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Possible long term impacts of ITS to support Green Driving and Clean mobility

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## Abbreviations

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<th>Meaning</th>
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<td>NoE</td>
<td>Network of Excellence</td>
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DECOMOBIL Summary

DECOMOBIL takes advantage of the structured research network set up in HUMANIST NoE and followed up in HUMANIST VCE, in order to develop and widely disseminate knowledge in the area of human centred design of ICT for sustainable transport. Expected impacts of DECOMOBIL are: widening the market for ICT based mobility and transport services by contributing to the development and the widespread of user-friendly innovative nomadic services, impacting bicycles, public transport and car-sharing use through the understanding of multimodal travellers needs; by setting up design recommendations for the next generation of cooperative systems and improving integrated road transport system; by analysing long term effects and potential impact of ITS deployment on clean and safe multimodal mobility and improvements in efficiency and environmental friendliness of mobility and transport in Europe by improving eco-driving behaviour leading to the decrease of vehicles carbon emission for car, bus and trucks and by understanding human behaviour critical parameters linked to the implementation of electric mobility system. For this, activities in DECOMOBIL will provide understanding on acceptability and usability of ICT for the population, and setting up design guidelines and recommendations to avoid misuse and to allow user-friendly interaction with ICT functionalities. Through organisation of scientific seminars and international conferences, definition of road mapping for future research priorities, reflection on JRIs, and dedicated structured contributions to the eSafety forum in the framework of the iCar Initiative and any relevant committees in this area, objective of the DECOMOBIL project is to contribute to the acceptability and the usability of ICT for cleaner and safer mobility through identification, discussion and dissemination of updated knowledge and know-how in HMI and Human Centred Design areas towards the ITS community at a European and international level.

1 Invitation

![Invitation: DECOMOBIL Workshop April 19th & 20th Vienna](image)

**Can Intelligent Transport Systems Support Green Driving?**

FACTUM is in the frame of the DECOMOBIL project planning a lunch-to-lunch workshop on April 19th and 20th (i.e. start Thursday 1300 and end Friday 1300) in Vienna. We plan an interactive workshop, in the meaning of "workshop", with 4 impulse speeches (~20 minutes) and then discussions in small groups and in the plenary.

- **Date:** Thursday April 19th 2012 to Friday April 20th 2012
- **Time:** Thursday 13:00 to Friday 13:00
- **Site:** Technical University, Vienna

**Registration until April 15th (limited number of places):**

Manuel Oberlader +43 (0)1 5041546-13 or +43 (0) 660 48 688 58
manuel.oberlader@factum.at

**On-line registration:** [http://fr.amaldo.com/NETPOREM](http://fr.amaldo.com/NETPOREM)

**Fee:** None

**The topics for both impulse speeches and discussion in the workshop will be:**

- a) are there ITS systems that fit DECOMOBIL goals - to enhance Green Driving and, in a wider sense, sustainable mobility - on the market or near to the market,
- b) how do you recognise at an early stage that systems have the wished-for effects or, in other words, how can you predict medium and long term effects of systems when you evaluate systems today,
- c) how do sustainability-enhancing systems work in a "hostile" environment, e.g. where - saying it exaggeratedly - "everybody" is driving a car and where "everybody" has a SUV and
- d) which new systems supporting Green Driving can one think of in the future?
2 Workshop introduction

This workshop was carried out in the frame of the DECOMOBIL Work package 3 "Organisation of Scientific Seminars" that is one of the key activities of the project.

Several ITS can deliver substantial benefits for a clean multi-modal mobility, but it is not possible today to form a reliable and quantitative estimate of these impacts – especially the medium and long term ones - because the systems are at an early stage of implementation and few are deployed at a large scale. The goal of DECOMOBIL is, among other things, to identify ITS functionalities potentially beneficial for clean multi-modal mobility and their possible impact in a long term perspective. Activities connected to this goal aim at improving vulnerable road users’ safety by, e.g. enhancing of their perception and detection, and providing appropriate functions that help protect them. This should increase both the safety feeling and the reality of vulnerable road users (VRU), thus encouraging walking and cycling, also in combination with public transport. But also ITS directly meant as a service for vulnerable road users and public transport travellers play an important role in this respect. Issues mentioned in detail were:

- The development and the implementation at a wide scale of eco-driving systems can encourage drivers to adopt smoother behaviour, with less sharp braking for example, leading then to a cleaner but also a safer style of driving.
- Define modalities to improve acceptance among users of ITS beneficial for sustainable mobility in order to increase potential positive impact, thus opening the path for developing habits compatible with clean mobility or at least with green driving
- Set up modalities of prospective analysis to better understand consequences of implementation and use of ITS potentially beneficial for sustainable mobility
- Learn to understanding travellers’ needs and requirements in transport context in order to be able to improve sustainable transport by providing preconditions that travellers appreciate and thus capture new user needs in order to understand the future context of a clean mobility.
The workshop that is described here represents one of the first steps taken in the frame of the DECOMOBIL project in order to reach the goals described above.

