
Toward sustainable freight traffic through the Alps: freight traffic impacts considering environmental, social and economic sensitivities of crossed areas.

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Toward sustainable freight traffic through the Alps: freight traffic impacts considering environmental, social and economic sensitivities of crossed areas.

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Abstract

Freight traffic through the Alps is growing significantly. Road transport, which is better adapted to the new requirements of production and distribution system, resulted in increased pollution, congestion, and safety concerns. The advent of the concept of sustainable development has called current modal split into questions.

In this context, the objective of this research is to develop a tool, which would contribute to assess environmental, social and economic impacts of freight traffic along a corridor. Looking for equity not only between generations but also inside the same generation, environmental, social and economic sensitivities of crossed areas will be taken into account.

Keywords

Freight traffic, corridor, Alps, sustainable development, community, Geographic Information System

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1. Introduction

The significant growth of freight traffic over the two last decades follows and even more exceeds the development of economic activity¹. Synergy among different factors (specialisation of production units, infrastructure improvement, technological innovations) tends to increase and internationalise freight exchanges.

The better adaptability of road transport to the new requirements of production and distribution system explains, why the growth concerns essentially this mode of transport. The expansion of road transport results in increased pollution (air pollution², noise), congestion³, and safety concerns.

This evolution is particularly worrying the Alpine region. Since the Gotthard tunnel was opened in 1980, freight traffic through the Swiss Alps keeps growing to reach 10.4 millions tons (7.4 via the Gotthard) in 2001⁴. This sensitive area is destined to become a privileged region for the application of sustainable policy measures.

Considering the environmental, social and economic sensitivities of zones located along the corridor, could freight traffic (road / railway) be considered as “reasonably good” bearing in mind the thresholds the decision-maker have chosen? Which consequences would a transfer of freight traffic (transit) from the road to the railway involved?

This paper first announces the context of this study. The scope of the research is then presented and finally, the objectives and a short presentation of the approach are exposed.

¹ European Commission, Directorate-General for Energy and Transport, *EU energy and transport in figures. Statistical pocketbook 2002*, in cooperation with Eurostat, Luxembourg: Office for Official Publications of the European Communities, 2002, 206 p.

² Air pollution, principally induces by oil consumption, is often considered as being the worth threat leads by transportation considering the noxious effects on humans, ecosystems, buildings and in a worldwide scale on global climate. in *Les incidences sur l'environnement du transport de marchandises*, OCDE, Paris, 1997, 40 p.

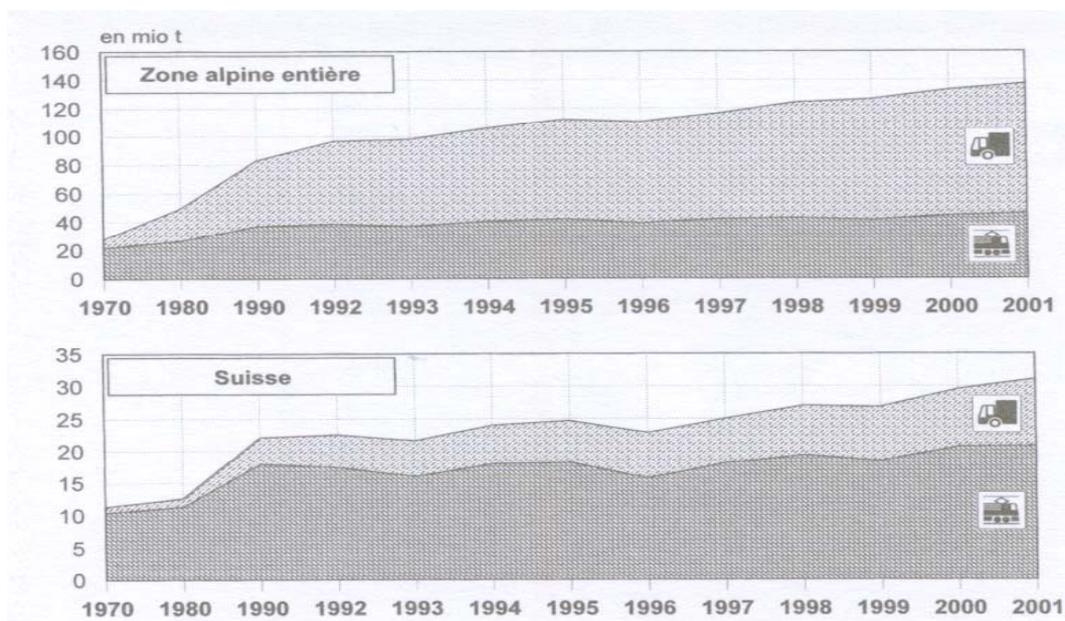
³ In 2010, cost of congestion in Europe is estimated about 80 milliards of Euros. in Commission Européenne, *Livre blanc. La politique européenne des transports à l'horizon 2010 : l'heure des choix.*, Luxembourg: Office for Official Publications of the European Communities, 2001, 127 p.

