non-trivial aspects of identifying, adopting, or implementing sustainable transport practices, and could even be used as an accountability instrument.

That is, since the CR method can be used throughout the sustainable transport decision-making process, it is a means for elected officials to oblige staff and consultants to provide detailed accounts of how and where the CR method is used in a project, and to provide detailed explanations of why it is not used.

Delphi Trend Forecasting

Murray Turoff

The objective of this type of Delphi process is to forecast (with foresight) a particular trend or set of trends. This might be the sales of a new product, the investment in a government program, demographics of a particular town, or market share for various modes of transportation. The concept is that such trends are affected by both controllable decisions and external events. One desires a forecast that contains not just the projection, but the rational model representing what knowledgeable professionals think will and could affect the future projection of the trend curve. Usually, using the Delphi rule of 3-5 professionals required in a given, related subject area, a heterogeneous group concerned with the future of non-trivial variables (sales, investments, market shares) easily numbers 15 or more professionals. The process is as follows

1. One presents the group responsible for each trend at least a five-year historical curve, and asks everyone to draw the curve five to ten years into the future on the provided graph (this can be done online by asking for numbers every year or two). Group members are then asked to fill in the following information:
    a. **Assumptions**: three to five of the major assumptions they are making about what will be true in the future.
    b. **Uncertainties**: three to five of the major uncertainties they have. These are things they are assuming will not be true, but if they became true they would change the projection they are making.
2. By examining the results for the group it becomes clear that some people's uncertainties are other people's assumptions, so that after eliminating overlaps one makes a list for a given curve of all these items and calls them "**potential assumptions**."
3. In the second round the group is now asked to take the list of **potential assumptions** and vote on the validity of each item on a scale of "**certain to occur**" to "**certain to not occur**" with "**maybe**" in the middle.
4. The assumptions for the given curve are then listed in order of the scale from those that are certain to occur to those that are certain to not occur.
5. The effort might conclude at this point by asking everyone to redraw his/her curve given the average original projection, the 50% range and the 100% ranges of projections, and the assumption list representing the **collective group model** of what is influencing the future of this curve.
6. The exercise might proceed with the same group or a new group with a mission oriented to focusing on the middle set of assumptions clustered around the "maybe" category.
    a. The voting distribution is examined to ascertain whether the vote on "maybe" was a **flat** distribution or a **polarized** distribution.
    b. If flat, this indicates either **ambiguity** or basic **uncertainties** that could be eliminated or resolved by more information from the subset of professionals with expert knowledge about the topic.

   c. If polarized, individuals at the extreme points (greatest **disagreement**) should be asked to present the reasons for their opposing views for consideration by the group as a whole.
7. Another option is to determine which of these potential "maybe" assumptions can be:
   a. Influenced by the organization doing the study, and what are the **actions, options, and costs** necessary to exert this influence.
   b. Considered to be **external events** that are not controllable or influenced by the organization doing the study, and how they can be **detected or measured** as to when they may occur in the future.
   c. It is also necessary to rate relatively how large an influence any of the above items can have.
8. Whether one or both of these additions (#6, #7) are undertaken, changes may be needed to the mix of professionals who make up the respondent group in either of the above options.

Whatever path of analysis is taken in the Delphi trend forecasting activity depends very much on the overall objectives of the sponsor of the study. Design options include a simple straightforward three round Delphi, or a five-round process in which disagreements are actively investigated rather than just documented in the first three rounds. And, it can also be a continuous process done online by a planning group which taps professionals throughout the organization, or consultants, to input their insights on a regular basis. Thus, any part of the process could be updated whenever there is new information to be used to update this rather unique type of "collaborative intelligence" system for an organization.

This Delphi process might also be merged with what is referred to as cross impact analysis (CIA), which can be used to investigate the relationships between future binary events. These events usually make up many of the assumptions that are brought out in this type of trend study, and/or in studies using the dynamic Delphi system which analyzes in more detail the consequences of various decision and action options that are usually made explicit when examining how an organization can act to influence the future.

We have seen the fallacy of making decisions on the advice of sole individuals paid such extraordinary amounts that they can't admit to needing major planning efforts to really understand future options. Perhaps organizations will begin to return to the efforts and processes that are really needed to do planning that takes advantage of all the knowledge that the organization has available. These Delphi processes would allow professionals from every part of the organization to contribute to both the process and to the resulting collaborative knowledge bases. Processes such as the Delphi trend forecast, cross impact, and dynamic option rating could be used to guide the options chosen for organizations and their missions, as well as providing an organizational memory that allows the evaluation of actions and efforts against a valid assessment of past performance.

Dynamic Delphi

Connie White

The dynamic Delphi process is an online decision support system available to users anywhere there is WEB connectivity. It is designed to support large groups of professionals engaged in urgent, distributed, dynamic decision and option analysis activities.

This process is designed to handle real-world problems, and can be used where distributed subgroups and individuals are determining the options and analyzing them to solve a complex problem or emergency. And as a further important feature of the dynamic Delphi approach, by virtue of being dynamic it provides a real-time mechanism to support continuous planning operations, whereby many individuals add intelligence and new input to the updating of plans, or deal with new products, cost overruns, and other events.

The central idea behind a Delphi process is that the collective opinion of a group of professionals is more accurate and informed than their separate opinions.

That is, the group approach produces "**collective intelligence**", and is a means for a number of professionals to interact in such a way that: 1) They can offer a feasible and analyzed list of options from which a decision maker can select the mix that satisfies the current problem; and, 2) They can better understand why some options were less satisfactory than those chosen.

A dynamic Delphi process can be used to help a group of professionals identify, evaluate and select an optimal-ranked list of options.

This particular method uses voting to identify areas of agreement and disagreement. Exposing areas of disagreement informs the group where they may need to focus their discussion input. On the other hand, letting a group know that they agree on an issue informs participants in a timely manner that consensus has been reached, and directs them to concentrate their effort on the next item on the agenda. While it is always important to respect the participants' time, it is even more important to do so in this environment because of the urgent aspect that could underlie the problem under consideration.

In a Delphi with heterogeneous professionals, they are asked to vote only on what they feel confident about, or wait until more information on uncertainties is provided by other experts in a field. Participants are informed of how many participants have voted on a given item, as well as the degree to which more votes are expected in the future and how that could affect the results.

This Delphi process is dynamic because of the following reasons:

- An expert can **participate in any phase** of the decision-making process at any time, that is, 1) problem identification, 2) information gathering, 3) solution generation, 4) evaluation.