The working method in this workshop was to present papers dealing with issues that are considered relevant for the topic (by Ralf Risser, Harald Frey, Juliane Haupt and Rob Methorst), to discuss questions emerging from these presentations, in small groups, and to present the results of the small group work in the plenary, for feedback and discussion.

3 Can intelligent transport systems support green driving?

Ralf Risser, FACTUM Chaloupka & Risser OG

Green driving & clean mobility

- Define ITS
- Describe green driving
- How can it be achieved
- Discuss its potential
- Criteria for measuring that green-driving goals have been reached including the medium and long term perspective
- How can the traffic system look like if ITS that enhance green driving are implemented

What is ITS?

From Wikipedia

- The term intelligent transportation systems (ITS) refers to information and communication technology (applied to transport infrastructure and vehicles) that improve transport outcomes

Definition of Green Driving (GD)?

- Anticipate Traffic Flow: Read the road as far ahead as possible and anticipate the flow of traffic
- Increase your scope of action with appropriate distance between vehicles to use momentum; increased safety distance optimises options to balance fluctuations in traffic flow, enabling steady driving with constant speed
- Maintain steady speed & use the highest possible gear at low RPM
- Shift up early à higher gear at approximately 2.000 RPM

(http://www.ecodrive.org/en/home/home.htm)

Connections between Green Driving (GD) & Clean Mobility (CM)

- Are driving styles that are more friendly to the physical and social environment the same?
  - characteristics of GD: slower, less accelerating & less braking → green with respect to exhaust, petrol consumption, less wear and tear, less noise, less space use (if road space can be adapted accordingly)
  - Social consequences of GD: better environment making walking, cycling and sojourning more pleasant; less dynamic motor vehicle traffic makes walking and cycling etc. (= CM) safer, easier & more comfortable

Sustainability goals of DECOMOBIL

- The ultimate goal is to enhance clean multi-modal mobility
• Before that:
  o Understand psychological mechanisms lying behind mobility styles
  o Identify existing ITS potential
  o Ideas for ITS that go for that goal
  o Understand relevance for society

**ITS and GD?**
• ITS is potentially beneficial for clean multimodal mobility and has possible positive impact in a long term perspective
• Development and implementation at a wide scale of co-operative systems aiming at improving VRU’s safety should lead to better perception & detection of pedestrians, bicycles & PTW, increase safety feeling and reality of VRU and thus encourage walking, cycling etc.

**Topics to be discussed**
• Behaviour changes that are wished for (expected?) & side effects that are not wanted
• What will support behaviour change towards, or preservation of, GD?
• Result/Product: List of ITS and effects we attribute to them

**Workshop goals**
• Systems that encourage drivers to adopt smoother behaviour, with less sharp braking for example, leading to a cleaner but also a safer style of driving.
• Set up modalities of prospective analysis to better understand consequences of implementation and use of ITS potentially beneficial for sustainable mobility

**What factors determine our driving and/or our mobility style?**

---

**Figure 1: Factors that influence behaviour – the Diamond**

- **Individual** (and his/her features)
- **Interaction between road users**
- **Vehicle** (and its features)
- **Society** (laws, rules, public discussion, media)
- **Infrastructure** (road, space and its features)
Intelligent transport systems?

- One thinks mainly of two fields:
  - Vehicle
  - Infrastructure

- Nevertheless the third field is also important – the individual – because issues like behaviour adaptation are determined by individual characteristics:

**Individual „interference“**

- Expectations, wishes, needs that ITS frustrate
  - Avoidance of systems or use in non-wished for way (turn off, manipulate, etc.)
  - Non-intentional erroneous use or non-use

- If more safety is provided by a system
  - Behaviour adaptation like going faster, reducing attention to outer world etc.

