

WORKSHOP ON ECODRIVING

International Transport Forum/International Energy Agency

Possibilities for evaluating ecodriving initiatives

Martin Lee-Gosselin

Université Laval, Québec, Canada & Imperial College London

Co-chair, PROCESSUS Network

22-23 November 2007

IEA Headquarters, Paris



Réseau international PROCESSUS International Network

*PROcesses of behaviour underlying Equity and Sustainability in Systems of Urban access and their Simulati on
PROcessus Comportementaux Essentiels aux Systèmes d'accès Urbain durables et équitables et à leur Simulati on*

Evaluation - effectiveness

(NB: evaluation for programme refinement not in this presentation)

- “*Evaluating the effectiveness of driver education is certain death for researchers*”
James O’Day, 1971
- Effectiveness means *payoff* from ecodriving programmes, but:
 - in what terms?
 - with which metrics?
 - using which instruments?
 - who needs to know if the programme works?

=> Construct an evaluation *framework*

In what terms?

- Do we care only about direct effects on per-kilometre energy intensity, or do we include:
 - *direct* effects on *other outcomes* (e.g. crashes, equipment wear-and-tear, costs....)?
 - *indirect* effects on activity and equipment choice?
- => which *decisions*, possibly affected by ecodriving programmes, are we interested in?

Decisions, decisions....

- En route:
 - micro decisions about vehicle control
 - real-time adjustments to routing, etc.
- Pre-trip/tactical:
 - congestion avoidance (time, re-route)
 - routing, chaining of destinations
 - vehicle assignment, vehicle sharing
- Strategic:
 - vehicle acquisition and selection, disposal
 - location of home, office or factory

What metrics: “ultimate”?

1. Fuel consumption per kilometre:
 - per vehicle
 - per passenger
 - per tonne
 - (NB not all “per kilometres” are equal...)
2. Absolute measures of energy consumption
3. Costs (operating, capital), to compare with program cost
4. Possibly:
 - crashes by severity of consequences
 - useful life of equipment
 - CAC emissions

What metrics: “intermediate”

1. Penetration/uptake of Ecodriving programme
2. Wider public/corporate eco-awareness
3. Measured shifts before/after in driver actions (speed, acceleration, braking, use of manual gears.....)
4. Shifts in en-route routing and timing relative to real-time information
5. Shifts in trip and destination planning
6. Shifts in vehicle allocation (including non-motorised)
.....but also observations of *adaptations*

Adaptations

- Can lead to positive or negative outcomes

“Off the radar” indirect effects. Example: *a participant in fleet ecodriving at work*

	NEGATIVE	POSITIVE
INTRA-PERSONAL	“Lets off steam” when driving own car	Applies ecodriving to own car
INTER-PERSONAL	Aggressive response by other drivers when slowing down early, or capping speed	Trains family, non- participant colleagues in ecodriving

Adaptations

- Can lead to positive or negative outcomes
- Longer-term *strategic adaptations* may also occur, especially regarding vehicle choice

Instrumentation - En route

- Monitoring of fuel consumption (and in fleets, driver hours)
- On board instruments: OBD data loggers and fleet-oriented software are of huge interest

Example of fleet monitoring technology

Davis Instruments 8241

CarChip Fleet OBDII Automobile Data Logger - USB Interface

CarChip Fleet includes all the data logging capabilities of CarChipE/X, but is designed to be used with our Fleet Management Software (sold separately).

You'll get up to 300 hours of trip details, including distance, speed, time, hard accelerations and decelerations, engine diagnostic trouble codes, and an accident log. You'll also be able to monitor any four out of 23 user-selectable engine parameters.