  - This feature allows individuals to have discussions in forums where they can present information and debate issues as replies to specific options. Because the dialogue is text-based, others can read and benefit from the content.
- An expert can **participate online** at any time during the day or night, given an Internet connection and web browser.
  - This feature helps professionals dedicate thoughts and ideas to the discourse as they arise after having time to think about a problem. This means they can choose a time to participate that is convenient for them. However, when some issues call for face-to-face meetings, the Dynamic Delphi approach can be used in preparation for, during, and/or after the group meeting as the meeting agenda or summary instrument.
- There is **real-time feedback** of both the professionals' individual opinions and of the group's opinion
- Experts can vote, change their votes or withhold their votes for some reason.
  - The merits of the situation can change, or new information can sway opinions. Either way, the vote mimics the real-time opinion of the expert and, hence, the group.
- Not all members of the group have to interact in order for a decision process to continue.
  - There may be cases where some of the participants cannot be present, or they may feel they do not have the expertise to engage in a specific option.
- Uncertainty as to the status of the current vote (How final are the votes?) is calculated, and produced as feedback to the participants.
- The system requests individual comparisons of options for preferences, and **converts this rank-order information to an interval scale** where distance represents the degree of preference between options.
  - This method has been modified to handle incomplete data with respect to participation in voting.

As an example for this Transport Canada project, a mission to examine options for implementing sustainable transport practices could entail the need for professionals in 20 to 30 different professional fields, including expertise regarding insurance and liability matters which restrict or prohibit using privately-owned vehicles for collective uses such as car-pooling, ride-sharing, etc.

Other methods such as Delphi trend forecasting and cross-impact analysis are useful for generating the need to develop options in specific areas of a planning operation. However, when it comes to taking options and discussing them on a relative basis in order to have the information to choose which options should go forward to implementation, the dynamic Delphi will be the most useful way to involve a large, heterogeneous group necessary to uncover all the potential bottlenecks and concerns that must be addressed and reconciled.

Follow the Money

Barry Wellar

While some elements of this method of decision making have remained constant for many decades, other elements have undergone major changes in recent years. As a result, it is important for all affected parties -- politicians, professional staff, and citizens -- to understand which element(s) of the follow the money method is (are) driving decisions. Some of the elements and their strengths/weaknesses may be summarized as follows.

The follow the money or FtM method is sometimes confused with a related method referred to as the other people's money (OPM) method, because **a core element of FtM is to base decisions involving capital projects on how much money can be obtained from other governments.** By way of illustration, if the federal and provincial governments in combination cover 90 per cent of the capital costs of a project, then that becomes a "ten cents on the dollar" initiative by a municipal government. As shown by the Canadian record over the past 40 or so years, a project with that level of funding is very attractive relative to one which requires the municipality to put up 80 or 100 per cent of the capital cost.

Similarly, and more importantly for many infrastructure programs, when it comes to the matter of never-ending and ever-increasing operating costs, municipal governments are much attracted to initiatives for which the **cost-sharing burden** falls in part, or, better yet, largely on other governments. The key point is that capital costs have an end, but operating costs continue until the facility is de-commissioned and removed, so there is considerable appeal in following money trails to the coffers of other governments if they lead to operating cost relief.

One major attraction of this method is that municipal politicians and staff can provide infrastructure at perceived bargain prices, property taxes do not take a hit, and municipal taxpayers can seemingly enjoy an infrastructure which is far "richer" than the one available if the money trail did not extend beyond city hall.

Unfortunately for municipal governments, a major weakness of the FtM approach lies in the **absence of guarantees** that the full amount of promised or expected capital funding or operating support will be provided in a timely, unconditional matter. Consequently, the FtM method can be the source of nasty surprises. And, as bad luck would have it, the bigger the project dollarwise, the greater its indivisibilities, the longer its lifespan, and the deeper its legacy hooks, **the nastier the surprises** when things go awry and for political, financial, or other reasons the money trail suddenly disappears leaving municipal governments holding the bag.

Other elements under the FtM umbrella include "zero-based budgeting", "lowest bid selection procedures", "value for money", "accountability", "the buck stops here", "zero means zero", and "the bottom line". In all cases **the focus is on "the**

money" raised and spent by municipal governments, and "the money" is a key factor in making decisions to do or not to do things, such as identifying, adopting, and implementing sustainable transport practices.

All these elements and others have aspects or dimensions that cause their presence to be felt regularly at municipal council and committee meetings, and always during budget deliberations. And, since money is involved, other parties such as corporations and ordinary citizens have an interest in the money trail, and especially if it leads to their tax bills and then their bank accounts/wallets.

In the remainder of this commentary about FtM I note characteristics of elements that illustrate why the FtM method ***could be used*** **in making or challenging decisions** in any of the identifying, adopting, and implementing phases:

- "**Equity**": Who receives the benefits, and who pays? FtM.

- "**Accountability**": Who approved the expenditures? FtM.

- "**Value for money**": Look to the opportunity costs, bearing in mind that knowing the cost of everything and the value of nothing does not bode well for achieving sustainable transport systems. FtM.

- **"Penny wise and pound foolish"**. Who determined that it is cheaper to pay the costs of civil suits than to properly maintain roads and sidewalks in winter? FtM.

- **"Pay me a little now or pay me a lot later"**. Words to this effect were/are used in an ad for Fram oil filters, and the point was/is to replace the oil filter at regular intervals for about $10, or run the risk of an engine job costing a lot more, say $2500. The Fram filter message is fully applicable to a number of sustainable transport deliberations, and is very relevant to situations involving pedestrians who trip on broken or icy sidewalks, cyclists who cannot safely navigate poorly-designed or non-existent bike lanes, transit riders who must clamber over snow banks to access or egress buses, and motorists who cannot evade wide and deep potholes, all of whom can and do sue municipal governments for redress. One informative way to learn about the reasons behind the decisions? FtM.

It is appropriate to emphasize in closing that the **follow the money method is directly related to at least ten of the other methods identified in these reports,** including benefit-cost analysis, impact assessment, cost-effectiveness analysis, highest and best use, life-cycle analysis, squeaky wheel, and those such as Walking Security Index which assigns responsibility and liability to municipalities for achieving practices that provide safe passage of pedestrians.

Impact Assessment (1)

William Garrison

(**Principal Investigator's forenote**: *In the late 1950s, William Garrison pioneered impact assessment (IA) studies in the transportation field while he was at the University of Washington, and he brought that work to my attention while I was a graduate student at Northwestern University in the late 1960s. In the early 1970s I extended Dr. Garrison's work into the environmental impact assessment field through a project for the U.S. Army Corps of Engineers, and did so again in the early 1980s when Prof. Len Gertler invited me to write a paper on urban impact assessment for a special issue of the Canadian Journal of Regional Science. During a recent meeting at the University of California, Berkeley, Dr. Garrison and I discussed the methodologies, methods and techniques direction of this project, and he generously agreed to provide a brief note on impact assessment for Research Report 3.* B. Wellar.*)*

The impacts of a change in transportation range widely. As a result, placing a net over them runs the risk of reciting boring classifications and list-making. There's also the risk of over-simplification.

