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Sébastien Rauch
Gregory M. Morrison *Editors*

Urban Environment

Proceedings of the 10th Urban Environment Symposium

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Urban Environment

ALLIANCE FOR GLOBAL SUSTAINABILITY BOOKSERIES SCIENCE AND TECHNOLOGY: TOOLS FOR SUSTAINABLE DEVELOPMENT

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ISSN 1571-4780
ISBN 978-94-007-2539-3 e-ISBN 978-94-007-2540-9
DOI 10.1007/978-94-007-2540-9
Springer Dordrecht Heidelberg London New York

Library of Congress Control Number: 2011944968

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

The 10th Urban Environment Symposium (10UES) was held on 9–11 June 2010 in Gothenburg, Sweden. UES aims at providing a forum on the science and practices required to support pathways to a positive and sustainable future in the urban environment. The UES series is run by Chalmers University of Technology within the Alliance for Global Sustainability (The AGS).

UES was initiated by Professor Ron Hamilton at Middlesex Polytechnic (now University) in the early 1980s under the title "Highway Pollution". The initial aim was to measure and assess challenges in highway pollution, with a strong emphasis on urban photochemical smog, ozone formation and particle release. After the first symposium, the emphasis on air pollution issues continued through to Munich in 1989 where diesel particulate issues and the relevance to health through measurements of PM10 emerged. The focus on air quality issues was also strengthened by the co-organisation of the symposium with Professor Roy Hamilton at the University of Birmingham from 1986 to 1998. In parallel, the symposium started to receive an increasing number of scientific contributions from the area of urban run off, indeed to the extent that the title of the symposium was changed to "Highway and Urban Pollution". Also at this time the importance of science in support of policy was emerging as a key aspect of the symposium.

The 8^{th} edition of the symposium was marked by an organizational change with Chalmers University of Technology taking over the organization of the symposium. At this stage, we decided to evolve the name of the symposium to "Highway and Urban Environment" (HUES) to provide a positive view of the challenges in the urban and roadside environment. That said, papers addressing pollution issues remain a central part of the symposium as they help to raise awareness around the issues to be solved. For the first time, the proceedings of the symposium were published as a book in the AGS book series. This continued at 9HUES in Madrid in June 2008.

The 10^{th} edition of the symposium was hosted at our home university, Chalmers University of Technology in June 2010. The 10^{th} symposium was marked by a further evolution of the name, with the term "highway" being dropped. With this change, we hope that the name of the symposium will better reflect its aim.

We would like to take this opportunity to thank all who have contributed to the success of 10UES. We would especially like to acknowledge Alexandra Priatna and Jessica Olausson at Chalmers' AGS office whose organizational skills were essential to the success of this symposium.

The next symposium, 11UES is planned for September 2012 and will be held in Karlsruhe, Germany in collaboration with the Karlsruhe Institute of technology (KIT).

Göteborg, Sweden

Sébastien Rauch
Gregory M. Morrison

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SUSTAINABLE URBAN DEVELOPMENT AND URBAN PLANNING

Transport and environmental regulation – common attitudes and social change

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Abstract

Since the Kyoto protocol in 1997, signatories States attempt by appropriate policies to restrict the traffic in urban space, considered as the first source of greenhouse gas emissions. On the scale of metropolises, the elected representatives borrowed in this policy and the organizing authorities of the transport, elaborate limitative measurements to show their environmental policy. The main stake of environmental policies is the social acceptability. Or, the behaviour change, depends of collective social attitudes, are produced in a comparatively long process. Two approaches are in work in the urban field and especially about urban transportation. The first approach is more technical. It arrests urban policies as being plans of action in a shorter time scale. It leans more on technical choices as main support of urban policy. The second heads rather with the sociological and cultural dimensions of urban phenomena. It takes into account social links, social organization and specific cultural values in every society or a community. Both approaches crystallize academic scientific disciplines dividing up between, the sciences of environment and engineer on the one hand, and human and social sciences of other one. Our objective is to show foundations and borders of both approaches and try to reconcile both acceptations in what we call interdisciplinary approach.