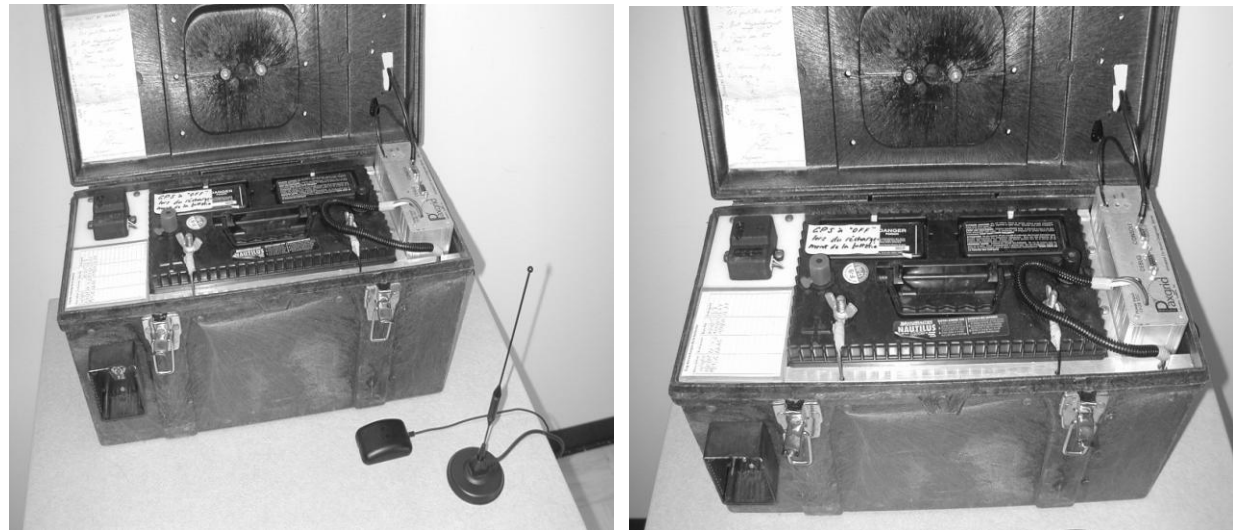
Advertisement from Ambient Weather Web site, accessed Nov 2007

Instrumentation - En route

- Monitoring of fuel consumption (and in fleets, driver hours)
- On board instruments: OBD data loggers and fleet-oriented software are of huge interest
- [NB: on board instrumentation can be a programme element: instantaneous or summary of fuel or **cost**]
- GPS: new possibilities for monitoring since early 90s
 - Add-on to OBD loggers
 - Some person-based loggers coming on stream
 - Huge recent improvement in GPS-aided devices (examples)
 - Significant *post-processing* challenges -- a “work in progress”

Evolution of the use of GPS equipment in research on travel survey methods

Phase II (2000-2001): Fully autonomous vehicle-based test platform built by GEOIDE Network Affiliate Specialty Sensor Technologies, St.-Laurent, Québec



- *Data stored only while vehicle is in motion, switched using motion sensor*
- *Up to 4 weeks of data collected*
- *Nothing attached to vehicle except small magnetic antenna*
- *We tested automatic data transmission via a pager network*

Evolution of the use of GPS equipment in research on travel survey methods

Phase III (2001-2002): Tests of a commercialised vehicle-based survey device manufactured by Battelle Memorial Institute, Columbus, Ohio



- *Data stored in the “black box” based on configuration set with a PDA*
- *Automatic detection of engine operation*
- *Possibility to query driver at trip ends using the PDA*
- *Most of our tests were for seven day periods without trip-end queries*

Evolution of the use of GPS equipment in research on travel survey methods

Phase VIa (2006-2007): Testing and pilot deployment of the StepLogger Model 51

**Neve ITS Pty, Adelaide, Australia,
in consultation with Stopher, Univ. Sydney**



- *Miniaturized combination: GPS logger, accelerometer, GSM modem*
- *Always ON - power management by accelerometer and/or GPS parameters*
- *Internal battery: cycle extended to more than one day of typical mobility (now testing)*
- *GPRS data transmission of GPS trace + equipment “events” including geofencing*
- *Hi-gain antenna: impressive receptivity from pocket or handbag, as good as or better than shoulder placement of antenna on earlier equipment*