It's useful to use division. First, divide the impacts of improvements into those that are **on-system** and those that are **off-system**, with on-system referring to such things as vehicle velocity, energy consumption, seat availability, safety, congestion, and pavement quality.

Experts have much to say about on-system impacts, for there are knowledgeable practitioners in each mode who hold impact knowledge. Indeed, experts involved in project proposals or alternatives generation may be the sole source of impact information. That's a rub, for experts may be already committed to project values, and use claims of expertise to press for decisions.

Another point is that **perceptions** enter the picture: others, for example elected officials and ordinary citizens, may see the world differently than experts, and they may differ from each other.

While transportation systems are technical entities, they serve society, and individuals and institutions are involved in their construction and operations. Experts sometimes forget that others may see things differently, and that sometimes the experts themselves are perception-laden. For instance, many planners and analysts work 9 to 5 in central business districts (CBDs), and they perceive transportation in that commuting context.

Having provided a taste for our subject, it's wise to present several *caveats* to bear in mind where impact assessment activity is concerned:

- Changes may be stated (promised) as cheaper, faster, better although they could have an inverse more expensive, slower, worse character.
- Reference will generally be made to projects, although plans and operations changes also have impacts that should not be overlooked or discounted.
- Experts come in great variety and in numerous guises, so it is important to do your homework when hiring or listening to experts.
- Analyses under names such as benefit/cost treat impacts, and it is important to be aware of the different methods and techniques that could be useful. The commentaries in this report are indicative of how impact assessments can be conducted.
- IA is a fill-in-the-blank subject because transport decisions have a wide array of economic, environmental, real estate, land value, etc., impacts, so care must be taken to include all the impact domains pertinent to the goals and objectives which are driving decisions about sustainable transport practices.

There is a long list of topics that must be simplified in this summary discussion, and the reader is asked to generalize.

In a sense, the fundamental on-system impact questions are, “What should the people do for transportation?” and, “What investments or changes in operations should be made?” The basic off-system questions are, “What should transportation do for people?”, and “How will changes in services make my life better overall?” The Roman roads extended Roman power. The first toll roads in England raised rents for farmland. Who gained, who lost? Classification plus a little reasoning may be helpful in thinking about such questions.

Frequently, off-system impact inquiries center on inputs to systems: cement and steel, land, energy for operations, and such.

Less frequently, the focus is on outputs. Here is where the sledding gets tough. Transportation is so much a part of everyday life that we seem to ignore how many different ways it affects our local, regional and national economies, as well as our social interactions at the neighborhood and community levels, and the quality of our local and regional environments.

It is also true that output impacts are frequently yesterday’s stories. One such story is that of the street car, and how it opened options for specialized shopping, working, recreation, and home construction. An important question here is, “**What lessons have we learned** over the years about doing different kinds of transportation impact studies, and how do they apply to making better decisions today and tomorrow about achieving sustainable transport best practices?”

Impact Assessment (2)

Barry Wellar

Conceptually and operationally, the field generally referred to as impact assessment (IA) encompasses some of the most powerful bodies of methods and techniques that could be used to assist in making decisions about identifying, adopting, and implementing sustainable transport practices.

The price to be paid for this capability is that the degree of technical difficulty is relatively high. On the other hand, a bit of technical difficulty is a small price to pay to achieve sustainable transport best practices in the face of capital and operating transportation costs that amount to millions of dollars every year in Canada's urban centres, to say nothing of the impact that excessive consumption of fossil fuel has on the environment, public health, and the earth's climate.

In this commentary I outline a selection of distinguishing features of impact assessment, including several that may assist the reader decide how to peruse the 4,850,000 results that a Google search (November 29, 2008) located for the phrase "Impact Assessment".

First, impact assessment is conceptually and operationally different from the related fields of activity known as policy analysis, policy research, or impact analysis in one very fundamental respect. While the latter approaches are concerned in varying degree with the basic who, what, where, when, why, and how of policy considerations,

> ***Impact Assessment (IA) contains an explicit evaluative component regarding the consequences of public policy processes, and the associated plan, development, and program interventions which implement public policies.***

Since the evaluative feature is central to ranking potential sustainable transport practices from worst to best, IA could be used to assist decision making in each of the identifying, adopting, and implementing phases.

Second, by design IA establishes **relationships between causes** (policy, plan, development, or program interventions) **and effects** (consequences arising from interventions), which means that IA could be used during the process of identifying, adopting, and implementing sustainable transport practices, all of which involve interventions to either do or not do something about a situation.

Third, an IA is a **multi-tasking capability** that can be structured to deal with evaluating policy, plan, development, and program consequences on a sectoral basis (e.g. environment, finance, energy, economic, social, health, resource consumption, etc.), or on a multi-sectoral basis (two or more sectors are combined in the evaluation of consequences). As a result of that flexibility, and very importantly for this project, the IA can be structured to evaluate the consequences of identifying and not identifying, adopting and not adopting, and

implementing and not implementing sustainable transport practices for people and freight transport modes, as well as for an entire urban transport system.

Fourth, an IA study can be organized on a **spatial basis**, which means that it can operate at the most disaggregate level for which data are available or can be collected, such as intersections for the road network, postal codes for the origins and destinations of cyclists, pedsheds for transit users, and traffic zones for the origins, distributions, and destinations of person and cargo trips by private motor vehicle operators. The consequences of interventions (sustainable transport practices) can therefore be evaluated wherever they occur, by mode, on a neighbourhood-by-neighbourhood, ward-by-ward, or other locational basis throughout the urban region. Moreover, and directly pertinent to this project on sustainable transport practices, the IA exercise can be designed to yield evaluative statements about the health, economic, environmental, social, or other consequences of changes in accessibility, mobility, etc., due to interventions.

Fifth, impact assessment exercises are **longitudinal** rather than cross-sectional studies. As a result, in addition to being a means to evaluating the consequences of states of affairs at points-in-time, such as annually, IA can be applied to processes by adding a points-over-time dimension to capabilities noted above. Hence, the process of identifying, adopting, and implementing sustainable transport practices can be associated with such processes as urbanization, intensification, densification, sprawl, congestion, environmental degradation, and resource depletion on a fine-screened temporal basis, such as hourly or daily.

Sixth, IA is a form of **macro method,** and provides an analytical/synthetical umbrella for other methods and techniques in Table 1 that can contribute to an evaluation of consequences arising from interventions. Candidates for inclusion in an IA exercise evaluating the consequences of identifying, adopting, and implementing sustainable transport practices include the methods and techniques in Table 1 which are numbered 7, 9, 10, 11, 12, 13, 16, 17, 19, 20, 21, 22, 23, , 27, 29, 30, 31, 36, and 38.

