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published in

Built Environment
1995

document version

Publisher's PDF, also known as Version of record

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citation for published version (APA)

Hilferink, M., Nijkamp, P., Pepping, G., & Reggiani, A. (1995). Acceptance of Telematics Systems by Transport Users: A Case Study of Italy. *Built Environment*, 21(4), 255-269.

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Acceptance of Telematics Systems by Transport Users: A Case Study of Italy

MAARTEN HILFERINK, PETER NIJKAMP, GERARD PEPPING and AURA REGGIANI

As a study of Italy shows, the development of transport telematics is driven not only by the need to reduce congestion and traffic accidents, but also by the huge potential market represented by individual vehicle drivers and commercial road operators. Here this market potential is investigated by relating driver perceived information needs to traffic conditions.

Introduction

The rise in car mobility has been one of the most remarkable social developments in recent decades. Parallel to this trend, car ownership has shown an unprecedented (five fold) increase over the last 30 years. As a consequence, this rapid increase in road transport volumes has led to drastic increases in energy consumption, travel distances, road accidents, and environmental damage caused by high pollution levels (Nijkamp, 1994). Nowadays, traffic congestion in Europe is often a normal state of affairs rather than an occasional inconvenience, while forecasts suggest that this growth will not come to a standstill in the next decade (MARTA, 1993).

The available transport infrastructure will likely not increase at the same rate to absorb this continuous rise in mobility, and hence congestion will increase. European regions face common problems in this respect, albeit with different intensities. Therefore, there exists a clear need and considerable scope for defining common strategies and solutions in view of the high costs of increasing congestion and other externalities. There is a growing policy consensus that traditional strategies and available levels of investment

will not be sufficient to match Europe's growing demand for mobility. Many improvements to transport efficiency can be achieved if better information on the state of the network were available to transport planners and users. In this respect, Advanced Transport Telematics (ATT) is often advocated as the transport planner's 'secret weapon'. ATT is the application of telecommunications and information technology in the transport field. Systems developed for monitoring and data processing, information dissemination and processing in fields such as the defence sector or the oil industry are now becoming applicable to the transport sector (e.g. Bollo, 1992; EC, 1993; OECD, 1992; Kawashima, 1991 and IVHS, 1992).

In this paper we will focus on new telematics systems applied to road transport and in particular, to inter-urban road transport. The main applications within this range of technologies are automatic debiting systems, road-side based information systems (e.g., signalling systems and variable message signs), navigation and dynamic route guidance systems and travel planning information systems providing pre-trip travel information. Except for debiting systems, these systems

can provide road users with information about issues like the road status, weather conditions, pollution, most efficient route, incidents, road works, congested conditions, queue lengths, speed compliances etc.

These ATT applications have the potential to offer new solutions to road transport externalities in Europe. However, as is the case for all new technological innovations, at the basis of success of road transport telematics lies the *acceptance* by potential users. This user acceptance manifests itself in the attitude, usage, change in travel behaviour and willingness to invest (intermediate users) or buy (private users) with respect to certain types of telematics. It is, therefore, of vital importance in current programmes on ATT research and development in Europe that decision makers (i.e. those influencing the adoption of ATT) have sufficient information on the needs of potential users and on the way they perceive ATT options in addressing their needs. Potential users may be private users (e.g., car drivers), collective users (e.g., public transport authorities) and commercial users (e.g., the freight sector). Until now investigations on the demand side of the ATT market have mainly concentrated on the value added as perceived by the end-user and the motives for this need for – and adoption of – these advanced technologies, as these exist among different kinds of users. Thus, in the past the main focus has been on key questions such as: which technologies prevail, who are the main users, and why – or under which conditions – should they adopt these new technologies?