**Involve the individual!**

- If we want any system to have intended „clean“ effect the individual has to be convinced

- If we only look at the infrastructure and the vehicle it will be difficult to determine whether any system will have the effects envisaged

**Focus on three areas**

[Diagram of three interconnected areas: Individual (psychology), Mode, “vehicle” (technology, psychology, sociology), Infrastructure (technology, psychology, sociology)]
For good use by individual

Three interrelated usability criteria are relevant:

- **Effectiveness**: user should feel that what he/she does fulfils the goal
- **Efficiency**: easy/economic to use a system, goals are achieved without exaggerated investment
- **Satisfaction**: the system is comfortable to use, looks nice, feels well when used

**Communication?**

- Of course we also have to look at the social environment: others press, others around me do not adopt green driving style, behaviour adaptation in a non-wished for sense will be enhanced

**Structural/societal issues**

- Topics discussed publicly, what media write, discussions in pubs, what is said at home etc. has an influence on long term development
- However: Those finally responsible for societal measures (laws, research financing, etc) will support or oppose research and measures that enhance improvements of infra-structure and vehicles in the above accentuated sense.

**Role and goals of industry**

- We also should discuss the role and goals of industry and whether the goals followed by them – sometimes as a hidden agenda - always correspond to reality

**Output and outcome variables to be taken care of**

*Criteria dimensions: Output*

- **Product**: good quality and functionality, appropriate instructions
- **Communication**: Show that product fulfils needs and wishes, helps achieve goals
- **Incentives**: opportunities to use product or to attach expectations to it
- **Distribution**: product easily available (= marketing variables)

*Criteria dimensions: outcome*

- **Perceptions & perception changes**
- **Attitudes and attitude changes**
- **Behaviour & changes (operational/tactical)**
- **Time-budget & changes (strategic level)**
- **Decisions/choices & changes (strategic l)**
- **Life-style changes** (What we should be able to measure as effects)

**Discussion**

- What characteristics should ITS have in order to reach the goal of achieving long term impacts on clean multi-modal mobility in a wished-for way?
- List of ITS and the effects we attribute to them
4 How green is Green Driving?

Dipl.-Ing. Dr. techn. Harald Frey, Vienna University of Technology, Institute of Transportation – Research Centre of Transport Planning & Traffic Engineering

Topics

- Description of „classical“ view on green driving
- Development of car fleet (vs. green driving?)
- Problems of rebound effects and system behaviour
- Assignability & alternatives of IST in relation to green driving

Classical definition of „green driving“

- Describe techniques that drivers can use to optimize their automobile fuel economy. The energy in fuel consumed in driving is lost in many ways, including engine inefficiency, aerodynamic drag, rolling friction, and kinetic energy lost to braking (and to a lesser extent regenerative braking). Driver behaviour can influence all of these. [http://en.wikipedia.org/wiki/Fuel_economy-maximizing_behaviors]
- A lot of guidebooks about fuel consumption of cars, car fleet, etc.

Figure 2: Freight traffic, trucks, delivery services, taxi (fleet of companies: business cars, vans,...) → easier estimation of effects
Green driving from user’s perspective

- Maintenance (tire pressure, wheel alignment, etc.)
- Minimizing mass and improving aerodynamics
- Efficient speeds (single user perspective ≠ system view (!))
- Choice of gear (manual transmissions)
- Acceleration and deceleration (braking)
- Turn of engine (stop > 10 sec.), auto-stop technique
- Technical accessories (A/C, etc.)
- Anticipation (inter-communication, information = f(v))
- Minimising ancillary losses (using air conditioning requires the generation of up to 5 hp of extra power to maintain a given speed)
- Trip computer (information systems for the driver)
- Etc.
- Change way of driving: up to 33%

Here are the facts about CO₂

- Every gallon of gasoline burned creates 18.5 lbs of CO₂, and every gallon of diesel burned creates 22.1 lbs of CO₂
- According to the EPA, up to 33% of a vehicle’s fuel efficiency is impacted by driver behavior
- The transportation sector is responsible for 30% of U.S. CO₂ emissions
- Reduced fuel consumption will translate into lower operating costs and CO₂ emissions

• Read how ITW achieved significant results using GreenDriver

Take a test drive now>

CO₂ reduction
GreenDriver Online Driver Training is a viable solution to reducing your CO₂ emissions by helping you:
- Improve fuel consumption
- Maintain and balance your tire pressures
- Use electronics to reduce energy consumption
- Contact driver training

Cost savings
"We got more than expected with GreenDriver. The information given helped me and it turned the good drivers into great drivers. Our accidents have dropped considerably, and our overall MPG is at an all-time high. What really made us a program is that having AHS Global create efficiencies that save us money and time.