Application of the IA approach at the identifying stage includes situations where empirical evidence is available for deriving the variables representing sustainable transport consequences of interest to municipal officials and citizens. The IA method could therefore be used for the all-important task of deciding which variables are designed into or out of a policy, plan, or program at the identifying stage. At the adoption stage IA has various uses, such as evaluating how, for example, part or parts of a transportation system could be affected by increasing or decreasing modal splits should a policy, plan, development, or program intervention be adopted to achieve a particular sustainable transport practice. Finally, the most obvious, potential application of IA is to the implementation phase, since it is unlikely that any municipal government in Canada would decide to proceed or not proceed with a non-trivial transportation intervention without **first having carefully evaluated the consequences of the decision.**

Indexing

Barry Wellar

The design and application of indexes is a highly effective method of quantitatively describing states of affairs, for developing transparent, alternative processes to address problems or pursue objectives, and for analytically evaluating the consequences of public and private sector proposals and initiatives. An argument can be made that governments, corporations, and other groups which do not include indexing among their suite of performance measurement and evaluation tools are not missing out on an information source that can significantly improve all aspects of decision making.

The indexing method can be generally summarized as follows. For a set of **variables**, such as those specified to measure quality of life, quality of housing, state of the environment, cost of living, intersection safety, intelligence, social interaction, and body mass, a formula, expression, equation, balance sheet, spread sheet, matrix, or other means is used to structure the relationship between and among variables, and record observations about variables. The results from applying the observation data to the variables are tabulated to create **scores** for each of the study units (intersections, road networks, shopping centres, baskets of food, countries, neighbourhoods, brains, human bodies, etc.,), the scores for the study units are **rank-ordered** from best to worst, highest to lowest, or vice versa, and the technical part of the indexing work is done.

With the study units now assigned to their relative positions, and depending upon the purpose of the indexing exercise, attention can now be focussed on the **rankings and scores that are of concern**, such as those representing worst intersections for safety, highest costs for a basket of food, worst countries for quality of life, worst school districts in terms of numbers of obese teenagers, and best neighbourhoods for public participation in civic affairs.

As an index illustration for this project, consider what might be termed a **"sustainable transport index"** or STI. For the STI, the number of persons travelling by the walk, cycle, transit, and private motor vehicle modes are recorded for signalized intersections. On the basis of the recorded observations, the numbers travelling by each mode are tabulated for each intersection, weights are assigned to each mode, and scores are produced for each intersection using the STI formulation that favours walking, cycling and transit movement in that order, and penalizes private motor vehicle trips.

If there are 500 signalized intersections in the study area, the scores rank them from most sustainable to least sustainable in terms of use by the travelling public. The 500 intersections can be treated as a single entity or, alternatively, to make better use of the information that can be derived from such an index, the intersections can be assigned to **classes** which reflect a spectrum of sustainable transport practices labelled best, better, and good on one side, and bad, worse,

and worst on the other side, with a neutral class in the middle for design logic purposes. The class approach could inform a municipal government and citizens about opportunities to enhance the city's performance involving sustainable transport practices. Kinds of **information to extract from the scores and rankings** include directions about where to focus targeted improvements on an intersection-by-intersection basis, and which classes of scores and rankings are most deserving of attention in order to learn which class of entities is likely to yield the best sustainable transport rates-of-return for the different practices that are identified, adopted, and implemented.

A key strength of this method is that the **rigour** associated with developing and applying indexes counters a common problem faced by municipal governments, advisory bodies, the police, citizens, and others dealing with **large numbers** of intersections, street segments, sidewalks, pedestrians, cyclists, buses, transit riders, and private motor vehicles and their operators and occupants. That is, in the absence of quantitative measures such as those provided by indexes, municipal government officials, citizens, and all other groups and individuals are often just guessing about which intersections, road segments, sidewalks, sections of bus routes, etc., are better or worse than others. Moreover, since this uncertainty prevails day after day, year after year, it does so at great expense in terms of misallocated resources, time consumed in meetings, the costs of not correcting problems, the stress of problems not being resolved, and the general loss of regard for municipal government as a decision-making body. The systematic application of indexes could be used to overcome such problems

Decisions about identifying practices could be based on using index scores and ranks in combination with the spectrum of ratings (worst to best) to select candidates to put forward for potential adoption, and the adoption process could be based on index-using decision rules such as which practices would most effectively and efficiently reduce transport-related CO_2 emissions. Further, the process of deciding which sustainable transport practices to implement could be based on parallel bodies of logic. As for **parameters to take into account** in constructing indexes to assist in making decisions about sustainable transport practices, they could include public health, public safety, pollution, finance, energy, equity, legacy, engenderment, and overall transport network flexibility.

Finally, it needs to be emphasized that decisions about identifying, adopting, and implementing sustainable transport practices are not made by the indexes or the people who create and administer the indexes. Rather, these decisions rest with municipal councils and their agents. **Indexes,** like all methods and techniques, **contribute information** that can be taken into account, or not, by officials responsible for sustainable transport decisions. That said, it seems likely that as pressure grows to achieve sustainable transport practices, municipal bodies which have not embraced indexes may be increasingly called upon by citizens to explain why indexes are not used. This commentary is a heads-up to the effect that **indexes could be used**, and I see no basis to argue otherwise.

Life-Cycle Analysis

Barry Wellar

The ideas behind "life cycle-related" concepts and associated methods and techniques come from a variety of disciplines, are used in a number of fields including construction, engineering, and manufacturing. Moreover, they received a substantial boost in popularity when they were embraced back in the 1970s for their contributions to defining and measuring sustainability.

As a result, there is a rich and diverse body of "life cycle" experience and documentation, with 'analysis', 'assessment', 'cost analysis', 'costing', 'engineering' 'impact assessment', 'inventory', and 'management' among the members of the life-cycle family referred to in the learned, government, professional, and other literatures.

Although any member of the life-cycle family would make useful contributions to the process of making decisions about identifying, adopting, and implementing sustainable transport practices, the **life-cycle analysis** technique is selected for this report for reasons which are outlined below.

It is appropriate at this early point in the commentary to belabour the obvious and emphasize that the term "life cycle" means just that, i.e., the **full life of the project**.

Therefore, and bearing in mind that projects may vary as a result of being built or bought, owned or leased, etc., it is indicatively noted that the full life cycle for a transport project could include such phases and activities as public hearings on planning, zoning, and economic development matters, appeals, design competitions, right-of-way acquisition, construction, operations, maintenance, upgrading, expansion, reduction, re-construction, modifications, replacement, and mothballing, removal, or environmental rehabilitation upon project termination.

As for selecting the analysis feature, the first point of import is that **"analysis" is open to considering both costs and benefits**. Consequently, life-cycle analysis, or LCA, is more than just a cost-based technique, but is capable of tying in benefits which can in fact change over the full life of a project.

In the case of sustainable transport practices, there are major **differences between the life-cycle costs and life-cycle benefits** of projects and programs for moving people by walking, cycling, transit, or private motor vehicle, moving freight by rail or private motor vehicle, and moving data (text, graphics, and voice). Analysis can address those differences.