Introduction

The environmental question is in the centre of public policy and public attention. It has become an important paradigm structuring the political, scientific and social spheres in the last three decades. We fear for our common future (natural resources, atmospheric pollution, physical and

S. Rauch and G.M. Morrison (eds.), *Urban Environment: Proceedings of the 10th Urban Environment Symposium*, Alliance for Global Sustainability Bookseries 19,
DOI 10.1007/978-94-007-2540-9_1,

mental health of world inhabitants…). This context has an effect on regulation tools in the urban space. In the field of transportation, of sorting of waste, of production and consumption of goods, of managing natural resources, we attempt to pay more attention to our natural environment in order to respect it. While most solutions have a technical dimension, they are conceived without taking social acceptance into account. We design solutions before looking for a social consensus. It is evident that our entire technical and material environment depends on us joining in the process and adopting it. The success of any public policy means adhesion of social forces. This paper focuses on the analysis of the gap between the two spheres, social logic and technical logic and their fundamentals. The field of research is urban transportation.

Environment and urban mobility

In spite of the close link between economic and social development and the increase of travel, the transportation sector is responsible for nearly a third of greenhouse gasses (GHG) emissions which are increasing rapidly. Emissions of carbon dioxide (CO2), the main greenhouse gas (GHG) produced by the transportation sector, have steadily increased along with the travel, energy use, and oil imports too. Urban transport policy aims at creating sustainable urban mobility through legal tools and technical solutions. The investments increase progressively so as to develop a public service in urban transportation. In France, some of these measures are part of what we call a PDU or urban transportation plan. Cities with more than 100 000 inhabitants must elaborate this PDU in which they commit themselves to reducing their GHG emissions by reducing the use of personal vehicles and encouraging the use of public transportation modes (bus, tramway, train...). These goals reveal a proactive aspect in sustainable development policy. Urban mobility means that transportation must respect the objectives of sustainable development. We give some examples of investments such as adjusting the layout of urban roads (one way/two way roads), developing toll urban parking, social pricing of tickets, creating new tramway lines...

The social challenge

The principal challenge of this policy, via such as tool as the PDU, is to encourage city dwellers to do without the personal car and to use more public transport. Most PDUs were developed and approved in the past decade (2000–2010). Since the “solidarité et renouvellement urbain”

(SRU) law [1], the evaluation of a PDU is an obligation. The authorities in charge of organising urban transportation are obliged to carry out an environmental assessment to see if their policy reached the objectives of reducing the emission of greenhouse gas and if there are more users of public urban transportation than before or not[1]. However, scientific reports on these evaluations, have pointed out the difficulty of demonstrating systematically a relationship between urban transportation policy and environmental goals. At the same time, the car is still the most important mode of transport within the urban space.

Despite the proliferation of restrictive measures and tools for the regulation of car use in cities, the results of these policies remain below the expectations of organizing authorities and experts in urban transportation, in terms of ambition for better protection of the environment and in particular of reducing emissions of greenhouse gases. In several recent studies, it was shown that personal vehicles remain the dominant mode of travel in the city compared to all other modes. This negative assessment puts into question the effectiveness of public policies in urban transport linked to the objectives of “sustainable mobility”. Some “politically manufactured” statistics show some evolution in the practices relating to the use of the car but this does not reflect a significant change. The dilemma of urban transportation policy is the gap between aims and results. Our hypothesis in this article is to explain this gap by the fundamental opposition which exists between the technical logic and the social one.

Background of policy makers

The urban transportation policy is designed according to a purely technical logic from a fundamental idea: rational choice theory. The rational choice theory is based on the rule of the rational individual. According to this approach, individuals are rational actors and act as if balancing costs against benefits to arrive at action that maximizes personal advantage. Indeed, social action is explained in terms of the rational calculations made by self-interested individuals. The rational choice theory sees social interaction as social exchange, modelled on

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[1] For example the Eval-PDU project (2009-2012), financed by the National Agency of Research (ANR). The project objective is to develop an optimized methodology to assess the environmental impacts of urban mobility plans (UMP, in French PDU), taking into account their social and economic consequences. With an interdisciplinary approach, the scientific researchers elaborate together indicators to measure the policy and the goals in an environmental dimension.