Evolution of the use of GPS equipment in research on travel survey methods

Phase VIb (2006 -): Development of a Blackberry-based, multi-channel LAD

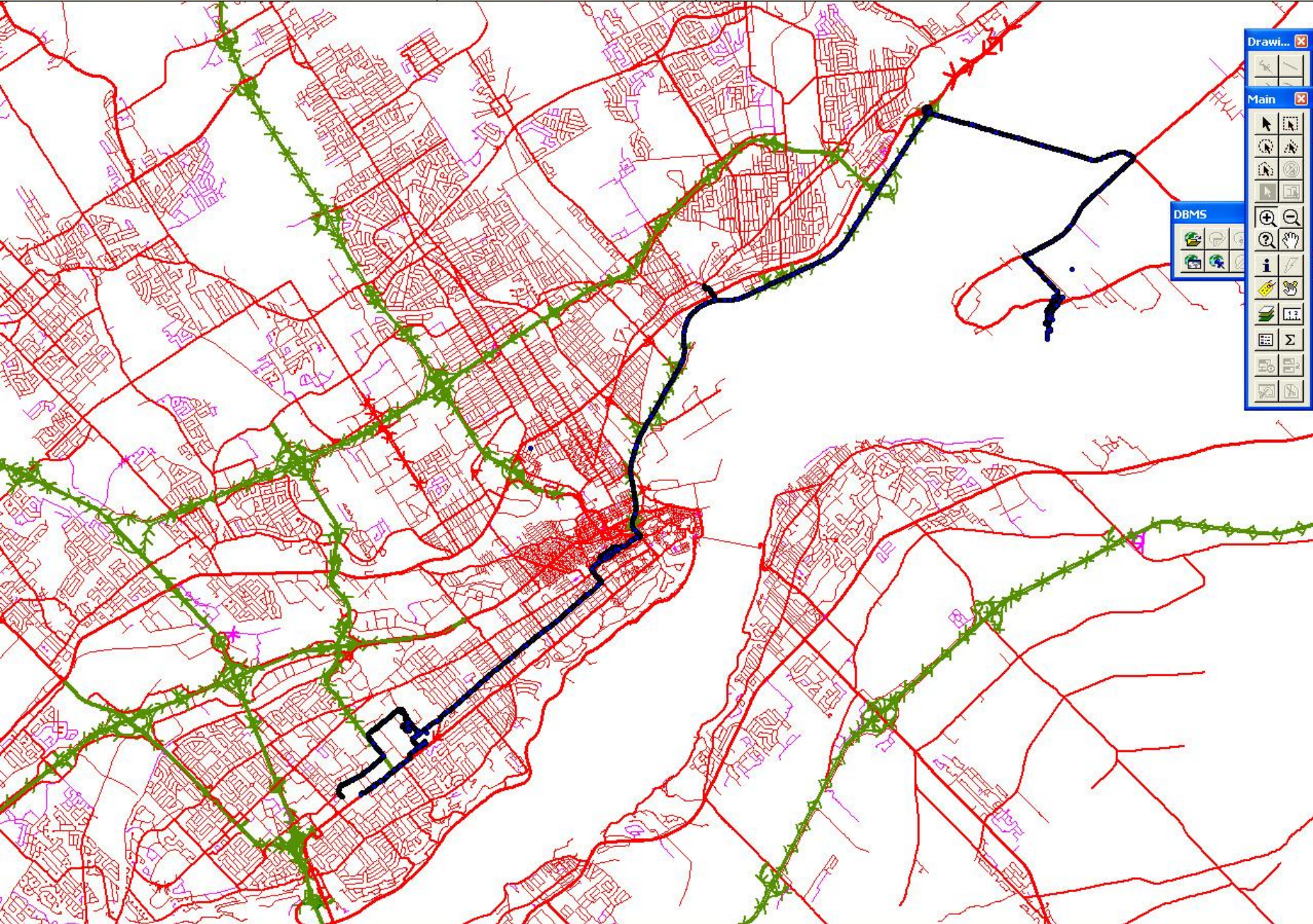
Doherty, Wilfrid Laurier University & Oh, Toronto Rehabilitation Institute, with