Second, LCA can significantly extend or expand the decision support information contained in life-cycle costing documentation. By way of illustration, life-cycle

costing (LCC) does not stop at capital or initial costs, but calculates the **total cost** of the project incurred during its lifetime, that is, from start to finish.

By adding an analysis dimension, decision makers can ascertain where and when costs are being incurred to achieve the intended sustainable transport benefits. Moreover, this can be done for each of the identifying, adopting, and implementation phases of each sustainable transport practice, which makes LCA a powerful force for achieving accountability.

Third, and sharing a feature of cost-benefit analysis, the costs and benefits of life-cycle analysis are often expressed in monetary terms, but they can be expressed in other terms including social, environmental, health, etc., as long as the condition is met that the costs and benefits are measurable and quantifiable. If that condition is met, in the case of sustainable transport practices LCA can be directed at one mode at a time or all modes together in a comprehensive LCA, with that decision influenced in large measure by the degree of difficulty or complexity that decision makers can accommodate.

The role of LCA, therefore, is to **quantify the inputs and the outputs**, as well as externalities at each stage, phase, or interval of a project's life cycle, which is significant information for decisions about identifying, adopting, and implementing sustainable transport practices.

In addition, however, that high level of time-based documentation in and of itself has decision-making value, because it requires taking stock of the inputs and the outputs over a project's full life cycle, including the legacy dimension for the different modes of transporting people, freight, and data. To paraphrase Garrison, the value in avoiding nasty legacy situations cannot be over-stated.

Fourth, **LCA** is an appealing technique because its **scope takes in all the impacts** over all the stages, phases, or intervals of a transport project rather than focusing on any particular stage, phase, or interval. This LCA feature is of paramount importance if decision makers want to know about the cumulative impacts that are forecasted to occur over the anticipated or assumed life of the project or projects, as the case may be. It is emphasized, however, that because LCA is an analytical tool, LCA outputs are probably best regarded as inputs to a synthesizing technique for cumulative impact assessment purposes.

With regard to drawbacks, they are not out of the ordinary and are not surprising. The LCA approach takes time and costs money when the analyses are rigorous and the projects complicated, and the state of data availability may not be conducive to immediately running high-level LCAs. However, that is not a cause for serious concern, because those drawbacks are common to many if not all the analytical tools identified during this initial discussion about methods and techniques that ***could be used*** to assist in making decisions about identifying, adopting, or implementing sustainable transport practices.

Multi-Criteria Decision Making

Anjali Awasthi

Decision making is a complex process. It often involves situations with multiple alternatives or choices, and the decision to choose any one of them becomes difficult. Let us consider the example of going to the office using a sustainable mode of transport. Among the available options are bus, metro and walking, and it may not be straightforward to select any one of them since all of them are environment-friendly choices.

Under these circumstances, one may select metro or bus over walking using other criteria such as travel time or ease of moving. It is clear from this example that one criterion may not always be sufficient to arrive at a decision. Multi-criteria decision making (MCDM) is the process of decision making involving **multiple conflicting criteria and objectives**. Two criteria/objectives are said to be conflicting if the satisfaction of one negatively impacts the satisfaction of the other(s).

A multi-criteria decision-making problem can be defined using **five elements.** These are attributes, goals, objectives, criteria and alternatives:

- **Attributes** represent the properties or the characteristics of the alternatives under evaluation, for example, design, cost, colour, and they can be objective (e.g., colour, size, and weight) or subjective (e.g., soft, beautiful, comfortable).

- **Goals** represent the desired levels of attributes which we want to attain for the alternatives (e.g., 100% fuel-efficiency for a new vehicle.) The goals of a problem, mission, task, etc., should always be defined *a priori*.

- **Objectives** are related to the goals and represent the directions of improvement for the attributes of the alternatives, such as maximize or minimize. For a new car, the objective to maximize can be efficiency, and the objective to minimize can be operating costs.

- Each **alternative** (purchase a large, medium, or small car, large or small SUV, all-electric, hybrid) is evaluated using certain measures, rules, and standards that are called criteria.

- Cost, mileage between tune-ups, performance in cold weather, and fuel efficiency can be the **criteria** for selecting a new car.

The multi-criteria decision-making approaches adopt a step-wise approach to problem solving. These steps are described as follows:

1) The first step in MCDM is the establishment of the decision context, the decision objectives (goals), and identification of the decision maker(s).

2) The second step involves identification of alternatives for evaluation.

3) In the third step, the criteria to be used for evaluating alternatives are identified, and the critical significance of this step cannot be over-emphasized. For the best results, all the important criteria must be included and redundant criteria removed. Include only tangible and measurable criteria.

4) The fourth step assigns scores to the criteria to measure their relative importance. The assigned scores are numerical. The scores can be obtained by selecting a value from a range, say on a scale of 1-10, or by doing a relative comparison. These scores are then used to compute criteria weights.

5) In the fifth step, assignment of scores to alternatives is done for each criterion. Several decision makers are involved in the evaluation process, and are usually experts in their areas. The scores are then used to compute alternative weights with respect to each criterion.

6) The sixth step involves computation of overall weights of each alternative using aggregation functions for product of criteria weights and individual weights of alternatives for each criterion. All the criteria are then sorted in the descending order of overall weights and compared against a threshold weight value. All those alternatives whose overall weights exceed the threshold value are chosen.

7) Finally, a sensitivity analysis determines which criteria the decision-making process is most sensitive to, and should therefore be better controlled.

Various multi-criteria problem-solving techniques have been developed based on these steps by varying the methods used for scores allocation and weighting. Commonly known among them are: SAW (Simple Additive Weighting), TOPSIS (Technique for Order Preference by Similarity to the Ideal Solution), ELECTRE (Elimination and Choice Translating Reality), AHP (The Analytical Hierarchy Process), SMART (The Simple Multi Attribute Rating Technique), and ANP (Analytic Network Process).

The potential of multi-criteria decision-making for problem solving is clear due to its capability of treating heterogeneous, uncertain, and conflicting information. Multi-criteria decision-making techniques are widely applied in facility location, impact assessment, resource selection, and project management problems. They offer numerous possibilities of application in situations involving decisions about sustainable transport practices, including indicators selection, and the aggregation of expert opinions on transport mode evaluations during the adopting and implementing phases.

Normative Delphi Technique

Barry Wellar

The Delphi technique is a means of organizing a group discussion in a structured way so that the views, expertise, beliefs, aspirations, etc., held by individuals effectively and efficiently converge to represent a group opinion about how to best address a problem, issue, concern, opportunity, etc.

There are a number of different kinds of Delphi exercise, but they tend to fall into three basic categories. The categories are briefly described, and then the normative Delphi is discussed in the remainder of the commentary.