economic action. People are motivated by the rewards and costs of actions and by the profits that they can make. With this approach, the rational choice theory cannot explain the origins of social norms, especially those of altruism, reciprocity, and trust. This theory did not cease showing its limits vis-a-vis the weight of social determinants such as age, status, social position but also social structure. Any individual is registered in one social organization, having a particular trajectory and carries the characteristics of his social origin but also of their own past experiences. This inscription in the body and the spirit, of the standards, the values and the cultural and these religious precepts, plays an important role in our daily choices. About the collective behaviour, we are faced with diverse kinds of non rational actions. How we can say that social attachment to a car, observed in many cities and different societies, is the sum of rational individual behaviour? Sociologists considered that the individual is modelled by society as well as these manners of view are socially constructed in a long process beginning at birth. Norbert Elias wrote his famous essays: *The society of individuals* and he argued that individual interiorized constraints and differentiation of society do define the behaviour of individuals.

But on another side, we can say that individuals today, in era of more of freedom, of new technologies of communication and information, of less of social control, more choice and chance, have the possibility to do what they like. Some contemporary sociologists note that “the society” does not determine any more the social conduits as straightforwadly as before. Society is more fluid and less rigid in the structures which compose it [2]. Therefore, social acceptability is not guaranteed. All social adhesions are produced within a social process. It’s not possible to have social acceptance automatically because it is a collective action. The urban sustainable mobility is a new kind of society here all categories act jointly. It is a collective social consensus. It is not possible to assume that a new tramway line will have the same social sense in different cities or in different kinds of societies. The social uses of techniques are determined by social culture and social history. It depends on social representations of the technical environment. If the car in some societies is just a way of going from one place to the next, in other societies it is a way to show social status. Indeed, we can’t have the same consequences for a given public policy. Michel Crozier titled his famous book *We can’t change society with a decree* [3].

Rational and non rational actions in sociological theory

The social rational or irrational behavior is at the heart of sociological theory. If we examine Weber's theory, there is a different kind of social action whose reveal different fields of references. Weber's emphasis on the subjective meaning that actors attach to their action implied an individual focus, often described as action theory. He distinguished four ideal types of social action: *traditional action*, justified as a repetition of the past; *affective action*, geared toward the expression of emotion; *value-oriented action*, in which the performance is taken as an end in itself; and *instrumental action* or means–ends rationality, in which actors pursue their economic or other interests. Any specific action might involve one or more of these rationales [4].

In Bourdieu's theory [5], concept of *habitus*[2] means all unconscious and sustainable dispositions accompanying each individual from birth to death. Each individual interiorize these dispositions, in socialization process, in response to objective conditions within which he lived. A large part of the concept of *habitus* is that it brings attention to the fact that there are limitless options for action that a person would never think of, and therefore those options don't really exist as possibilities. In normal social situations, a person relies upon a large store of scripts and a large store of knowledge, which present that person with a certain picture of the world and how she or he thinks to behave within it. A person's habitus cannot be fully known to the person, as it exists largely within the realm of the unconscious and includes things as visceral as body movements and postures, and it also includes the most basic aspects of thought and knowledge about the world, including about the habitus itself.

Then we can act for other reasons which are not rational. The religious actions like example. Some of our daily reactions are linked to love or hatred in fact related to our emotions. If the rationality it means the interest, this interest not systematically economic, it may be symbolic, social or religious. If we applied this approach in the field of transportation policy, we can explain the social resistance who's appears as non rational. But there is others rationalities characterizing the choice of modes of moving. Indeed, the hypothesis that public transportation it is accepted by all social categories is not evident. Many people are more attached at their car than public transportation mode. The personal vehicle

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[2] Habitus is defined as a "system of sustainable and replicable rules, structured structures arranged to function as structuring structures, that is to say, as a principle generating and organizing practices and representations that can be objectively adapted to their purpose without assuming conscious aiming for express and control operations necessary to achieve them".

guarantees freedom and comfort. The individuals are very attached at comfort of their lifestyle and conceive the car as private space in which they realizing their personal freedom. Indeed, use car not automatically the alternative of absence of public transport. This social phenomenon reveals the attachment to the car as tool permitting more comfort and flexibility in daily travelling. Therefore, the fundamentals of social action and the goals of urban transportation policy are not coherent. We will see in following lines how the two logics are different.