⁴ In 1980, 1.3 millions tons (0.5 via the Gotthard) of goods were transported by road. Railway freight traffic represented 11.3 millions tons in 1980 (8.4 via the Gotthard) and reached 20.7 (15.8 via the Gotthard) in the year 2001. These data take transit, import, export and local traffics into account. Source : LITRA (service d'information pour les transports publics).

2. Towards a sustainable freight traffic

2.1 Growth and evolution of the cargo traffic structure

Freight traffic through the Alpine Arc doubled during the two last decades (cf. figure 1). In 2001, the tonnage transported between Vintimille and Wien (14 important corridors) neared 170 millions tons. This growth is principally induced by the contribution of road transport, which market share in the Alpine regions has gone up from 44% (22 millions tons) in 1980 to 66% (60 millions tons) in 1999.



Railway via St-Gothard, Simplon, Lötschberg, Brenner, Tarvisio, Mont-Cenis, Vintimiglia;
Road via St-Gothard, San Bernardino, Simplon, Grand-St-Bernard, Brenner, Tarvisio, Mont-Blanc, Fréjus, Vintimiglia;

Figure 1 Freight traffic through the Alps, source: LITRA

Two categories of factors explain the freight traffic modal split evolution, which is noticed in the all European countries. The first one is linked to the new requirements of production and distribution system and the other are competitiveness factors.

Transport market and transport demand are strongly determined by the production system and its evolution. The expansion of manufactured goods, the specialization of production units, the low prices of transport, the technical door-to-door, the decrease of problems at the frontiers inside the European Union and the better interoperability tend to increase supply and distribution zones. The interdependence between production units dispersed throughout Europe requires a regular supply: just-in-time, zero stock. These new industrial strategies necessitate more transport and a transport of height quality⁵.

⁵ That means faster, more reliable, more frequent.

Factors of competitiveness⁶ also explain the modal split evolution. They are linked to the transport market, which influences modal transport supply. We can distinguish geographical (ex.: expansion of the road network), technical (ex.: improvement of vehicles and handling equipment) and organizational factors (ex.: strengthening of road competition).

2.2 Freight traffic and sustainable development

The evolution of industrial production and marketing progressively lengthens the travel distances, reduces consignment weight and volume and increases the deliveries frequency. This explains the dynamism of the road sector⁷, which concerns and worries most of the European countries, aware of the congestion of the main transport axes, and of the costs generate by road transport, but also of external costs like social or environmental impacts. Whichever mode of transport is used, freight traffic induces environmental, social and economic impacts. Those impacts on natural resources are now viewed also as sustainability issues. Resources include available energies, a non-aggressive atmosphere, silence, living potential and its biological diversity. Those natural resources should be preserved despite demographic and technical pressure. It is not possible to neglect them any more (even if it is sometimes difficult to quantify or give prices to evaluate them) especially as a large ecological assessment including social consequences⁸ is considered.

The collective awareness that we are living in an “finite” world has called current modal split into questions. In 1987 the Brundtland Report, also known as *Our Common Future* provided a key statement on sustainable development, defining it as: « development that meets the needs of the present without compromising the ability of future generations to meet their own needs. »⁹.

Since the Rio Conference in 1992, the international community recognizes sustainable development as an objective (solemn commitments and conventions). Sustainable development has three fundamental components: environmental protection, economic growth and social equity (cf. figure 2).