Delphi Categories

Normative Delphi exercises are explorations of *what should be*, and are therefore pertinent to this project which has specific regard for the methods and techniques which are used, could be used, and should be used in making decisions about sustainable transport practices. Achieving consensus about a preferred future state or process is typically the primary research objective, and the research might seek an opinion on targets for trip shares by mode and geographic area that best advance a sustainable transport agenda, or it could focus on infrastructure-based intensification levels most likely to encourage active transportation and discourage private motor vehicle use.

The objective of ***Forecasting Delphi*** exercises is to derive *predictions* about events for which limited, uncertain, conflicting, or undirected knowledge currently exists. For example, the research problem could involve wanting to know when a municipality will need to remove roads and streets from the transport grid because of maintenance costs, or when a city's public transit fleet and operations will require major make-overs to deal with an expanding clientele of seniors who are prepared to give up their private motor vehicles but not their mobility.

Policy Delphi exercises focus on issues, problems, questions, etc., that have a *public policy* or *political* aspect. The purpose of the policy Delphi is not to achieve expert consensus; rather, it is concerned with ensuring that the range of politically relevant variables and contextual parameters are identified and explored, and a basis is in place for informed policy discussions by elected officials, bureaucrats, or citizens, all of whom have an interest in policy choices. A policy Delphi exercise of broad interest would be an exploration of how mixed-use development promotes active transportation while achieving health, tax, greenhouse gas, and global change benefits in the process.

With those paragraphs as context, and noting that each category is pertinent to this project, the normative Delphi is briefly discussed.

Normative Delphi and Identifying, Adopting, and Implementing Sustainable Transport Practices

As discussed in regard to the design of the set of research reports on the ***are/could/should*** states of decision-making, the first opportunity for a group dynamic is to identify sustainable transport practices. The practices can be associated with each of the people modes (walk, cycle, skateboard, scooter, bus transit, rail transit, rail, ferry, private motor vehicle, etc.), each of the freight or cargo modes (courier, private motor vehicle, rail, pipeline, etc.), as well as the data-moving (e.g., telecommuting) modes, and the practices that should be identified for possible adoption and implementation can be done on a mode-by-mode basis, on a comparative mode basis, or on a system basis.

As for the "experts" on the normative Delphi panel(s), they include users of modes; representatives of mode advocacy groups, public interest groups or vested interest groups; planners; engineers; health professionals; public safety professionals, and elected officials. The primary criteria for membership on the panel include **expertise by training and/or experience** in prescribing what should be in regard to achieving sustainable transport practices by mode or modes, and the **willingness to adjust personal positions** in order to make unbiased decisions in the pursuit of group consensus.

The second task for the normative Delphi group or groups of individuals is to **achieve consensus** on which of the identified sustainable transport practices should be adopted, with pertinent issues addressing such topics as the priority of practices adoption, the timing of adoption, and the trade-offs to be made under different financial, economic, social, political, environmental, geographic, or other scenarios particular to a municipality. In large measure the same criteria for panel membership apply, but the extent to which members have knowledge about and experience in using research methods and techniques is likely to directly affect both the amount of time needed and the quality of findings.

Task three in this normative Delphi illustration is to achieve consensus on which of the adopted practices should be implemented, and again such issues as when to implement which practices, where they should be implemented in what order, the priorities for implementation, proper evaluation procedures, financing arrangements, and legacy strategies come into play as the identifying and adopting processes come to the final, action stage of "doing" the practices.

The media, listserves, newsletters, and conference sessions are increasingly noting the number of occasions that discussions about transportation matters frequently seem to go around in circles, return to square one after months or even years of meetings, or otherwise fail to come to a productive conclusion. The normative Delphi is a technique which is designed to achieve consensus on what should be in regard to sustainable transport practices, and ***could be used*** to facilitate the identifying, adopting, and implementing decision process.

Open House

Barry Wellar

The term "Open House" is used by municipal and provincial government agencies to refer to come-and-go meetings that are portrayed as opportunities for citizens, business people, community associations and interest groups to provide feedback on planning, development, transportation, zoning, and other proposed initiatives.

However, open houses are not solely within the purview of government bodies.

For reasons that include informing citizens about civic issues, shaping opinions on public policy and planning matters, and creating media events, open houses are also organized by the proponents or opponents of proposals, priorities, programs, and activities of municipal and provincial governments, as well as those of quasi-public and private corporations such as hospitals, universities, development companies, land developers, waste disposal operators, health facilities, and transportation companies.

Depending upon the issue, an open house can feature from a half-dozen to fifty, sixty or more static display boards, as well as videos, PowerPoint slide presentations, and interactive computer presentations. The number of professionals on hand (staff, consultants) can range from two or three to 15 or 20. Members of the public in attendance may be fewer in number than the staff, or may outnumber staff by a ratio of 50-1 or more if the planning, development, transportation or other proposal is a contentious issue.

In terms of format, an open house may begin with an opening statement by an elected official or officials, a staff person, or a consultant, and then one, two, three or more professionals (staff, consultants) make presentations about the purpose of the open house and offer general comments about the display materials distributed around the hall, gymnasium or room. The open house process generally involves members of the public perusing the displays, videos, slides, etc., and then asking questions of the organizers, expressing opinions about the respective displays, and filling in a comment sheet or sheets.

Pros and Cons of the Open House as a Decision Support Tool for Sustainable Transport Practice Decision Making

Initially the open house technique was regarded by governments, interest groups, and citizens as a useful and reasonably productive means of engaging members of the community in civic affairs. Further, open houses were also an opportunity for members of the community to pick up reports or other documentation, share views with other members of the community about an issue, and arrive at a consensus position. **Open houses in their early days were deemed to provide a good read of the politics of an issue**, largely

because open houses were "the place" for the community to make its values, attitudes, and voting inclinations known.

However, **within the past decade several fundamental changes** have occurred that make the open house a marginal and perhaps even dubious technique for many of the decisions involving sustainable transport practices. The changes and the causes of the changes are summarized as follows.

First, **online access** to municipal and provincial materials in many jurisdictions has significantly **diminished the role** of the open house as a place for many people with civic talents, and especially technical skills, to obtain information and participate in civic affairs. The loss of these people downgrades the quality of discourse that could be used for decision purposes, and also raises major doubts as to the representativeness of any notion of consensus that might be reached.

Second, whether for reasons due to amalgamation, complexity of issues, a general decline in public participation, or other factors that diminish the quality of public discourse, there is an increasing sense that **the open house has become less a means of informing and listening to the public and more a means of simply going through the motions of public consultation.**

Indeed, references such as fraud, exercise in futility, waste of time, manipulation, and staged are often encountered in media reports to describe open house topics that have broad and complicated scope, a long timeline, multiple decision points, and involve mathematics, statistics, engineering drawings, and other technical elements.