RIM, Telus, ExpeData, Life:Wire, CIHR, HDX, University of Toronto Innovations

*First pilot, 50 diabetics, :
Toronto, Nov-Dec 2006*

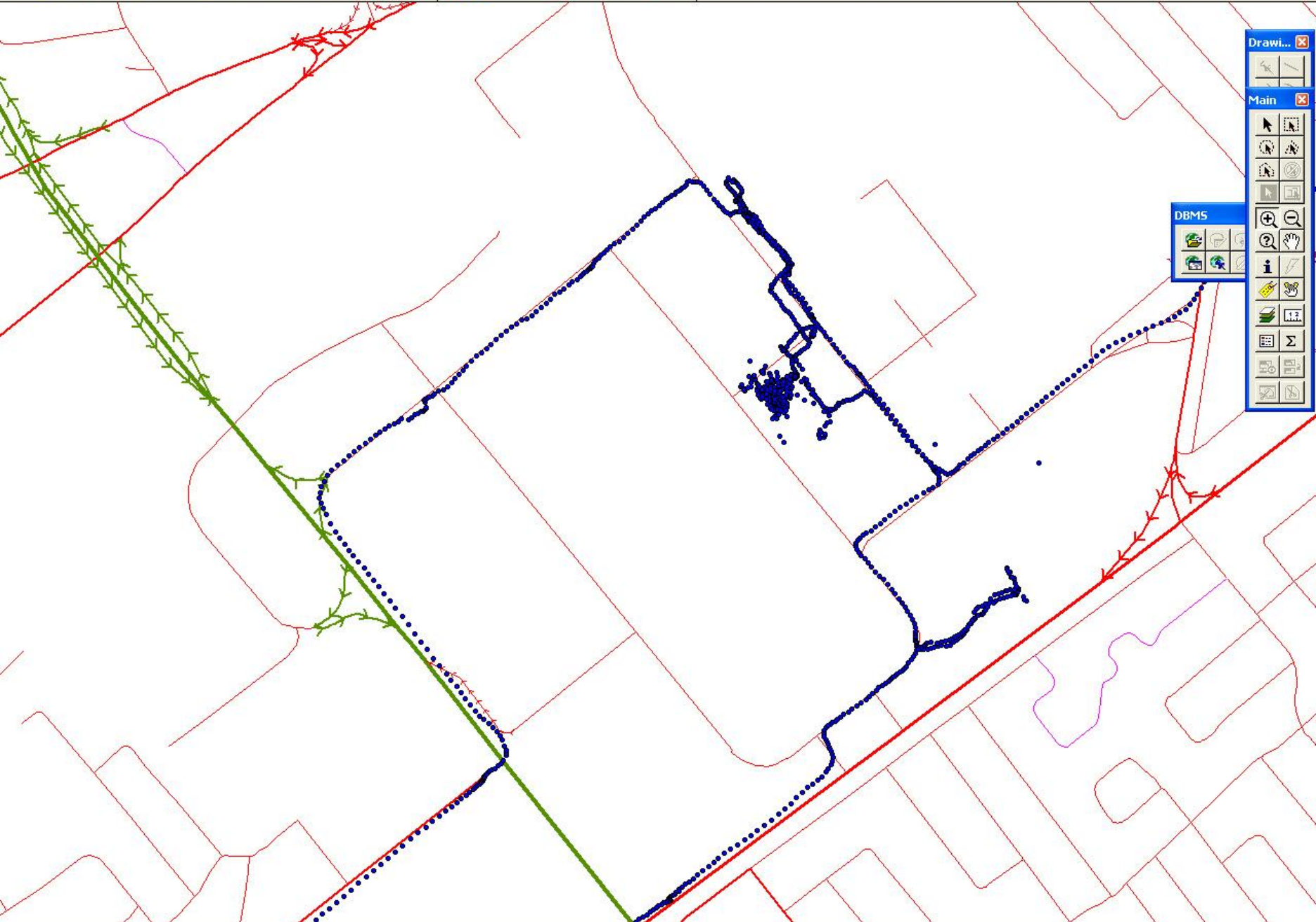
- **GPS-equipped Blackberry 7250, employs GSM data transmission**
- **Platform and Java application adaptable to multiple sensors**
- **Now: Bluetooth communication to accelerometer, heart-rate and blood sugar monitors**
- **Web-based prompted recall system with interactive maps to help ID activity locations**
- **Prompted recall includes characterizing the nature of physical activity**
- **Link to digital hand-written forms**





Drawi...
Main
DBMS

- Navigation icons: pan, zoom in, zoom out, home, previous view, next view.
- DBMS icons: connect, disconnect, refresh, refresh all.
- Information icon: i.
- Other icons: print, save, undo, redo, delete, copy, paste, find, zoom to fit, zoom to extent, zoom to selected.





Drawi...
[Icons for drawing tools]

Main
[Icons for main navigation and editing tools]

DBMS
[Icons for database management tools]

GPS Web Diary - Sep 22, 2006 10:47:28 AM

File Help

Date	Time	Event	Location	People
Sep 22, 06	10:51 AM	-Trip Car	N/A	None
	10:59 AM			
11:00 AM	10:59 AM	-Activity Indoor	CHURCH near Hemlock St 	Charlene
	11:01 AM			
	11:01 AM	-Trip Walk	N/A	Charlene
	11:02 AM			
12:00 PM	11:02 AM		SCHOOL near University Ave W 	Charlene, Lauren
1:00 PM				
2:00 PM		-Activity Indoor		
3:00 PM				
4:00 PM				
5:00 PM	05:17 PM			