Considering the development of advanced telematics systems at a pan-European level, therefore will also be a need to look at the ATT market from a *spatial*, i.e. regional or site-specific, viewpoint. From this perspective, another relevant question arises: where would ATT have the highest potential, in terms of both expected benefits to the transport system as well as the market among end-users? The impact of ATT on the transport system depends on the nature and

size of problems related to safety, environment and efficiency on inter-urban corridors, because clearly road conditions on most European corridors are different in terms of density, congestion, fatality rates, geo-physical conditions, quality of infrastructure etc. The existing differences between corridors or regions in which certain parts of the main road network are located imply that also from the user perspective differences may exist in needs for ATT. One may argue, for example, that information on fog will be more desirable for motorway drivers in areas with recurrent fog conditions than in other areas where this is not the case, so that such conditions will have implications for the regional ATT market among end-users.

The ATT market is thus characterized by spatial heterogeneity, which means that it will be impossible to assess *the* market potential and penetration of *the* ATT technology. Instead, various road corridors and/or parts of these corridors may lend themselves for specific applications of ATT technologies. This has also become European practice: there is a wide variety of *site-specific telematics* applications.

It is possible to identify representative road corridors and/or segments thereof for which meaningful telematics technologies can be used. Looking at the user side, a useful typology of motorway corridors can only be created in parallel with a socio-economic typology of areas on the basis of average income and population density, given the need for an assessment of the socio-economic profile of actual motorway users (which is basically a part of any market research that needs background data on market target groups). These typologies/classifications have the additional advantage that the results from a given case study (i.e., given road corridors/segments and given ATT technologies) can be transferred to other comparable situations (without claiming that all results have to be generalizable).

The main goal of this paper is to describe and analyse regions and road corridors/

segments with respect to features that play an explanatory role regarding the relevance, use and adoption rates of ATT applications, including socio-economic, infrastructural and traffic demand related aspects as well as (revealed) motorway driver needs. It should be emphasized that this goal does not contain an explicit assessment of the ATT market potential, but rather of the regional and corridor-specific conditions that influence this potential. The case study area chosen for this study was Italy, a country with significant spatial contrasts between North and South in terms of socio-economic profile.

The structure of the paper is as follows. In the next section the main general factors of interest and the analytical approach adopted are presented. In the third section, the case study is introduced: the Italian regions are described according to their relevant socio-economic differences and network interactions, followed by a description of motorway corridors according to ATT relevant features. The fourth section will then focus on spatial differences in attitudes of Italian motorway users, given the hypothesis that certain attitudes may

depend on local traffic conditions. Finally, in the fifth section the main conclusions of the present work will be summarized.

Analysis Framework

In order to answer the question of where transport telematics applications will have a high potential for coping with region-specific traffic conditions and externalities, a set of (locational) factors has to be taken into account. These factors relate to (1) *spatial-economic and sectoral-economic structures*, (2) *motorway infrastructure and traffic volumes* and (3) *drivers' attitudes towards the use of ATT*. These factors are summarized in table 1.

The spatial differences in economic patterns are relevant for an assessment of structural mobility patterns between economic core regions. These factors determine the economic importance of corridors between respective core regions and consequently, the importance of advanced traffic management tools on these corridors. Furthermore, an assessment of the size of the road authorities' and private consumer market for inter-urban ATT applications

Table 1. Factors causing spatial variations in the inter-urban ATT potential.

<i>Factor</i>	<i>Influence on:</i>
<i>Factors related to local (socio)economic structures</i>	
economic spatial and sectoral compositions	urban network interactions
income levels	road authorities investment budgets consumer purchase power
car ownership	potential private ATT consumer market
<i>Factors related to motorway traffic & infrastructure</i>	
congestion levels	potential contribution of ATT to improve traffic performance
traffic flow	potential private ATT consumer market potential reduction in externalities
freight traffic flow	importance of freight transport monitoring and control
accident rates	safety benefits of ATT
<i>Attitudes of motorway users</i>	
attitudes towards ATT	ATT market penetration

will be partially based on direct market variables, such as income structures and car ownership levels in various regions. These may influence the ability and willingness to invest in road-based ATT systems or to purchase private consumer ATT applications.