— Fleet Manager, AHS Global, 385-car, light-medium duty truck"

MPG increase
Driver behavior has a major influence on a vehicle’s MPG. GreenDriver’s guide to good driving will help you reduce speed by:
- Maximizing your MPG potential
- Enhancing driver awareness
- Treating driving on roads to boost MPG
- Improving your journey performance
- Decreasing drivers against peer to create strong habits

Figure 3: Green Driver Home page
Fuel prices today are actually cheaper than they have been in the past, calculated by the time you have to work for buying 1 litre of petrol.
Figure 6: Availability of energy over time...

Figure 7: World wide oil production since 1600

Die Weltölproduktion von 1600 bis 2200 (historisch und projiziert) in Millionen Barrel pro Jahr.

Quelle: C. J. Campbell
Value of fuel

- 1l adequate for 10 – 20 km distance by car
- A pedestrian needs for this distance 2,5 – 5 h
- Hourly rate about 10 €
- 25 – 50 € per litre gas therefore justifiable
- Still too cheap, because haulage of 1 to 2 tons of steel of the car is not taken into account in this calculation.

Transport planners topics - traditional view – (related to „green driving“)

- stabilization of traffic flow (using existing infrastructure capacity in an optimal way)
- Information about congestion (driver information, communication,...)
- safety, ...etc.

Most of the fuel energy loss occurs in the thermodynamic losses of the engine. The second largest loss is from idling, or when the engine is in "standby", which explains the large gains available from shutting off the engine.
Development fleet consumption

- Between 2002 and 2012: average fuel consumption of cars in Germany has been reduced from 8,4l/100km to 7,6l/100km (in average)
People buy more SUV, so why „green driving“?

In Austria: Between 01/2012 – 03/2012: +33% more SUVs than in the same period 2011, Stagnation of acquisition of small cars; Every fifth new car in Austria is a SUV (VW Touareg: 7,4 – 9,9l/100km, Skoda Octavia: 4,8 l/100 km).
Figure 13: Weight and fuel consumption

Figure 14: Fleet-average weight and fleet-average CO2 emissions by carmaker, compared with UE target line

Figure 15: Cars are getting bigger and heavier
Rebound effects (1)

Figure 16: Change in dimension of cars

![Figure 16: Change in dimension of cars](image)

Rebound effects (2)

Figure 17: Käfer – Golf I – Golf IV

![Figure 17: Käfer – Golf I – Golf IV](image)

Figure 18: Improved Fuel Rate for a Given Vehicle Type Failed to Lower Fuel Consumption per Vehicle

![Figure 18: Improved Fuel Rate for a Given Vehicle Type Failed to Lower Fuel Consumption per Vehicle](image)
Rebound effects (3)

Figure 19: Development of traffic kilometres - an indicator for the lack of mental/intellectual mobility

Rebound effects (4)

Figure 20: The International Energy Agency says that if the world cut its oil use by only 8%, oil prices would come down by 16%.
The problem of the system...

Figure 21: Causal loops, rebound effects, difference between individual and system behaviour

Figure 22: What we all experience, when we drive a car...
“The US government 2005 Fuel Economy Guide includes a plot showing the optimum between 50 and 55 mph (80 and 89 km/h) for an unspecified vehicle.” (www.fueleconomy.gov; Fuel Economy Guide 2005)

Fuel consumption – The system

![Graph showing fuel consumption per kilometer vs. speed](image1)

![Graph showing fuel consumption per hour vs. speed](image2)

Figure 23: Single impact

Figure 24: Real system impact

Source: Pfleiderer, Dieterich, 2002

Nowhere on the globe a saving of travel time has been observed so far

![Graph showing individual daily trip length with travel time budget under consideration motorization per household](image3)

Figure 25: Individual daily trip length with travel time budget under consideration motorization per household. Source: (Zahavi, 1981).
Congestion is not a transport problem – it's necessary for system-control.

Figure 26: High speed – longer distance (Source: Knoflacher)

Figure 27: Delay in minutes
Figure 28: Days after congestion beginning

Figure 29: Heidelberg, Germany, 1993; 3 lanes reduced to 2
Mobility in interaction with other disciplines

Figure 30: If we change the transport system we change everything! (Source: Knoflacher)

ITS - Technology helping & improving

- Car-Pooling and car sharing (supported by infrastructure)
- Increase occupancy level
- Improve wellbeing of human beings or car drivers
- Best way to save energy - don’t use the car (esp. for short distances)

Regarding main indicators and system view

- Speed is the main indicator (efficiency in the system, impacts on structures (living, economical, social, etc. – feedback loops)
- User ITS for adaption of speed to a „social“ - intelligent - level.
- Parking organization and information (choice of means of transport depends on circumstances at start/end of trip)
- What do we want? (consider: rebound effects, causal loops, etc.)
- Discuss symptoms or causes?
- Take interdependency between means of transportation into account and
- interdependency with all other disciplines outside of transportation
- Methods of the past have not solved the problems (quite on the contrary: -> expanding the capacity has led to bigger and bigger transport problems)
5 Small group work – Day 1

Think of the intelligent systems that you know by now and that are in effect à what green driving aspects are supported by those systems

Here follows a summary of the discussion results of the four small groups:

First of all, when we talk about Green driving we have to talk about Green-mobility as well as Green driving refers basically to Green car-driving.