⁶ Maurice BERNADET, « L'évolution de la répartition modale : effet de la production ou effet de compétition ? », *Transports*, n° 359, mai-juin 1993, pp. 177-180

⁷ This dynamism has been accelerated with important investments in road traffic.

⁸ DRON Dominique, COHEN DE LARA, *Pour une politique soutenable des transports*, Cellule de prospective et stratégie, La documentation française, Paris, février 2000, p. 22

⁹ COMMISSION BRUNDTLAND, *Notre Avenir à Tous, rapport de la Commission Mondiale sur l'Environnement et le Développement* (Rapport Brundtland), Les Editions du Fleuve, 1987, p. 51



Figure 2: Concept of sustainable development

The objective of sustainable development is to go beyond the confrontation between ecology and economy. Indicators can be useful to appreciate sustainability. To be sustainable a system has to present a balance between the different strengths that influence the system. Definitions and measures of sustainable development have to take into account that the real details referring to the functioning of a system are not known. This new conception of the development requires a global and interdisciplinary approach.

A transportation system can be considered as sustainable if it complies with ecological limits, presents a social equity and is efficient for the economy. These notions of respect, equity and efficiency are strongly dependant of the spatial scale. This dependence has a major importance in the estimation of sustainability. In transport, sustainability particularly supposes the research of a balance between shipper's needs and community's demand¹⁰ (cf. figure 3).

¹⁰ Community means a group of individuals, who are gathered together because of common interests and objectives. In this research, community regroups all the actors except shippers (sender or cargo owner), carriers (transporting goods) and railway operators (individual or legal entity, who leads or organizes the transport). This definition regroups actors, who are subjected to freight traffic's consequences without directly taking part in (inhabitants, traders, companies, communes, etc.).