Looking at the traffic environment, a critical problem is that frequently inter-urban transport demand outweighs the capacities of road corridors, resulting in high levels of congestion on these corridors. High congestion levels determine the level of externalities of traffic and thus indirectly the potential benefit of ATT for traffic efficiency and environmental quality. It is also evident that corridors with large traffic flows have a higher potential for ATT implementation than corridors with lower traffic volumes, and that corridors which form part of important freight transport axes require ATT applications that serve to improve specific problems related to freight operations (e.g., hazardous goods monitoring).

Furthermore, from a social science perspective it is clear that the ATT market penetration rate among private motorway users should be investigated *inter alia* on the basis of their attitudes towards forms and types of driver information. The adoption of ATT technologies by road authorities depends in turn on the behavioural responses of drivers to traffic information, since these responses together determine a system-wide ATT impact on traffic performance, which is the main criterion for ATT investment decisions by road authorities. It has to be noted however that for many ATT applications, the efficiency of individual trips may be increased, although this will not necessarily result in a greater overall benefit to the transport system in terms of safety, traffic flow efficiency or a better quality environment (Emmerink *et al.*, 1994).

The factors considered differ strongly in nature, since they consist of both aggregated and disaggregated (individual) variables at different spatial scale levels. Thus there is not a uniform research method which can be

used to analyse the specific contributions to the assessment of ATT potentials. Therefore, our analysis follows a two-step procedure:

- In a first step (page 259) an *aggregate, descriptive analysis* based on a structural assessment of mobility needs at the inter-urban level in Italy will be carried out. This structural assessment is based on the analysis of mobility patterns, traffic conditions and structural characteristics of the underlying urban/regional system, which are basically social and economic in nature.
- In a second step (page 265) a *disaggregated, quantitative analysis* is carried out, in which spatial differences in ATT preferences of motorway users are assessed, as they are revealed by a large national driver survey in Italy. Here some hypotheses are tested about the needs for different types of traffic information perceived by the drivers in relation to the various traffic conditions in which they are used to driving. For instance, one may expect larger revealed needs for accidents-information on so-called risky roads (or corridors) or larger needs for weather information in areas with recurrent fog-conditions. A significant influence once proven has consequences for the transferability of empirical results on drivers' telematics attitudes to other road corridors.

Both parts of the analysis are supported by the use of Geographical Information Systems (GIS). Standard GIS tools are used to support the descriptive analysis by means of visualizing the spatial data. A dedicated GIS tool is also used to support the quantitative analysis: a spatial linkage technique has been developed in order to relate network data and survey results at the same scale level, based on the corridors used by the respondents. Application of this technique enables the investigation of relations as mentioned above and the visualization of spatial differences in ATT potential on a more detailed level.

Description of Italian Spatial Networks*Characteristics of Urban and Regional Networks*

A marked feature of the Italian economy is the dichotomy between the Northern and the Southern regions. This dichotomy is reflected in several aspects ranging from socio-economic composition and productive basis to employment and urban structures.

A large set of indicators may be used to assess such differences. We will focus here on a few aspects of the North/South dichotomy which are directly related to the mobility patterns and needs, by focusing in particular on the role of the urban structure as a background framework.

The Italian urban pattern has an interesting structure which has in recent years

Table 2. Demographic data of Italian cities with more than 150,000 inhabitants (average figures concern all cities of more than 20,000 inhabitants)