Examples mentioned in the discussion:

Speed

- Most systems rely on speed; try to find solutions that take speed out of the system in an intelligent way. Promote all issues on different areas (e.g. see the diamond).
- “Section control” (see for instance “section control” in Austria) which changes behaviour in accordance with flow.
- A mixture of infrastructure & vehicle that takes also in account fuel consumption → ACC could be linked with eco-info (e.g. design).
- Navigation systems and speed limiter have potential
- Variable Speed limiter
- Important ITS are automatic pay tolls (not stop pass/pass with unchanged speed or with 60km/h).
- Favourable aero dynamics has high GD potential (not an ITS).
- Lower speed gives more time for anticipation and ISA etc. can help in this respect (though people do not accept them well).
- ISA (Intelligent speed adaptation) can be very effective if attitudes towards ISA can be improved viz. if better acceptance is reached. There are cultural differences in this respect.

Multimodality and route optimization

- Systems to promote intermodality should be implemented. Integration between different modes by, e.g., information systems is an important issue for the future. Information that can be used to decide concerning ones mode choice is seen as a good thing.
- In urban areas: information about parking (reduces parking traffic).
- Parking: Do not only give information by smartphone about the nearest parking but also about free spaces at an early stage, so the drivers can follow routes that directly lead to parking from the beginning.
- Dynamic route planning has high potential, it analyses the environment and gives information about congestions, you can adapt to this and by this reduce fuel consumption.

Information, Training and Behaviour adaptation

- Information should be given to drivers for promoting eco-driving: how is their style? This is especially relevant for truck drivers, company fleets, busses (stress vs. green-driving?)
- Information about consumption and about behaviour that leads to good results is a good motivation.
- On a company level: competition for the good goal (“fuel-saving driver of the month” with the help of econometer in the car etc.). Instruct for driving characteristics that reduce fuel consumption and
reward measured achievements, support behaviour with intelligent equipment. Also: Talking about oral experience with sustainable behaviour in groups, use ITS that support such behaviour (see above) for this.

- Discuss travel time budget vs. living place/work place and the commuting time necessary to reach this living place/work place.
- The communication about how systems work has the potential to influence behaviour (see "marketing approach" above).
- Infrastructure-based systems should be used to reach behaviour changes ("you are driving 55km/h").
- Provide clear consequences for unwanted behaviour, otherwise people will not believe that it is serious; think how ITS can be used to this end.
- Vehicle based systems should no longer strive for changing the driving culture (which is difficult) but directly for changing individuals, by giving contingent direct feed back to the behaviour of individuals.
- The alcolock maybe does not support green driving but has the potential to influence mode choice at relevant occasions.

New forms of Mobility

- Hybrid car: question whether this is an ITS or not?
- Bike sharing and car sharing can reduce individual car use.
- Provide good preconditions for bicycling: lower motor vehicle speeds, less dangerous car driver behaviour, etc.

New media

- Platforms and mobile phone applications
- Web-based apps should be made use of and integration of social networks for car sharing/pooling plus information about users is recommended (with whom do you have to share your car).

In general, we have to think about harmful effects connected to new solutions. Green Driving refers not only to fuel but also to air, noise, and space consumption. Further, support for special groups by systems should be strived for. Stress reducing effects could also be of interest. There is a competition between individual needs and system demands concerning new technical solutions (e.g. think of navigation - might be a good individual solution but can be bad for the system or society as a whole).

6 Assessing driver behaviour with respect to medium and long term developments

Juliane Haupt, FACTUM Chaloupka & Risser OG

Behavioural adaptations

“... those behaviours which may occur following the introduction of changes to the road-vehicle-user system and which were not intended by the initiators of the change. Behavioural adaptations occur as road users respond to changes in the road transport system such that their personal needs are achieved as a result. They create a continuum of effects ranging from positive increase in safety to a decrease in safety” (OECD, 1990).
Behaviour is much more than just what you see the people doing on the road. Michon discerned three levels – strategic, tactic and operational. Mika Hatakka (see below) suggested to think of behaviour on four or five levels. The higher the level, the more difficult the empirical approach.