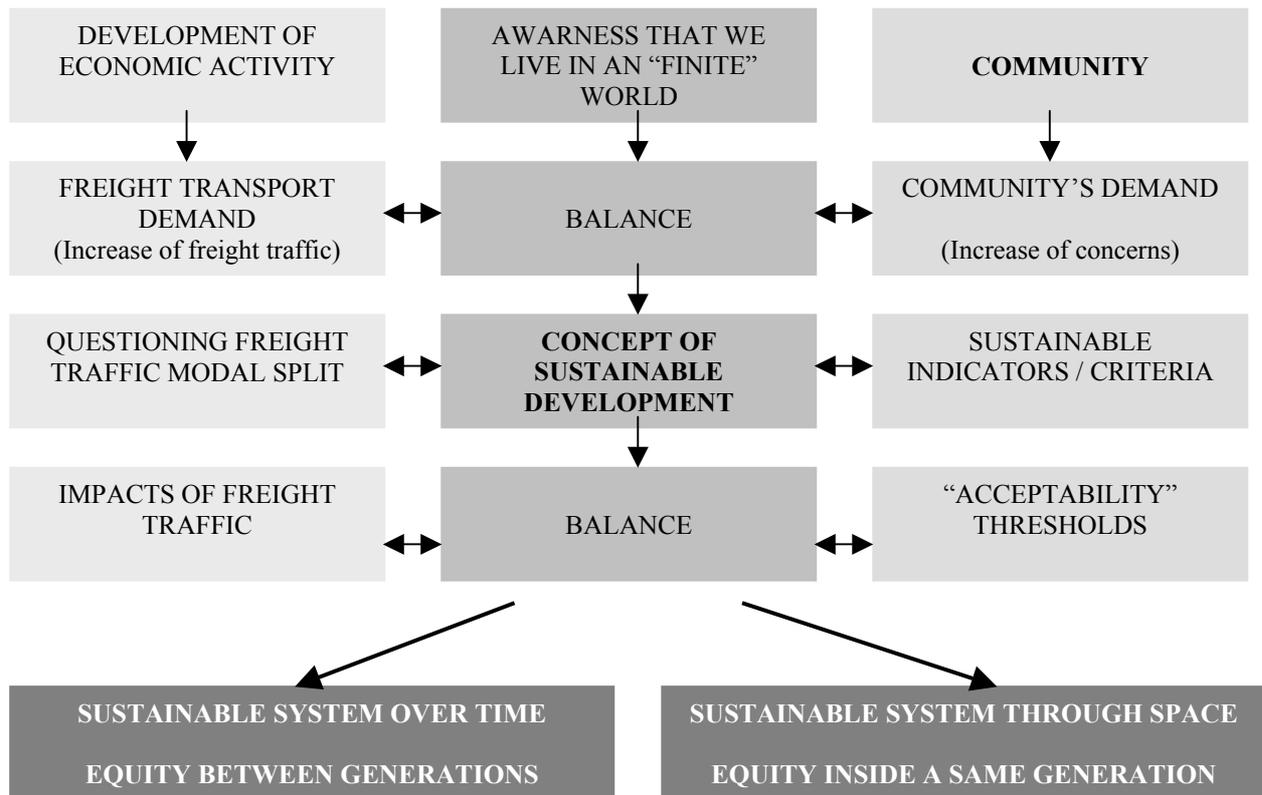


Figure 3 Problems

2.3 Intermodality: association of transport mode efficiency and their interfaces

To reach a sustainable solution, it seems necessary to join economic, regulatory and technical means. In Europe, there is a consensus about the necessity of rebalancing the use of different modes and particularly promote railway development. The characteristics of road survey (price, flexibility, speed, reliability) now determine freight transport demand. A real alternative to road transport has to be proposed in order to change the modal split.

The objective of the development of intermodal transport¹¹ is to associate the advantages of several modes of transport to create an integrated transport chain. Advantages refer to transport cost, quality (speed, flexibility of deliveries, freight security, etc.), expenditure of energy, but also environmental and social costs. The optimisation of freight traffic modal split could help decision-maker to reach the most efficient use of the transport network.

The development of this technology would probably contribute to a sustainable development based on a rational, reasonable and balanced use of the capacity of the existing infrastructures.

¹¹ Intermodal transport is the movement of goods by successive modes of transport without handling the goods themselves when changing modes. Goods stay in one and the same loading unit or vehicle: containers, swap bodies, trailers, lorry-trailers combination.

3. Impacts of freight traffic through the Alps...

This research focuses on the environmental, social and economic impacts of freight traffic using road or railway transport. In thus, it focuses mainly on fulfilling the concerns of the community¹² rather than those of particular groups (shippers, carriers, railway operators).

3.1 Importance of the modal split

The background of this research is the objective of intermodal transport, which aims to result in the most efficient use of the transport network with the help of an optimisation of freight traffic modal split. In this context, it is opportune to look for satisfying the shippers' demand using the existing or planned transport infrastructures so as to minimize the impacts on the community, on the populations¹³.

This research will only consider environmental, social and economical impacts of freight traffic. The impacts generated by the presence of transport infrastructures will not be taken into account. On the one hand, this choice is due to the fact that motorways and railways often represent an asset in terms of accessibility for people living in the crossing zones. Transport infrastructures notably allow local and regional traffic of passengers and goods transport. On the other hand, impacts induced by freight traffic are strongly dependant of the used mode. It was therefore decided to concentrate this work on the modal split.

Freight traffic impacts will be assessed with the help of freight traffic volumes with regard to the complete traffic (% of heavy goods vehicles, % of freight trains).

3.2 To search a spatial balance

The term "impact" means all factors from technical or social origin, which makes the life unhealthy or difficult. Impacts wrong environment (all the components of the nature: soil, water, vegetation, faun, etc.), society (health and well-being of human beings) and economic activities like agriculture or tourism.

This definition refers to the notion of external costs, which are economic costs not normally taken into account by markets or by market agents' decisions. These external costs are air pollution, noise pollution, insecurity and congestion¹⁴. A distinction has been made between negative external costs, which have negative consequences, as opposed to positive external costs.

¹² Cf. foot note 10 page 6

¹³ Human beings who live in a determined area.