<i>Name</i>	<i>Population (1991)</i>	<i>Employed Population (1991)</i>	<i>% Employed in Industry (1991)</i>	<i>% Employed in Trade (1991)</i>	<i>% Employed in Services (1991)</i>	<i>Income per Capita (x 1000 liras) (1987)</i>	<i>Cars per Capita (1990)</i>
NORTHERN REGION							
Turin	961916	441686	34.1	21.3	44.6	18.5	0.56
Milan	1371008	765808	25.4	24.2	50.4	21.3	0.59
Brescia	200722	96798	28.3	22.8	48.9	22.3	0.59
Verona	252689	100690	29.3	23.9	46.8	18.7	0.56
Venice	308717	139305	25.3	23.1	51.6	15.2	0.38
Padova	215025	99798	20.3	26.9	52.8	20.2	0.56
Treist	229216	82383	16.6	26.0	57.4	17.0	0.53
Genova	675639	234103	23.6	23.1	53.3	15.8	0.48
Parma	168905	85349	38.3	20.8	40.9	19.4	0.59
Modena	176148	86212	36.2	22.6	41.2	19.4	0.63
Bologna	404322	207097	21.7	21.8	56.5	20.2	0.59
<i>Average</i>	168629		26.9	23.1	50.0	19.0	0.55
CENTRAL REGION							
Florence	402316	203534	22.6	25.3	52.1	19.0	0.67
Livorno	167445	57251	19.1	24.6	56.3	13.6	0.56
Rome	2693383	950309	16.2	21.8	62.0	15.9	0.59
Naples	1054601	300573	16.3	20.1	63.6	10.8	0.40
Salerno	153436	46423	18.7	18.4	62.9	16.2	0.48
Foggia	155043	43708	17.8	33.2	58.2	11.3	0.40
Bari	341273	110412	21.2	24.7	54.1	15.2	0.45
<i>Average</i>	190129		21.2	22.1	56.7	15.4	0.59
SOUTHERN REGION							
Taranto	232200	73080	37.1	17.5	45.4	11.9	0.42
Reggio Calabria	169709	36316	8.8	25.9	65.3	12.5	0.45
Palermo	697162	161966	14.3	28.9	56.8	10.9	0.48
Messina	272461	63825	13.9	23.0	63.1	11.9	0.45
Catania	330037	97524	19.7	25.4	54.9	11.9	0.53
Cagliari	203254	85914	16.4	21.6	62.0	14.4	0.56
<i>Average</i>	159354		17.9	22.6	59.5	13.0	0.46

received a great deal of attention in both policy and research, especially by economists, geographers and demographers. In general, we may identify five metropolitan areas (Turin, Milan, Genoa, Rome, Naples), three polycentric systems (Veneto, Emilia-Romania, Tuscany) and several minor urban nets. This suggests already the drastic contrast of urban density and other features in the Northern part compared to the Southern, as well as a prominent role of interurban relationships in Italy.

What emerges from several studies is also the prominent qualitative difference between the spatial pattern of interurban relations in the Northern urban nets (see Celant *et al.*, 1992). In particular, the Milan metropolitan area and the three Northern polycentric systems are actually evolving into a spatial phenomenon which has sometimes been described as 'the network paradigm' (see Dematteis, 1985). In other words, the spatial division of work and function is less and less driven by the principles of hierarchical organization that inspired Christaller's central place model (Christaller, 1993). Functions and activities located in the nodes of the urban networks are less dependent on demand thresholds and surrounding market areas, but rather on complementary relations with other nodes in a larger region. This tendency, which is actually driving the spatial evolution of many advanced countries, is rather dominant in the whole of Northern Italy, while it is almost absent in the Southern part (see Muscarà, 1978 and Reclus, 1989).

In this context, a further analysis of the Italian spatial structure can be carried out by investigating some basic socio-economic indicators describing the nodes of the interurban network we are interested in (tables 2 and 3).

First of all, we will consider the indicator 'income per capita'. Tables 2 and 3 give a clear picture of the sharp difference between North and South. Average income per capita in urban nodes of the North is 19,047 millions liras, while it is only 13,053 in the South. The role of income per capita is rather relevant for mobility. It is generally accepted that a clear direct relationship exists between income level and mobility (Blaas *et al.*, 1992). Income per capita gives not only a measure of what may be called ability to pay, but also, given some plausible hypotheses on the evolution of consumption patterns, a clear indication about willingness to pay for personal mobility. The urban and spatial-economic structures illustrated in table 2 also suggest something like a 'rich' satellite system around Milan, with at least three 'rich' corridors (Milan-Bologna-Ancona; Bologna-Padua-Venice-Trieste; Milan-Verona-Vicenza-Padua) and a rich cloud in the Tuscany system. Central and Southern Italy are from a socio-economic angle more homogeneous, showing lower income per capita levels. Around Naples we observe a sort of 'poor' satellite system.