Technical logic and social logic

The main important objective of sustainable mobility is to encourage urban people at using more public transport. Then the principal stake is to change society, change social behaviour. We hope so that all these investments going to make urban transport conditions more favourable to urban mobility and in fine give up personal vehicles. The investments have mostly a technical nature. Reducing urban space for parking car, modified road direction or created a new tramway is a technical change. We can ask now if it is possible to change society justly with technical innovations.

Anthropologists of techniques such as Robert Creswell [6] demonstrated that is possible after introducing a new technical process to produce social change. On the other hand, the opposite is possible: social change may have effects on the technical system. But the nature of social change is not known before. We can’t program the social change. It depends of the effect of technical innovation: the scale of innovation, the social organization system, the social culture, the technical level and social history of inhabitants. Jean-Pierre Digard, anthropologist of techniques too, said that “The technical facts thus are by no means isolated but belong to a coherent technical system, itself not separable from a social and cultural unit broader, whose study requires the contest of several disciplines, in the forefront of which obviously, ethnology and linguistics appear” [7]. Therefore the technical change can trigger a social change as well as the social change can trigger a technical innovation. There is a dialectic relation between social structure and technical structure. We note too that the technical change is on a much shorter scale while the social change occurs on a longer scale.

Societal change, how?

In sociological theory, there are two tendencies to explain social change. Firstly a holistic approach which considers that social change is a global and radical project: the French revolution as example of social movement, or as the labour movement for Marx, Dahrendorf or Touraine. For Alain Touraine [8], the social change is a society project born out of and carried by a labour movement. Changing society is a collective action with common goals. We call this approach, holism. We consider that the characteristics of collective action are different from the characteristics of individuals.

The second approach focuses on individual action. It considers that social change is the effect of the sum of individual actions. The paradigm of this approach is the one of methodological individualism. In the broad sense, one can characterize the methodological individualism by three proposals which postulate that:

- Only the individuals have goals and interests (principle of Popper-Agassi).
- The social system, and its changes, result from action of the individuals.
- All the socio-economic phenomena are explainable in the terms of theories which refer only to the individuals, with their provisions, beliefs, resources and relations.

If we refer to the first theory, today we can't mobilize a large part of population to be more sustainable in their moving practices. In spite of the fact, there are tendencies such as movements against global capitalism or, for example, local associations of producers of organic products having a controlled designation of origin (AOC, appellation d'origine contrôlée).

If we use the second approach, through what means we can change social behaviour? Individuals are the base of society but they are radically different. Society is composed to a diversity of social positions. The working classes do not have the same conditions as middle classes who are different from those of upper social classes. The individual behaviour is closely linked to his social and economic conditions. The response of individuals' vis-à-vis public policy is different because their conditions are specific. In fact, individual response to public policies is never systematic.

Then, the systematic effect of transportation policy on social behaviour isn't evident. This conception applied in the social sphere comes from the sciences of nature. In this sphere of knowledge, the techniques are supreme form of rationality. The social phenomena are of another nature. We can not submit it to a formal rationality as well as we can not be programmed their directions. We can not change society only if work of social mechanisms, and we can not explain what is social only by what is social, as Durkheim said [9].

Ecological culture and contemporary consumerism

In the contemporary world, individuals are socialized according to a model characterized by the following elements:

- Hedonism: research of all kinds of pleasure.
- Comfort: Less effort and more rest.
- Freedom of circulation: moving usually in space and in time like holidays, journey and recreations…
- Consumption freedom: property of goods, eating different kinds of food, clothes according mode.
- Individual interest before the collective interest: exacerbates individualism.
- A global culture of consumerism which more rooted by following means: cinema, publicity, mass media, school, new technology of communication and information…

Jointly to this collective culture of consumption which is very recent in history, we add another fundamental element of modernity: freedom. We compare societies with this criterion of freedom of persons. Democracy is based on freedom. Without freedom, capitalism can't maintain his global domination. I'm free to do what I like and when I like. Therefore, individuals and social groups have become very attached at a standard lifestyle which is characterized by a culture without constraints and with more hedonism. There is a social consensus which legitimates the collective aspiration at having this life mode. Consumerism is the myth that the individual will be gratified and integrated by consuming. It offers the tangible goal of owning a product, and offers only short term ego-gratification for those who can afford the luxury and frustration for those who cannot. For many individuals taking public transportation, they don't own a car because their low income. Usually they belong to popular classes.