¹⁴ OCDE-CEMT, *Internaliser les coûts sociaux des transports*, Résolution n°98/1 sur la stratégie des pouvoirs publics à l'égard de l'internalisation des coûts externes des transports, [CEMT/CM(98)5/FINAL], les Ministres des Transports de la CEMT, réunis à Copenhague les 26 et 27 mai 1998, CEMT-OCDE (Organisation de Coopération et de Développement Economique), 1998

The economic approach first searches a balance likely to answer community's requirements. Researchers devoted themselves to the assessment and the internalisation of external costs¹⁵. Some measures aim now to restore the real costs in the transport domain. They allow to act for decreasing the impacts and seem to induce a reduction of road traffic (ex.: RPLP¹⁶).

The assumption has been made, for this research, that it is absolutely necessary to really decrease the impacts in order to satisfy the community's requirements. The needed diminution depends on the situation. The objective is to succeed in having a "reasonably good" situation throughout the territory. The notion of acceptability depends on the thresholds the decision-makers will choose.

In contrast to the extensive literature on « inter-generational » equity (equity between generations), which deals with trade-offs between traffic growth and environmental protection, « intra-generational » equity (equity inside the same generation) has received only limited attention until recently. The development of popular movements in favour of quality of life in alpine valleys raises also questions of equity not only between generations, but also inside the same generation.

The search of an intra-generational equity throughout a delimited territory (corridor) represents the heart of the matter.

3.3 The Alps: a sensitive area

This natural barrier between North and South Europe is more and more aggressed by freight traffic. The important growth of road traffic worries the European Union who discerns a risk of "asphyxia".

The application of this research concerns freight traffic through the Alps because of the high sensitivity of this natural area. This sensitivity is principally linked to its topographic and climatic characteristics.

The limited number of the routes through the Alps (valleys, cols, tunnels) leads to focus the traffic. The approach route and the valleys (where transport infrastructures, firms, agricultural areas, population are concentrated) are susceptible of being overloaded¹⁷.

In valleys, conditions are unfavourable for noise and airborne pollutant dispersion. The limited mixing of air masses (winds canalisation, thermal inversion¹⁸) induces a concentration

¹⁵ Prof. Werner Rothengatter (IWW, Karlsruhe), Dr. Samuel MAUCH (INFRAS, Zürich), *Effets externes des transports*, novembre 1994 / CEMT, *Internaliser les coûts sociaux des transports*, OCDE-CEMT, Paris, 1994 / COMMISSION EUROPENNE, *Livre Vert*, « Vers une tarification équitable et efficace dans les transports », Options en matière d'internalisation des coûts externes des transports dans l'union européenne, 20/12/1995

¹⁶ Redevance sur le trafic des Poids Lourds liée aux Prestations ; Levy on heavy vehicles

¹⁷ The growth of freight traffic and traffic bottleneck near the tunnels lead insecurity. Remember fires in the road tunnels: Mont-Blanc (24 march 1999 / France), Gothard (24 october 2001 / Switzerland), Tauern (29 may 1999 / Austria).

of noise¹⁹ and airborne pollutant in Alpine valleys. The consequences of freight traffic in the Alps are especially worrying because of the scarcity of habitable land.

The expenditure of energy and airborne pollutants production increase together with the required tractive power on the steep gradients of transport infrastructures necessary to pass through the Alps.

People who live in valleys, association, N.G.O.²⁰, etc. demonstrate for a diminution of road freight traffic²¹. Politicians feel the effect of the pressure and try to act in that way. In Switzerland, for example, an article about Alps' protection was introduced in the federal constitution. This article forces the federal council to find a solution for decreasing freight traffic through the Alps. The principle of non-discrimination between regions is also mentioned.

¹⁸ The thermal inversions happen mostly in valleys or near mountains. In normal conditions warm air rises and disperses pollutants while cool air circulates downward. When there is thermal inversions, the warm air is trapped between cool air layers and traps also pollutants. Mostly thermal inversions appear in winter or during the night when the mixing of air masses is unfavourable.

¹⁹ Noise pollution is favored by thermal inversions and slope. Cf. « Le trafic assourdit les vallées alpines », supplément, journal *échos*, Association « pour la protection des régions alpines contre le trafic de transit », n° 66, 17 mai 2002

²⁰ Non-Governmental Organisation

²¹ « Alpine transport policy: a regional problem with European consequences or an European problem with regional consequences? », Workshop on Trans-Alpine Crossing, ALPNET, 27-28 May 2002, Lago Maggiore, Italy

4. ... considering environmental, social and economic sensitivities of crossed areas.