![Image of the three-level model](image_url)

**Figure 31**: A three level model of Driver Behaviour by Jean Michon

<table>
<thead>
<tr>
<th>Level/Dimension</th>
<th>Knowledge and skills</th>
<th>Risk increasing factors</th>
<th>Self-evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level V&lt;br&gt;Company awareness, characteristics, safety situation (organisational level)</td>
<td>In logistics, safety systems, management, economy, safety culture, values</td>
<td>Production/protection, feedback system, company’s motivational system</td>
<td>Company’s / organisation’s awareness of safety situation and its development</td>
</tr>
<tr>
<td>Level IV&lt;br&gt;Goals for life and skills for living</td>
<td>Lifestyle, age, group, culture, social position etc. vs. driving behaviour</td>
<td>Sensation seeking, group norms, peer pressure</td>
<td>Introspective competence, own preconditions, impulse control</td>
</tr>
<tr>
<td>Level III&lt;br&gt;Goals and context of driving</td>
<td>Modal choice, choice of time, role of motives, route planning</td>
<td>Alcohol, fatigue, low friction, rush hours, young passengers</td>
<td>Own motives influencing choices, self-critical thinking</td>
</tr>
<tr>
<td>Level II&lt;br&gt;Driving in traffic</td>
<td>Traffic rules, cooperation, hazard perception, Automation</td>
<td>Disobeying rules, tailgating, low friction, vulnerable road users</td>
<td>Calibration of driving skills, own driving style</td>
</tr>
<tr>
<td>Level I&lt;br&gt;Vehicle control</td>
<td>Car functioning, protection systems, vehicle control, physical laws</td>
<td>No seatbelts, breakdown of vehicle system, worn-out tyres</td>
<td>Calibration of car control skills</td>
</tr>
</tbody>
</table>

**Figure 32**: The 5-level model by Mika Hatakka (Keskinen, E., Peräaho, M. & Laapotti, S. (2010)).
Figure 33: All ITS can have influence on the different behaviour levels.

Figure 34: Assessing driver behaviour: assessing level I & level II
Assessing driver behaviour: assessing level III, IV & level V

- Company awareness, safety situation, organisation level
- Goals for life and skills for living
- Goals and context of driving
  - Questionnaires
  - Interviews
  - Expert workshops
  - Focus groups

Assessing driver behaviour: assessing level III, IV & level V - Point in time: repeated studies/longitudinal vs. narrative approach

7 Brave new world? Hopes and fears concerning ITS and Green Driving

Rob Methorst, Dutch Ministry of Transport (Rijkswaterstaat), Centre for Transport and Navigation

Brave New World: ITS as religion?
- Huxley’s novel: Science + Soma: no dangers?
- Role Technology:
  - make life easier by providing aids / tools
  - Functionalities: inform warn take over
  - There is no perfect tool (SWOT’s)
- Role in our project:
  - Greening of transport
  - Sustainable: no drawbacks and side-effects

Systems Approach
- Start with user
  - Activity levels: needs, abilities
  - Actors, roles & interests
- Analyse comprehensively
  - Context
    - content (Demand & Supply, ‘Diamond’)  
  - Process
- Use multi-layered integral policy
  - Cascade: start with contexts of activity level
  - Integral, demand & supply
  - Interaction, procedures
## Hopes

- **Strengths**
  - Functionality and Ergonomics:
  - ITS does what is promised (expands scope; saves mental and physical energy)
  - ITS is easy and safe to use (Design for All)
    - Effectiveness for achieving GOAL: Sustainable Transport
    - Efficiency: Value for money and energy input; release for new activities
    - Satisfaction
- **Additional values (Opportunities)**
  - Increases general Happiness, Health & Wealth scores
  - Promotes equity in participation/mobility opportunities

## Pitfalls – what could also happen

- **Tool functionality and quality**
  - Disappointing functionality (‘readability’, convenience, comfort, connected, safety & forgivingness; Life cycle: wear (functionality, economics)
- **Conflicting actor-role and interests**
  - Cf. Liability, power distribution / monopoly, providers market, pathological attitude towards service, ...
- **Inequality (haves and have-nots)**
  - Segregation, segmentation, power struggles
- **System functionality, efficiency and safety consequences (cf. DRL)**
- **Side effects & drawbacks**

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### Table 1: Activity levels concerning Green Driving (Source: Hatakka, 1999, 2002; PQN Final Report, 2010.)