We need to introduce a new social culture that we will call: *ecological culture*. The notion of Ecological culture is the sum of collective values which model the social conduits so as to respect the natural cycles and the natural resources. This ecological culture means practicing self-control, a limitation of consumption, less comfort for individuals and less freedom. Therefore, we will be in the age of the global culture of frustration which is the opposite to the global culture of hedonism. This is the political and social challenge today to protect the future generations' interest. As well as the global culture of hedonism resulted from social mechanisms and of a specific socialization, the new ecological culture has needs innovation to socialize models which focus on awareness about our common future and the preservation of natural resources.

Conclusion

It appears from the above that the technocratic logic can only succeed if it is accompanied by a social acceptance or even a total adhesion of all social categories. However, this social consensus is not the work of political institutions or voluntary associations, in spite of their important role in creating greater social awareness of acute environmental problems. It is the result of a long-term socialization of younger generations. Social resistance to fully engage in a more ecological and sustainable culture is a tangible reason of rooting of this lifestyle characterized by hedonism and consumerism socially shared.

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Environmental impact assessment of urban mobility plan: a methodology including socio-economic consequences

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Abstract

The project objective is to develop an optimized methodology to assess the environmental impacts of urban mobility plans (UMP, in French PDU), taking into account their social and economic consequences. The main proposed methodology is based on a systemic approach: multi-factor (air quality, noise, energy consumption, greenhouse gas emission) numerical simulations with a chain of physically-based models, based on alternative and comparative scenarios. The social and economic

S. Rauch and G.M. Morrison (eds.), *Urban Environment: Proceedings of the 10th Urban Environment Symposium*, Alliance for Global Sustainability Bookseries 19,
DOI 10.1007/978-94-007-2540-9_2,

consequences of these alternative simulations are assessed by means of econometric models. Two alternative approaches are explored: (i) the use of composite environmental indicators to correlate the sources to the impacts, especially health impacts, and (ii) the analysis of sample surveys on what makes inhabitants' quality of life, well-being and territorial satisfaction and on citizens' behavioral changes linked to transport offer changes.

Context

Mobility is at the heart of the stakes for urban sustainable development and transportation policies that are set up in cities increasingly incorporate environmental components. Urban mobility plans are, in France as in most European countries [1], an essential tool of urban mobility policies. Their environmental features have received increasing attention during the last decade, so that environmental impacts assessment of the mobility plan actions is now compulsory.

The research program Eval-PDU was launched from the request by Nantes Métropole, the community of communes of the Nantes urban area, for a methodology allowing to assess jointly the various environmental impacts of the actual (2000-2010) urban mobility plan (UMP) and of the future plan (2011-2020), taking into account their social and economic consequences. This situation is a good illustration of the need of local public authorities for rigourously based tools to assess a series of impacts (air quality, noise, ...) effectively associated with various actions (or groups of actions) they lead. Beyond the monitoring of objective indicators, it is a matter of understanding and quantifying a cascade of physical and social causalities and, further, its consequences for the quality of life and its perception by the inhabitants. The need concerns as much *ex post* evaluations of what has already been done, as *ex ante* evaluations of what is being planned. A first one-year research-action grant with Nantes Métropole allowed to imagine the main features of the methodology and to build up consequently the project research team. Since January 2009 the program is funded for 3 years by the French national research agency (ANR) within its "Sustainable cities" program.

A priori, the proposed methodology is based on the assumption that quantitative environmental impact assessment require alternative, comparative simulations with physically-based numerical models of air quality (pollution emissions and dispersion), noise generation, energy consumption and greenhouse gas (GHG) emissions. For a joint assessment of these different environmental compartments, the simulations must be based on the same situations, hence on a common description of the transport traffic – this requires (i) a multi-modal traffic numerical model allowing to represent the actual traffic flows and their counterparts in alternative, hypothetical situations, and (ii) a full description of these alternative situations or scenarios, compatible with each of the involved numerical models. The social and economic consequences of the environmental impacts are to be assessed by econometric model calculations based on the results of the physical process simulations.

This approach raises a large number of methodological questions.