4.1 Objectives of the project

In this context, it is interesting to develop a tool, which would contribute to assess environmental, social and economic impacts of freight traffic (road, railway) along a corridor considering environmental, social and economic sensitivities of crossed areas. The application of this generic decision support system would be possible on every corridor

The area of the study will depend on models used for the estimation of airborne pollutant and noise dispersion. The research will concern a corridor (buffer) along the transport axis. Beyond this corridor the impacts of freight traffic will be taken into account by means of studies realized at a national scale.

Freight traffic impacts will be underlined with the help of indicators. Taking impacts and sensitivities of the crossing areas into account, indicators will be useful to identify critical zones along the corridor. They can be considered as little pieces of information which reveal the characteristics of the system and underline what is happening²². They also allow to simplify information so as to make communication easier.

Different alternatives will be assessed. They will be based on current data, on forecasts 2015-20 and on modal transfer hypothesis (in relation to the railway capacities). These alternatives will be useful to let observe how freight traffic volumes affects the indicators.

As much as possible, this research will try to define a maximal freight traffic volume for road and railway (% of heavy goods vehicles, % of freight trains) considering the environmental, social and economic sensitivities of the crossing areas.

²² The term « indicator » has a Latin origin. It comes from the verb *indicare*, which means, « to reveal or to show, to announce or denounce in public, to assess or to assign a value ». Adriaanse 1993, Hammond et al. 1995

4.2 Idea of the approach

To carry through this research we propose three main stages.