It seems clear, therefore, that proposed, open house contributions to decisions about sustainable transport practices would be highly suspect except under particular conditions and constraints. That is, each of the three phases of identifying, adopting or implementing sustainable transport practices requires more examination and analysis than can be provided by the current open house model employed in many municipalities. **Major shortcomings** include the inability to ask detailed questions, share and debate responses, discuss responses among all interested participants, have time for reconsideration of choices, priorities, etc., and then re-visit such major concerns as budgets, timing, and legacy implications associated with each of the three phases.

If, however, an issue revolves around a matter that is particular to a neighbourhood, to a group of transport modes users (e.g. pedestrians, cyclists, transit riders), or sub-groups such as teen, adult, and senior pedestrians, or is otherwise limited in scope, complexity, and legacy implications, and the open house is seeking a **popular opinion or an overall impression** among the group or sub-group, then the open house can be a useful, inclusive means for achieving an input for **indicative** decision purposes.

Surveys

Jean Andrey

In the context of transportation planning, a survey can be defined as the assembly of facts and opinions about people's mobility and/or their accessibility to goods and services. Surveys are widely used in transportation planning. In fact, **travel surveys** have been the main input to the four-stage urban transportation model that has been the backbone of municipal transportation analysis for many decades. Travel surveys provide information on trips that have already occurred, i.e. on "revealed preferences".

Most urban areas in the developed world conduct travel surveys every five years. Data are assembled for a large sample of households (typically five percent), and are aggregated upward to traffic zones, planning districts or entire urban regions. These surveys provide information on personal (as opposed to freight) travel, including details on the timing, purpose and spatial properties of trips. The data produced by the surveys allow municipalities to model future mobility patterns, including the number of trips expected to be made, where these trips will start and end, what the modal split will be (e.g., driving, auto passenger, transit, walking), and which specific road segments or bus routes will be taken. Travel surveys have traditionally been conducted by telephone, but the Internet and road-side cordon surveys are alternative ways of gathering travel data, as is the practice of collecting postal code information from shoppers at retail outlets.

Travel surveys are well-designed for conducting supply-management transportation planning; in other words, they allow municipalities to anticipate and respond to expected changes in travel patterns. They are also useful for identifying problems, such as enumerating ways in which current transportation systems are not sustainable. However, travel surveys traditionally have not been designed to yield data that could be used in making decisions about identifying, adopting and implementing sustainable transportation solutions.

Sustainable transportation solutions often emerge from demand-management rather than supply-management thinking. The idea behind demand-management is that decisions are made to deliberately alter the demand for transportation. In many cases, the goal is to reduce single-occupancy vehicle trips. Various types of surveys are relevant to demand-management analyses.

One survey approach that is seen to have value in identifying sustainable transportation solutions is **activity analysis**. In this case, data are assembled in order to better understand the ways in which current mobility patterns are "doubly derived".

In other words, human wants or needs are manifest as activities. These activities occur in different locations, giving rise to travel. Activity diaries provide some of the same information as conventional travel surveys, but they provide more detail

on people's lives, and thus provide a starting point for understanding why certain types of trips are made. They also provide a basis for anticipating how people might respond to change. Some of these changes may be related to broad shifts in society, such as the development of technology that allows people to work remotely, and others may be deliberate interventions in the transportation system, such as the implementation of road tolls or the expansion of transit services. Activity data can be assembled through the Internet.

Another family of surveys that can be useful in both identifying and adopting sustainable transportation policies and practices is based on **stated-response techniques**. Under the stated-response umbrella, stated-preference surveys use questionnaires to ask respondents to choose options from a fixed list. For example, respondents could be presented with a list of strategies for reducing vehicle idling in parking lots (e.g., permanent signs, warning stickers, and fines) and asked which would be most effective or most preferred.

Another approach is to use stated-adaptation experiments whereby respondents are presented with a change in circumstance (e.g., higher fuel prices, extended transit hours, improved cycling facilities), and asked how they would respond to that change. **Stated-adaptation surveys** allow us to see how people might respond when faced with a hypothetical situation -- something that they have not experienced but can imagine in a concrete way. These surveys are particularly useful in scoping out the range of adjustments that might occur, and may be used to help design a more focused stated-preference survey.

Both stated-preference and stated-adaptation surveys provide information on decisions as well as insights into choice processes. Their value is in designing policies that will deliver the intended outcomes.

Attitudinal data are also useful in planning for sustainable transportation, although the link between attitudes and behaviours is complex and only partially explained by existing theories. Attitudes are generally thought to include both feeling and beliefs. Attitudes are often measured using scales that indicate level of agreement or satisfaction, e.g., Likert scales or semantic differential questions.

Often respondents are asked about items that are thought to be either drivers of, or, alternatively, constraints on particular decisions. For example, office staff who work at home one or several days day each week might be asked to explain their motivations for teleworking (e.g., higher productivity at home for some tasks, reduced costs associated with the commute) and their constraints on doing it more often (e.g., reduced effectiveness when working on group tasks, too many distractions at home.).

As illustrated, various kinds of survey techniques ***could be used*** in making decisions about identifying, adopting, and implementing sustainable transport practices.

Walking Security Index

Barry Wellar

The Walking Security Index (WSI) project was approved in 1994 as an element of the Transportation Environment Action Plan (TEAP) of the Region of Ottawa-Carleton (now the City of Ottawa). One of the goals of TEAP was to encourage more trips by walking, and the **primary mission of the WSI project was to design indexes measuring levels of safety, comfort and convenience experienced by pedestrians at intersections.**

The thesis of the WSI research was that indexes could be designed that provide scores on the performance of intersections from the perspective of safety, comfort, and convenience of pedestrians, and the scores could be arranged in rank order. Then, for public safety, quality of life, engineering, mobility, traffic, enforcement, maintenance, health, or other purposes, the **scores** could be used to identify needed corrective actions at intersections rated from best to worst, or at problematic intersection quadrants, and the **rankings** would provide elected officials and Region/City staffers with information for prioritizing remedial actions.

More than 40 publications describe the research design and findings of the WSI methodology. This commentary overviews a selection of elements of the WSI project which are pertinent to a report on "Methods and Techniques that Could be Used in Making Decisions about Identifying, Adopting, or Implementing Sustainable Transport Practices".

During the **design phase** (1995-1998) ten indexes were developed, and in the subsequent **pilot study phase** (1999-2002) three macro indexes were tested for operationality. In this commentary, the macro indexes are presented along with several observations about similarities between the WSI project and the Transport Canada project in regard to the identifying, adopting, and implementing phases of decision making.

Intersection Volume and Design Index (IVDI)

The IVDI is a dot product formula, IVDI = V1 • V2 • V3 • V4 •V5 • V6 • V7 • V8, that scores and ranks intersections in terms of "pedestrian friendliness", *where*,

V1 = number of passenger car equivalents2/hour
V2 = number of pedestrians/hour
V3 = number of lanes rating
V4 = number of turn lanes by type rating
V5 = intersection geometry rating
V6 = intersection slope rating
V7 = direction(s) of traffic flow rating
V8 = number of channels adjacent to intersection rating.