Data on demographic and employment compositions are both presented in table 2. Both these aspects will certainly affect

Table 3. Socio-economic indicators

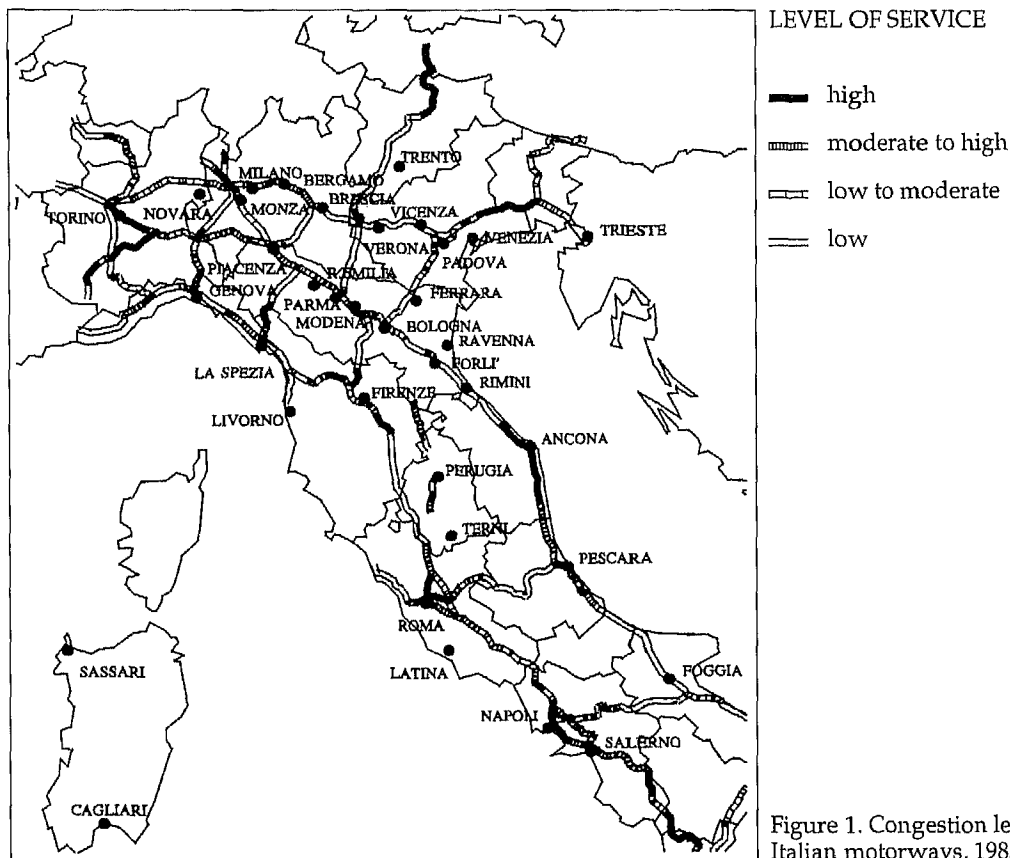
Region	Number of Towns	Population on Average	Employed in Industry ¹	Employed in Trade ¹	Employed in Services ¹	Unemployment ²	Income per Capita	Cars per Head	Number of Cars
Year		1991	1991	1991	1991	1991	1987	1990	1990
Northern	46	168,629	27%	23%	50%	5%	19,047	0.554	4,303,750
Central	27	190,129	21%	22%	57%	10%	15,385	0.586	3,011,947
Southern	32	159,354	18%	23%	59%	19%	13,053	0.456	2,326,364

Note:

1. Share of total employment.

2. Share of Labour force.

Source: Italian statistics (Capoluoghi di provincia)



mobility patterns. Densely populated areas often have congestion problems, while spatial employment compositions affect daily mobility patterns, mainly commuting. With regard to demography, the prominent position of central urban areas (Milan, Genoa, Rome and Naples) clearly emerges. Once more, the relevant Northern inter-urban patterns show also a high population density, while the Southern metropolitan system is less densely populated. Looking at employment compositions, the Northern nodes present on average a higher degree of industrial and trade employment, while the Southern parts are more weighted towards the service sector, basically public administration.