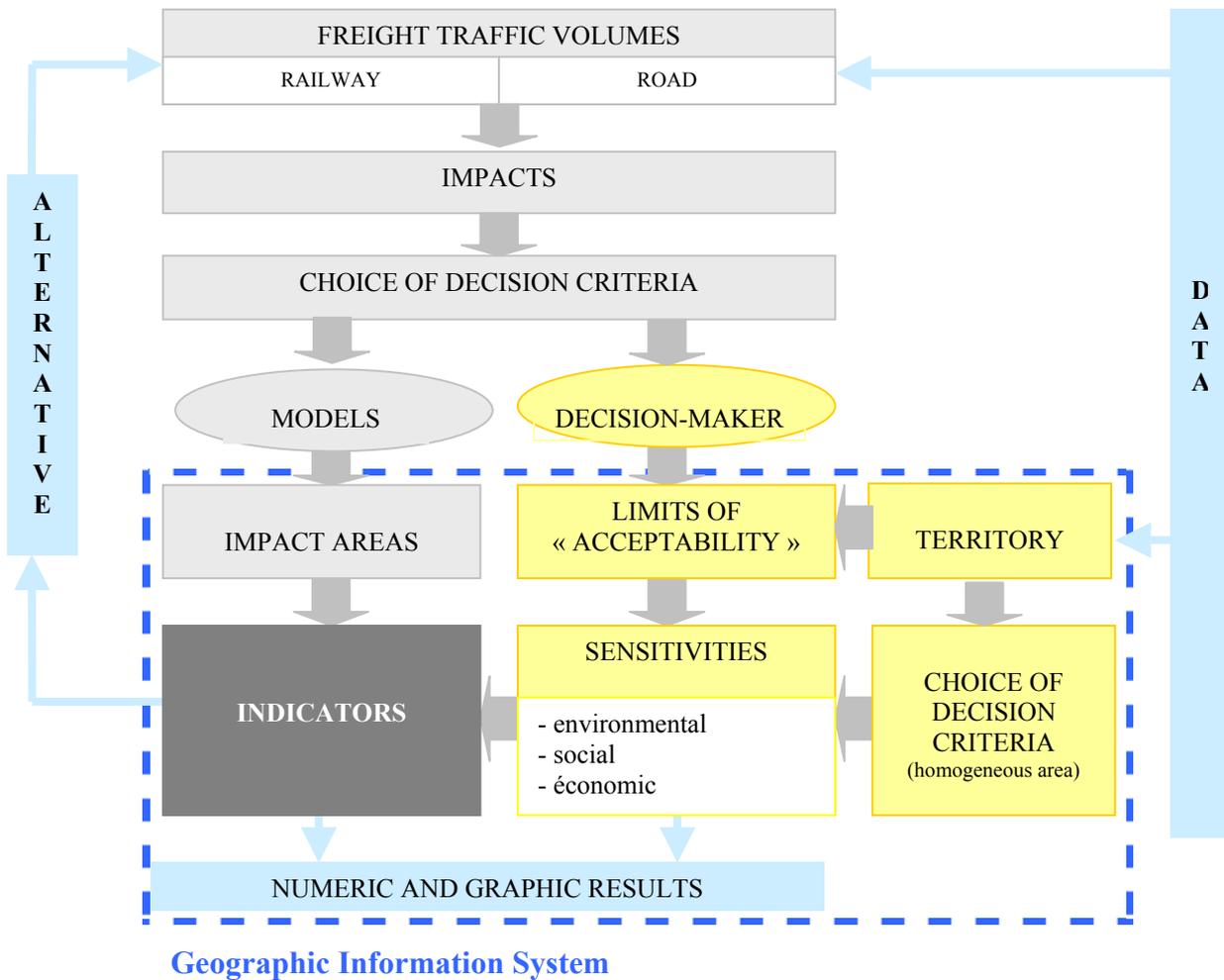


Figure 4 Development of a decision support system

First of all (figure 4: light grey), decision criteria have to be chosen to assess freight traffic impacts along the corridor. In this research, chosen criteria will be susceptible to concern directly crossing zones and to vary in relation with freight traffic volumes and their modal split. These criteria would be airborne pollutants (NO_x^{23} , PM_{10}^{24} , VOC^{25} , etc.), noise and eventually insecurity in road tunnels and congestion. However the correlation between the

²³ nitrogen oxide

²⁴ particles

²⁵ volatile organic compound

increase of insecurity or congestion and the increase of freight traffic volume has to be examined.

After that, decision criteria in relation with the territory will be chosen (figure 4: yellow). It will be necessary to have an equivalent number of decision criteria for each domain: environment, society and economy (ex.: population density, agricultural areas, tourist areas, protected areas, etc.). For each of them we will try to delimit homogeneous zones.

Simultaneously, discussions with specialists from different domains (economy, sociology, ecology, etc.) will help to choose "acceptability" thresholds for each decision criteria (ex.: 30 $\mu\text{g}/\text{m}^3$ of NO_2 in areas containing poor soils since they are more sensitive to acidification). Afterwards decision-maker will fix these thresholds.

These decision criteria will be standardized and pondered to identify sensitive zones in terms of environment, society and economy. The social sensitivity could be, for example, more important where there is a high population density than in a rural area. The results will be represented by means of a GIS (Geographic Information System): maps of sensitivity (cartography of areas' vulnerability).

Finally, the impacts of freight traffic will probably be pondered with the environmental, the social and the economic sensitivities of the different zones present in the corridor. The objective is to obtain indicators (figure 4: dark grey), which will help decision-maker for the evaluation of the consequences of their decisions. The communication of the results will be made easier with the use of an SIG. This work will permit to identify critical zones along the corridor.

5. Conclusion

Considering the time available to carry on this research, only one corridor (Basel-Chiasso) will be concerned by this application. The long-term objective is to extend the application of this tool for several corridors to search an optimisation of the modal and spatial distribution of freight traffic through the Alps, considering the environmental, social and economic sensitivities of the crossing areas.

Most of the decision-makers are now confronted to the improvement of their knowledge: a better comprehension of the impacts of their decisions, a better comprehension of the link between environmental, social and economic dimension but also the interdependence between territorial and temporal scales. This knowledge supposes a global approach, which has to be able to give elements for estimation, measurement and follow-up.

The development of this tool is notably motivated by the insufficient knowledge transmission to be validated by decision-maker. A decision support system would probably make easier the comprehension of the results by actors who have different priorities. It would probably be useful to objectivize the debate about freight traffic impacts, especially freight transit through a sensitive area like the Alps.

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