Instrumentation - tactical/strategic

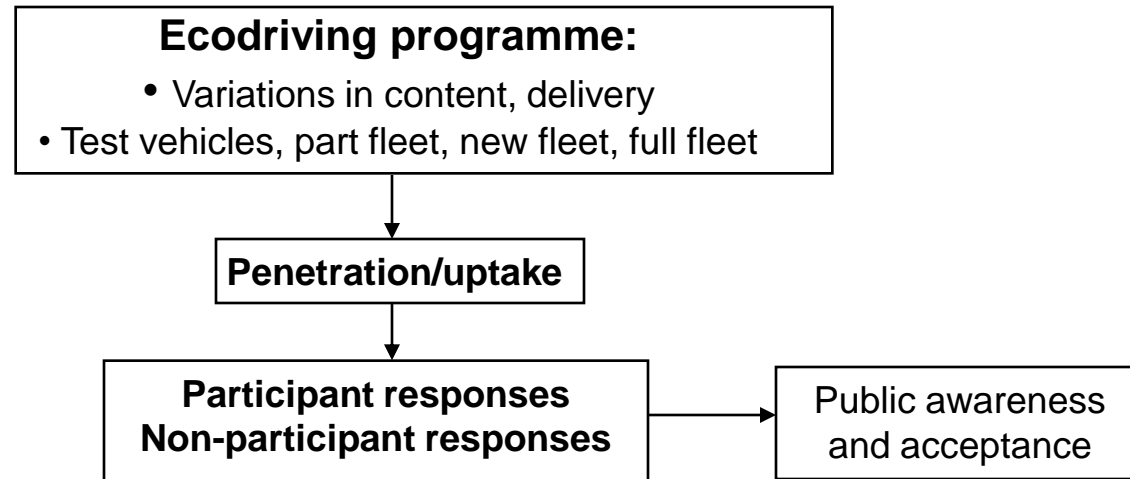
- Observing people's decisions about when, where to travel and how => models that assess levers for change
- Large body of research on activity planning and scheduling, especially in Netherlands, Canada
- Example, Quebec City and Toronto (2002-2006): in-depth survey techniques used to observe a week of activity/travel by 500+ households, and to explore how decisions were made: can use data to look at the role of eco-efficiency in longer-term decisions and day-to-day tactics
- Expect increase in interest in the context of carbon pricing

Overall evaluation design

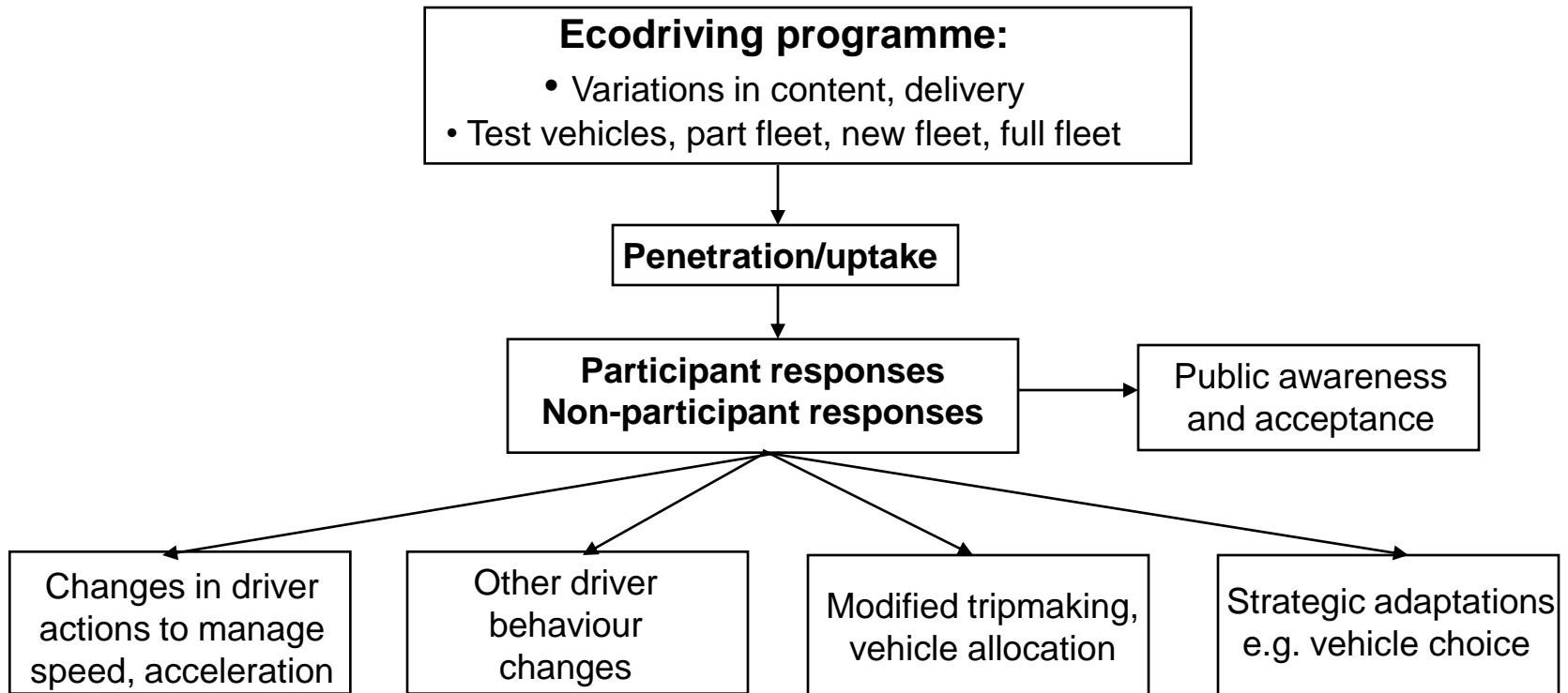
Ecodriving programme:

- Variations in content, delivery
- Test vehicles, part fleet, new fleet, full fleet

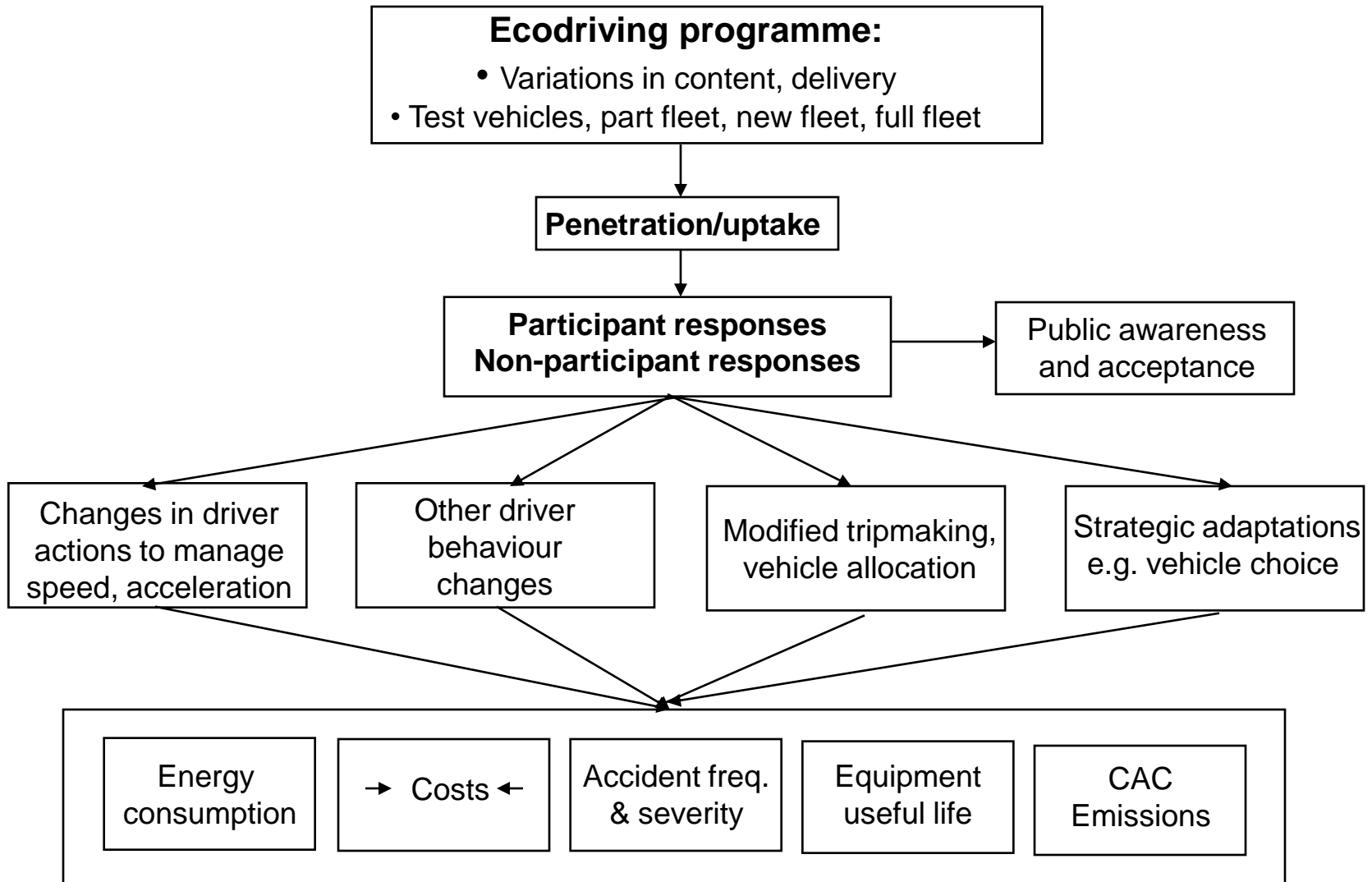
Overall evaluation design



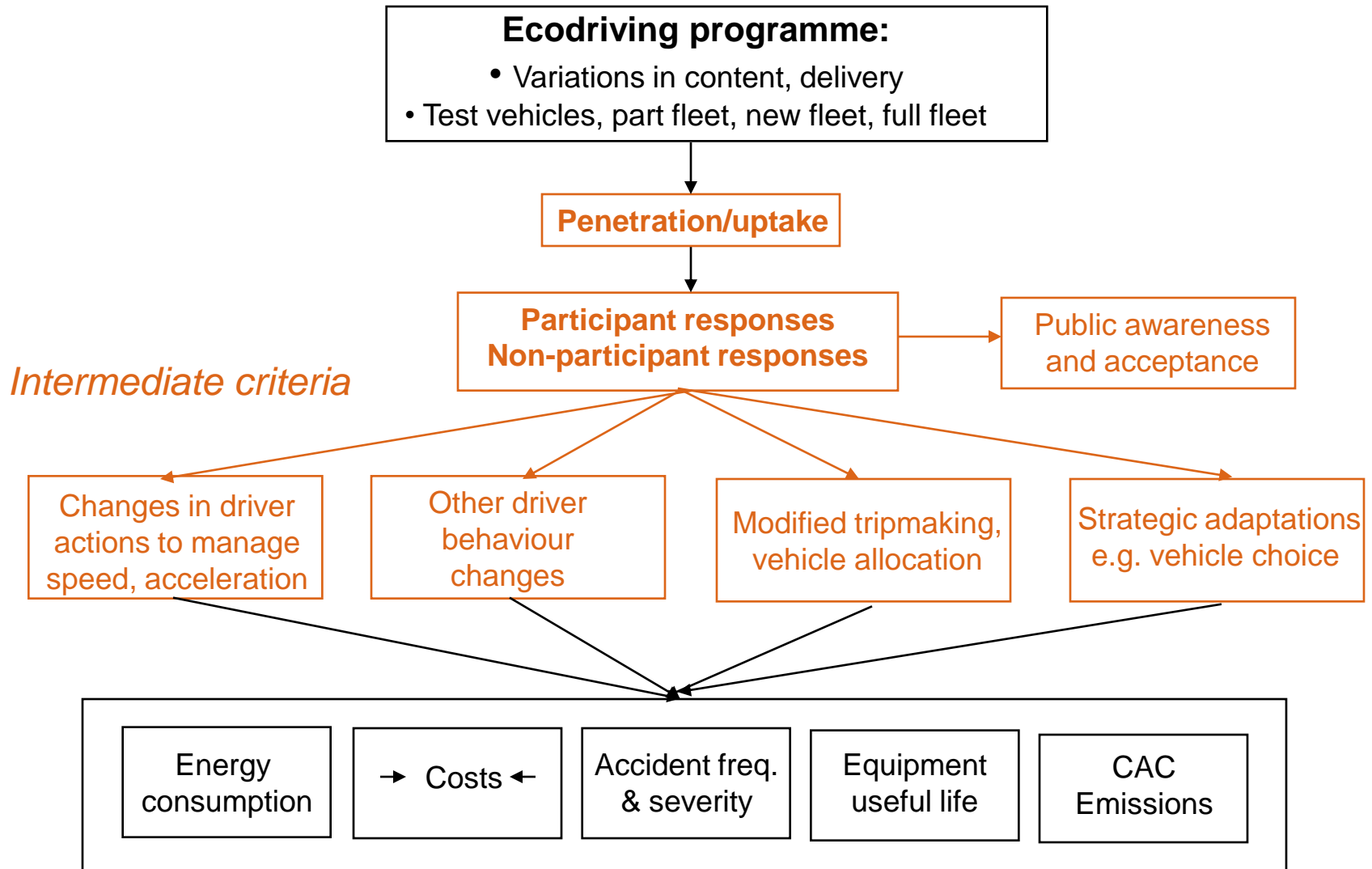
Overall evaluation design



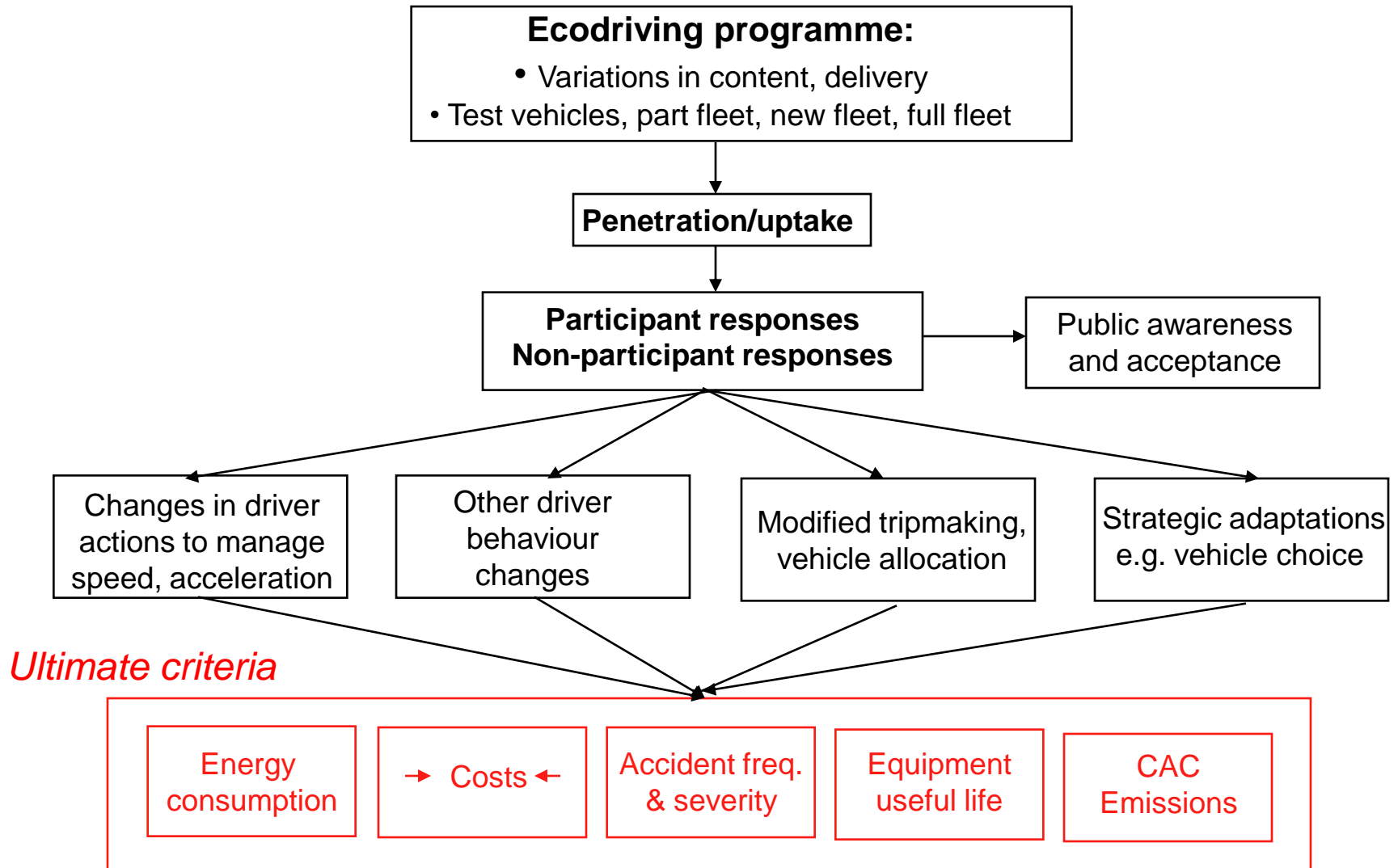
Overall evaluation design



Overall evaluation design



Overall evaluation design



Some of the things that can go wrong

- Measurement with little thought for analysis
- False or faked baselines (fuel, costs, accidents, etc.)
- Inappropriate or naïve scaling-up of “pioneer” effects
- Evaluation too short: effects may decline (or increase)
- Off-the-radar effects on participants and others
- “Too complex -- too much to measure”!
 - Solution: select key criteria and build a “causal chain” of intermediate and ultimate criteria
 - Solution (if stronger evidence is needed): apply experimental design, i.e. measure a “control group” in same circumstances as the programme participant

Summary: a sound framework

1. Sort out who is going to use the evaluation -- more than programme justification and refinement
(NB: eco-driving often part of a larger initiative)
2. Instrumentation is not enough: it must fit into an analytical design, a logic for interpretation
3. Determine if a “control group” of untreated drivers is required
4. To have a good story to tell:
 - A balance of en-route and pre-trip variables
 - A balance of intermediate and ultimate criteria

Conclusion

*With your good sense,
you can survive certain death*

Merci - Thank you