- **About scenarios and data**: What is the pertinence of alternative scenarios to render the changes generated by the UMP? Is-it possible to define different situations "everything else identical"? Can they be translated into coherent data sets? What is the availability of these data, which are necessary to run the various models? Especially in the case where the UMP "starting point" has not been defined in advance?
- **About the physical process simulations**: In the present state of urban transport modeling methods, is a multimodal model able to translate the different scenarios in significant changes of vehicle fluxes and travelled distances? Are multi-factor simulations possible with several mono-factor models? Considering the data and modeling uncertainties, will the simulation results be significant?
- **About the consequence analyses**: Can the simulation results be combined in an integrated assessment? By means of composite indicators? or by "socio-economic" analyses? Are the health impacts identifiable and quantifiable or masked by non-environmental influences? Are the social and economic consequences of environmental impacts of a lower order of magnitude than the direct social and economic impacts? Can they be evaluated in terms of well-being and satisfaction of UMP actions without a full economic computation of the whole UMP?
- **About the methodology itself**: Is-it possible to shorten the long chain of numerical models by using integrated, composite indicators relating the sources (transport fluxes) to the impacts (air quality, nuisances, human health) based on empirical correlations? What is the value of citizen's sample surveys on mobility and behavioral changes in response to mobility offer changes and, since they are more easy to launch by territorial authorities, could they be an efficient alternative?

Project structure

The main approach is based on multi-factor numerical simulations (air quality, noise, energy consumption, GHG emission) representing a set of alternative scenarios (with/without, before/after) rendering the changes in the citizens mobility over the metropolis area generated by UMP actions. These environmental impact simulations require input data sets, among which the emission inventories by the traffic of the different types of transport. Maps of the traffic fluxes are provided by a geographically-based multi-modal traffic model, whose main part is road traffic which is the key of the environmental stacks. The traffic intensities on the rails and road/street segments are the linear sources in the noise calculations. Combined with an engine emission model, they allow to compute energy consumption and emission inventories of regulated air pollutants and GHG. A urban pollutant dispersion model takes into account the meteorology interactions with the urban morphology to evaluate and map the pollutant concentrations and exposures.

The outputs of these numerical model simulations are the inputs of social and economic consequence calculations. The impacts of air quality and noise are computed on two types of socio-economic indicators: (i) well-being and declared satisfaction indicators, extracted from a survey of 1500 ad-hoc questionnaires to a representative population sample on 8 different districts; (ii) property values of housings, spatially correlated with the transport system main features. Econometric methods are further used to isolate the influence of environmental factors from those of other, preponderant factors.

Two alternative approaches are also explored, aiming at skipping all or parts of the numerical model chaining while keeping the capability of analyzing the processes from the socio-economic point of view. The first method, based on the works of COST action 356, consists in designing composite environmental indicators which correlate the sources and the impacts, i.e. the different transport mode intensities and the environmental quality indices; this method will be especially developed for assessing the health impacts, and compared to the results of the previous method. The second alternative approach consists in evaluating the environmental consequences of the changes in citizens' behavior linked to key UMP actions, from another survey among specific inhabitants especially concerned with these actions, by identifying their individual adaptation strategies to the variations in transport offer.

The program includes a large amount of result analysis and experience feedback in view of (1) applying the assessment methodology to the special case of Nantes urban area actual and future plans, (2) revising and optimizing the proposed methodology, (3) taking into account the knowledge obtained from the alternative approaches.

The research program is composed of 11 main tasks: project coordination, construction of alternative scenarios representing UMP actions and methodology optimization, data flux management and storage in a common geographical information system (GIS), multi-modal mobility modeling, simulation of pollutant emissions, GHG and energetic consumption, simulation of air quality, simulation of noise propagation and impacts, socio-economic assessments by econometric and well-being models, assessment by composite indicators, assessment of environmental consequences of the induced changes in citizens' behavior. These tasks are structured into 8 task packages according to their nature and the participation of the eleven research groups.