<table>
<thead>
<tr>
<th>Levels of behaviour</th>
<th>Type of decisions</th>
<th>Behavioural goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifestyle</td>
<td>Fundamental decisions. Relates to goals for life and skills for living.</td>
<td>‘Being’ and identity</td>
</tr>
<tr>
<td>Strategic</td>
<td>Decisions relating travel or purpose (motive), where to go (destination) and which mode will be used.</td>
<td>‘Going’</td>
</tr>
<tr>
<td>Tactical</td>
<td>Decisions with regard to the route to be taken, places to cross, walking or driving speed and so on.</td>
<td>‘Traveling’</td>
</tr>
<tr>
<td>Operational</td>
<td>Operational decisions or reactions relating other road users, the traffic situation and other interacting persons and obstacles.</td>
<td>‘Driving’, ‘Riding’, ‘Walking’</td>
</tr>
</tbody>
</table>
Addiction / dependence, inactivity & health, privacy, others bear the consequences.

And what now?

- Do we really need the systems?
- Quest for potential system disrupts and counter forces along the decision path
- Devise ‘defenses’ for potential failures
- Provide back-up systems

What is the societal Added Value?

According to Reason’s model, one can argue as follows: If at the Lifestyle level a non-green driving decision has been taken, like going to live in the countryside, while having work in the city, at the strategic level measures can be taken to green the transportation, like go by public transport. If the car is taken instead (strategic decision), in the critical path to green driving 'a hole in the cheese' appears. This can be remedied by taking measures at the tactical level by taking measures ('defenses') like active motor management, setting a speed limiter, shutting down the air condition etc.). If not, in the critical path a hole in cheese appears. This again can be remedied by measures on the operational level: drive smoothly, with the help of the cruise control, traffic light all on green by means of ITS, traffic management, speed control etc. In all these cases ITS can support the decisions in the right, but also in the wrong direction.

8 Small group work day 2

Group 1: What endangers positive outputs and positive outcomes of those systems that you know today?

What endangers normal or regular products is hard to predict, testing products with a predictive value is difficult.

If a product does not what it is supposed to do, or if it does unwanted things in addition to the envisaged ones, and if this is not disclosed clearly, the drivers usually do not know this in the beginning unless they are informed beforehand. If not they are not able to overcome the drawbacks.
Problems also arise when products are designed without considering needs, contexts or heterogeneity of the target population.

If products need prerequisites to function, e.g., if the country or area needs to have infrastructure that allows user to use system fully, or if there are different prerequisites for different systems, this may endanger positive outcomes.

To reach higher levels of functionality cause difficulties: many systems work on the operational level (car & road), but for reaching higher levels more and more complex preconditions are needed.

What also can hinder positive outcomes is relying too much on a system and/or using new freedom (e.g. better safety preconditions, so you do not have to care so much about safety any more) to do other things than dealing with the primary task of driving. There may also be delegation of responsibility from man to machine or man-machine competition.

Also systems that give us the impression that we already do a lot for the environment may not give us the real impression of what we are doing.

Finally, the question “what is a positive outcome?” is considered an important point but was not discussed in detail.

**Group 2: What new ITS can or could you think of that would fulfil the goals achieving green driving without unwanted side-effects?**

There is no system without side effects, every system has risks. Thus there must be some focus on discussing how to manage such risks, how to mitigate them, but also on the question how dangerous such risks are and how to measure them. And of course we do not know about all possible side effects.

Which improvements are possible? Maybe the technical definition of how systems can improve things, e.g. air resistance, lower distances between vehicles, is not enough but it has also to be said exactly what the driver has to do in order to achieve such advantages?

Systems cannot be without mistakes, this would be a dangerous expectation. If the driver is not warned about possible functional problems the driver has reduced time to react (but of course it goes against marketing principles to inform about possible short comings).

Concretely one should improve automatic gears, they are connected to unnecessary high fuel consumption today – one could make use of driving cycle data from centres in order to learn how automatic gearing could function in an optimum way (aggregate data for learning about driving behaviour and adjusting new systems accordingly).

BUT motivation is one important issue: the driver is the decision maker and his behaviour on all levels is essential. Is it however possible to motivate drivers just by ITS? Maybe additional devices in cars are necessary, or the use of social media could be included in the measures, etc.

**Group 3: Address different groups of drivers and what systems help them**

Different groups of drivers can be defined, for instance novice, older, professional, or impaired drivers. Furthermore commuters, driving under special circumstances (ambulances, fire brigade), or PTW can be mentioned, however in our case not concerning safety but Green Driving. ITS should fit such demands. Eco driving is mainly dedicated to novice drivers, so that they start early to consider relevant processes, they are/should be supported with information and with feedback on-line and off-line, both on the strategic level and on lower levels.