Quality of Intersection Condition Index (QICI)

The QICI formulation uses a tabular format, and consists of 18 variables which represent a selection of design, construction, condition, and maintenance, standards and practices that affect pedestrians' use of sidewalks and intersections. The QICI uses a "Condition Met?" system which is quadrant-based, and the scores for quadrants or overall scores for intersections can be used for remedial and/or ranking and prioritizing purposes by elected officials and staff, as well as for calls for action by citizens and community groups.

Driver Behaviour Index (DBI)

The DBI formulation is an equation, and this index measures the level of aggressive driver behaviour at intersections used by pedestrians. Thirteen variables (two for running reds, two for running ambers, and nine for fail-to-yield) were considered when formulating, testing and refining the DBI.

$$\text{Driver Behaviour Index} = \frac{ALI}{P} + \frac{RLI}{P} + \frac{FTYI}{P}$$

where,

$\frac{ALI}{P}$ = amber-light incidents per phase,

$\frac{RLI}{P}$ = red-light incidents per phase,

$\frac{FTYI}{P}$ = fail-to-yield incidents per phase.

The research on methods and techniques in the design phase of the WSI Project is directly relevant to the design phase of the Transport Canada project, as is the WSI pilot study research in the operational or implementation phase. Making decisions about identifying variables, adopting indexes, and implementing the indexes and acting on index scores and rankings, corresponds to the decision processes of identifying, adopting and implementing sustainable transport practices. In addition, the WSI reports suggest ways of customizing the indexes to make them more appropriate for differences in weather, demographics, motor vehicle types and traffic, etc., which may lead to the kind of flexible methods and techniques needed for decisions about sustainable transport practices.

Finally, the WSI project reports include applications and critiques of a number of methods and techniques that are likely to be pertinent to the Transport Canada project, including attitudinal surveys, authority, comparative analysis, focus groups, indexing, indicators, modelling, panel evaluation, pilot study, policy Delphi, pre-test, and trial run.

E. Summary

Research Report 3 is an extension of Research Report 2 (Wellar, 2008b), which is an extension of Research Report 1 (Wellar, 2008b), and the remarks made in the prior reports about the methods and techniques that underlie sustainable transport decisions are fully applicable for this report:

> "Three states of usage of methods and techniques in decision-making are pertinent to this project, and are illustrated by the following questions:
>
> - Which methods and techniques *are used*?
> - Which methods and techniques ***could be used***?
> - Which methods and techniques *should be used*?

The three states of usage have been referred to individually and in combinations on numerous occasions (discussions, presentations, emails, reports) since the onset of the project, and will continue to be discussed formally and informally as the project enters its concluding phase.

As explained in the communications, the survey of municipalities is intended to elicit information about the methods and techniques that ***are used*** in decision making (Wellar, 2008c), and the focus of the three research reports is on the methods and techniques that ***could be used*** in making decisions about identifying, adopting, and implementing sustainable transport practices. It is further intended that the survey results and the research reports contribute to the basis of a rational, substantive, and grounded discourse on the fundamental question, "**Which methods and techniques *should be used*?"**

This report extends Research Report 1 and Research Report 2 by increasing the number of commentaries from five in Research Report 1, to ten in Research Report 2, to 19 in Research Report 3.

Since the intent of the research reports is to present an indicative overview of methods and techniques that ***could be used*** in making decisions about sustainable transport practices, it is suggested that the 19 commentaries serve that purpose.

Further, it appears fair to say that the 19 commentaries not only provide an overview of considerable scope, they provide a sound basis for extending the commentary approach to other methods and techniques, including those identified in Table 1.

Finally, media reports, and listserve communications hosted by various interest groups, reveal that many municipalities across Canada are confronted by difficult, transport-related issues. Moreover, these same sources reveal that most if not all of these municipal governments are frequently in what might be termed "contentious circumstances", and that situation is due at least in part to differences of opinion regarding how municipal governments make decisions about identifying, adopting, and implementing sustainable transport practices.

For municipal governments that want to compare the methods and techniques that ***are used*** by their organizations for sustainable transport decisions with those that ***could be used***, the sampler of commentaries in Research Report 3 may contain materials of interest.

Similarly, citizens, advocacy groups, business groups, and senior levels of government may also want to better understand the state of decision making about sustainable transport in municipal governments.

The commentaries in Research Report 3 are among the elements that could be included in a performance measurement index, framework, or system that examines, and compares and contrasts how municipal governments make, and could make, decisions about identifying, adopting, and implementing sustainable transport practices.

E. References

Wellar, B. 2008a. *Methods and Techniques that Could be Used in Making Decisions about Identifying, Adopting, or Implementing Sustainable Transport Practices*. Research Report 1. http://www.wellarconsulting.com/

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APPENDIX 1

Contributors to the Transport Canada Project Report,

Sampler of Commentaries on Methods and Techniques that Could be Used in Making Decisions About Identifying, Adopting, or Implementing Sustainable Transport Practices

Barry Wellar, Project Principal Investigator
Principal, Wellar Consulting Inc.
Professor Emeritus of Geography
University of Ottawa
Distinguished Research Fellow, Transport 2000 Canada
wellarb@uottawa.ca
http://www.wellar.ca/wellarconsulting/

Jean Andrey, Associate Professor
Department of Geography
Faculty of Environment
University of Waterloo 200 University Ave. W.
Waterloo, Ontario, Canada
N2L 3G1
519-888-4567 x33629
519-746-0658 fax
jandrey@envmail.uwaterloo.ca

Anjali Awasthi, Assistant Professor
Concordia Institute for Information Systems Engineering - EV6.221
Concordia University - 1515 Ste-Catherine Street West,
Montreal, Quebec, Canada H3G 2W1
Tel : 514 848 2424 x 5622
Fax : 514 848 3171
awasthi@ciise.concordia.ca
http://users.encs.concordia.ca/~awasthi/

Victor A. Bañuls, Associate Professor
Pablo de Olavide University - Sevilla - (Spain)
+34 954 97 7926
vabansil@upo.es
http://www.upo.es/dde/personal/vabansil

William L. Garrison
Professor Emeritus of Civil and Environmental Engineering
Institute of Transportation Studies
106C Mclaughlin Hall
University of California
Berkeley, CA 94720-1720
(510) 642 9062(T)
(510) 642 1246 F)
garrison@newton.berkeley.edu
http://www.ce.berkeley.edu

Murray Turoff
Consultant
Distinguished Professor Emeritus,
New Jersey Institute of Technology
973 361 6680
turoff@njit.edu
http://is.njit.edu/turoff
Skype: mturoffsrhiltz

Connie White
Assistant Professor
Institute of Emergency Preparedness
Jacksonville State University
connie.m.white@gmail.com
http://iep.jsu.edu
Homepage: http://sites.google.com/site/conniemwhite/