Coordination, construction of the methodology and scenarios

Coordination

The first task consist in the usual management of the program, including relations with the ANR funding agency, inter-teams and external communications (web, meetings, presentations and publications), and the coordination of the advancement of the different tasks. This last part is especially delicate due to the chaining of the successive modeling tasks and to the relatively large number of young scientists specifically hired for the program. Internal reporting is very important in such a program where several tasks are strongly inter-dependent. The task also includes coordination with Nantes Métropole, which is presently involved in its UMP assessment and revision, and which is the main provider of input data to the research program. Finally it includes coordination with other associated researches as, e.g., a series of student works on the relationships between the UMPs and other local territorial plans for air quality protection, climate, noise protection, ground occupation, and development schemes, and on the "environmentalization" of rules and instruments of urbanism and land law.

Methodology construction and optimization

The construction of the proposed methodology is a continuous task, from the program start since it is necessary to define the research work, until the end since an optimized methodology is the expected result of the works. A preliminary version will be first established, based on the situation of Nantes Métropole. A further analysis of its assumptions, principles, difficulties, drawbacks, … will be pursued during the course of the researches, with the aim of adapting the methodology to other urban areas. An optimized version will finally be drafted based on the results and returns of experience of the other task groups.

The task includes first an in-depth analysis of the previous examples of French and foreign UMP assessments, as well as of the relationships between the principles behind the design of the mobility plan of Nantes Métropole and their translation into actions on the transport network.

These actions cover a very large range: infrastructures, parking, urban toll, traffic restrictions, public transport, eco-driving, multi-modal information … They are categorized as a function of their time-space scales, their mechanisms (actions on behavior, traffic, modal split, prices), and the importance of their expected environmental impact, for selecting the different assessment methods, measurement tools, and pertinence for the urban mobility management.

In the final phase, the experience gained by the different task groups will be integrated to optimize the proposed methodology and to adapt it to either the ex-post assessment of achieved plans or ex-ante assessment of the expected impacts of plans in construction.

Construction of alternative scenarios representing UMP actions

The alternative scenarios are a key to the joint multi-factor impact assessment. For ex-post assessments, they must express the main features of the actual transport system and offers, and those they would have if the UMP actions had not been realized. This implies to select the data sets which define a reference situation “before” the UMP and to imagine the values of these data in situations “without” the UMP but taking into account all the changes which are not related to the UMP actions as, e.g., gas and energy price variations, urban sprawling, local and national economic transformations … Furthermore these data sets must be effectively available for the representative time horizons, e.g. just before and after the period of the plan, or a reconstruction method must be designed.

This task objective is to formulate the methodological principles of construction of alternative scenarios for environmental impact assessment. These principles are further applied to the main actions of Nantes UMP, and their feasibility and effectiveness are analyzed. In a further stage, the additional assumptions which are necessary to define the model input data sets will be explicitly described.

The chain of physical process models and data flux management

Data acquisition, repository and GIS

The data flux is an important key of the proposed methodology since many model inputs are some outputs of the previous calculations. The uniqueness and/or coherency of input data is also a key of the joint multi-factor assessment. All the data obtained from external sources are stored in a common repository geographical information system based on the open source platform OrbisGIS developed by IRSTV for urban researches. Further, all model outputs are stored in this GIS prior to their further use as inputs of other models, ensuring spatial coherency and quality control.

The common GIS construction includes a spatial semantic, definition of common mapping modes, adapted geo-statistical calculation and representation tools. It allows direct comparison, superposition, and fusion of results from the various tasks. It is also a powerful tool for the presentation of the program results.

Multi-modal mobility

The model calculations include two parts: transport offer and transport request.

The multi-modal traffic software VISUMis used to compute the traffic over the road and public transport networks. The calculation domain has an area of 2242 km^2; 300 traffic zones have been defined with a grid density increasing towards the city centre. The simulation includes explicit calculation of inter-zone traffics over 4100 street segments (2300 km, i.e. 25 % of the total) and calculation with an implicit method for intra-zone traffics. It separates heavy duty (HD) and light duty (LD) vehicles, computes transport by trains, trams and buses over the whole network, and includes free and toll parking possibilities, including modal exchange P+R, but not bikes and motorbikes. Modal split procedures involve walking courses.

The model calculations are driven for 4 periods of the average week day: morning peak (7–9 am), evening peak (5–7 pm), night (8 pm – 6 am) and the rest of the day. Long term integrations thus require weighting factors for vacation periods and week-ends. The model outputs are traffic densities, fluxes and speeds over the segments, journey times and costs as a function of transport mode and population type.