Professional drivers are also a relevant group, they can save money for the employers by saving fuel, they can help reduce pollution, they can also save time (e.g. with the help of intelligent navigation advice).

Navigation systems in-vehicle can help older drivers and impaired drivers by providing dedicated information that supports them in their needs and helps compensating individual short comings, thus contributing to keeping up individual mobility and to make it possible to avoid losing the option to drive.
Multi-modal information systems, e.g. internet based ones, can support switching between modes, e.g. old persons who want to stop car driving, or commuters who want to use public transport in the future. Even part use of public transport can be supported in this way (park and ride).

**Group 4: Green driving could also be green mobility; plus harmful effects that are barriers to achieving the goal**

The groups discussed the time horizon for „long term” and decided to go for a 10 – 15 years perspective. During this time changes would be possible on all levels. Car characteristics could change, destinations, behaviour on the road (speed, acceleration, fuel consumption).

Green mobility requires also changing the context (infrastructure, organisational issues etc.) and not only waiting for the initiative of the end user. For this you probably need a political will leading to a mobility concept that includes differences and special exigencies, for instance different preconditions for urban and rural environment, for multi-modal approach where this is possible vs. situations where this is not possible, etc. As an example for special conditions self organisation in the village is mentioned, where mobility problems are solved by sharing & cooperating.

**9 Summary of results and conclusion**

When summarising the contents of the presentations and the results of the small group discussions the priorities to be considered seem to be the following:

- Start the process with discussing higher levels of behaviour (life style, strategic issues; see models of Michon and Hatakka) and proceed to the lower levels stepwise. It seems to be obvious that the highest potential for greener & cleaner mobility lies in the life styles and in the strategic decisions of people.
- Still it is not useless to take initiative on the lower levels. Measures that support intelligent strategic use of the car and that enhance the use of other modes in addition to car use, initiatives to improve driving style towards a more eco- and socially friendly one, and also systems that help minimise energy investment and optimise efficiency of the car in a technical sense can be considered positively.
- However, also side effects are known to appear on all levels of deployment. The discussion of possible side effects should thus be led at all stages of implementation: Do not strive for a terminal problem solution in this respect, but consider the fight against side effects a continuous process where we steadily learn.

<table>
<thead>
<tr>
<th>Level of deployment</th>
<th>Type of support</th>
<th>Type of system</th>
<th>Evaluation methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimum sustainability, mobility as a life style issue, choice of living place that makes car use unnecessary</td>
<td>Support use of alternative modes, support changing of habits, provide security connected to changes of habits (old persons or commuters giving up driving etc), provide relevant information</td>
<td>Platforms making use of internet and mobile phones, information systems for walking, cycling, public transport and all kinds of combinations</td>
<td>Narrative approaches, longitudinal design, repeated studies: Qualitative interviews, heuristic procedures; assess mobility patterns with the help of verbal data – but also smart phones could be used!</td>
</tr>
<tr>
<td>Strategically intelligent car use</td>
<td>Support part use of the car viz. the car in the frame of an intermodal chain, support companies/professional drivers in reducing length of trips etc.</td>
<td>Intermodal information and navigation systems, Park &amp; ride information, Public transport information connected to congestion info, last-mile information that</td>
<td>Counting vehicles in park houses &amp; distribution; measuring sums of trip lengths, time on the road, fuel consumption, but also narrative approaches</td>
</tr>
</tbody>
</table>
makes parking further away from ones goal less of a problem etc. (see above)

| Tactic and operational level (driving style, equipment in use) | Measures to improve the driving style towards a more eco- and socially friendly one, systems that help minimise energy investment and optimise efficiency of the car in a technical sense | Dynamic route guidance, speed limiters, ACC, parking information, econometers, etc. | Behaviour observation & behaviour registrations with different degree of structuring, measuring driving cycles and calculating exhaust, fuel consumption etc. on basis of this |

Table 2: Summary and conclusions

The assessment of the behaviour at the higher levels is more complex, though. Empirical access is limited and one has to rely more on verbal data, results are most often more of a qualitative type. This may be one reason why higher level issues in connection with the introduction/implementation of ITS are not so well researched, as quantification is always asked for, almost like a reflex. In contrast to this, it seems necessary to demand that we learn better use of qualitative methods in order to be able to better understand and influence higher level behaviour processes. At the moment, however, most of the research is done, with very high investments (FOT, NDR), on the operational and tactical level of behaviour.

The discussion of these issues will be continued in the frame of the further activities carried out in the frame of DECOMOBIL.