Car ownership may be regarded as a proxy for potential interest in ATT, since the number of cars per inhabitant is a measure of the ability to travel by car. If we

look at table 2, the relationship between car ownership and the level of income can be investigated. Comparing the Northern region with the Southern region, it seems that the socio-economic contrast is also reflected by car ownership levels in these two regions. Surprisingly such a relationship is not found when we look within the North. Car ownership in the Tuscany polycentric system is clearly higher than in Lombardia or Veneto, although these latter two regions have a higher average level of income. This is probably due to higher traffic congestion problems and to more reliable alternative transport modes in the latter areas.

Characteristics of Network Segments

The inter-urban road network considered in our case study consists of the Italian motor-

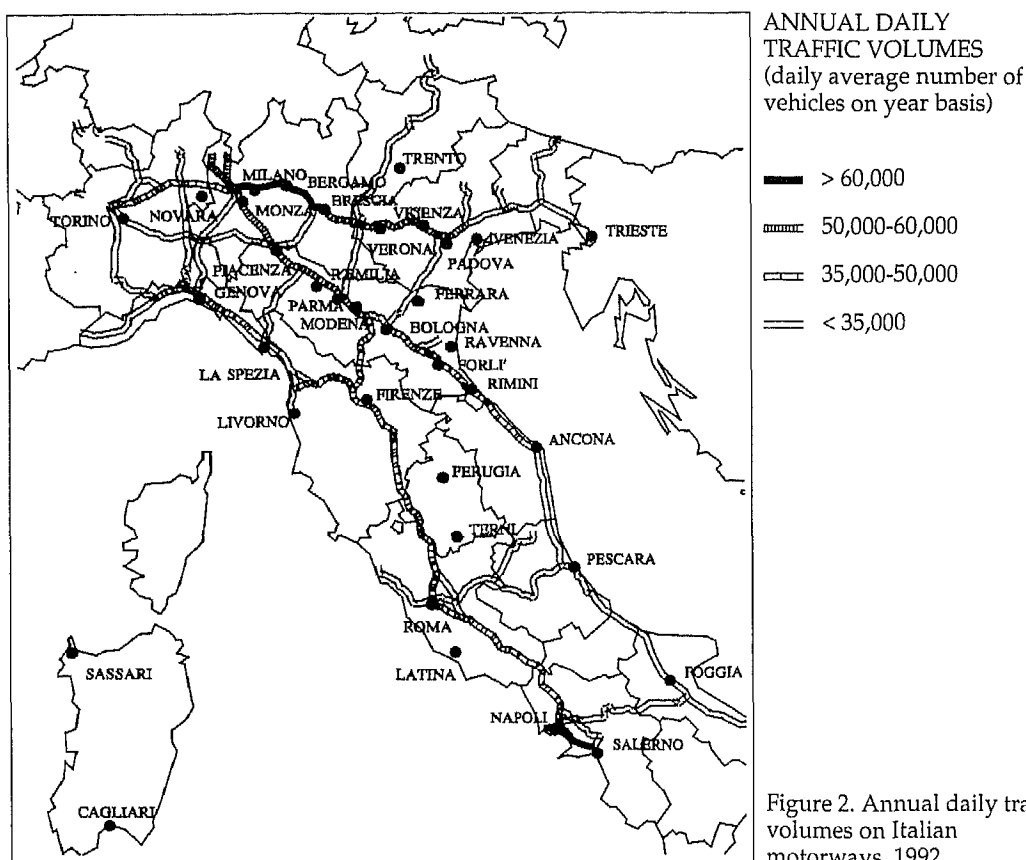
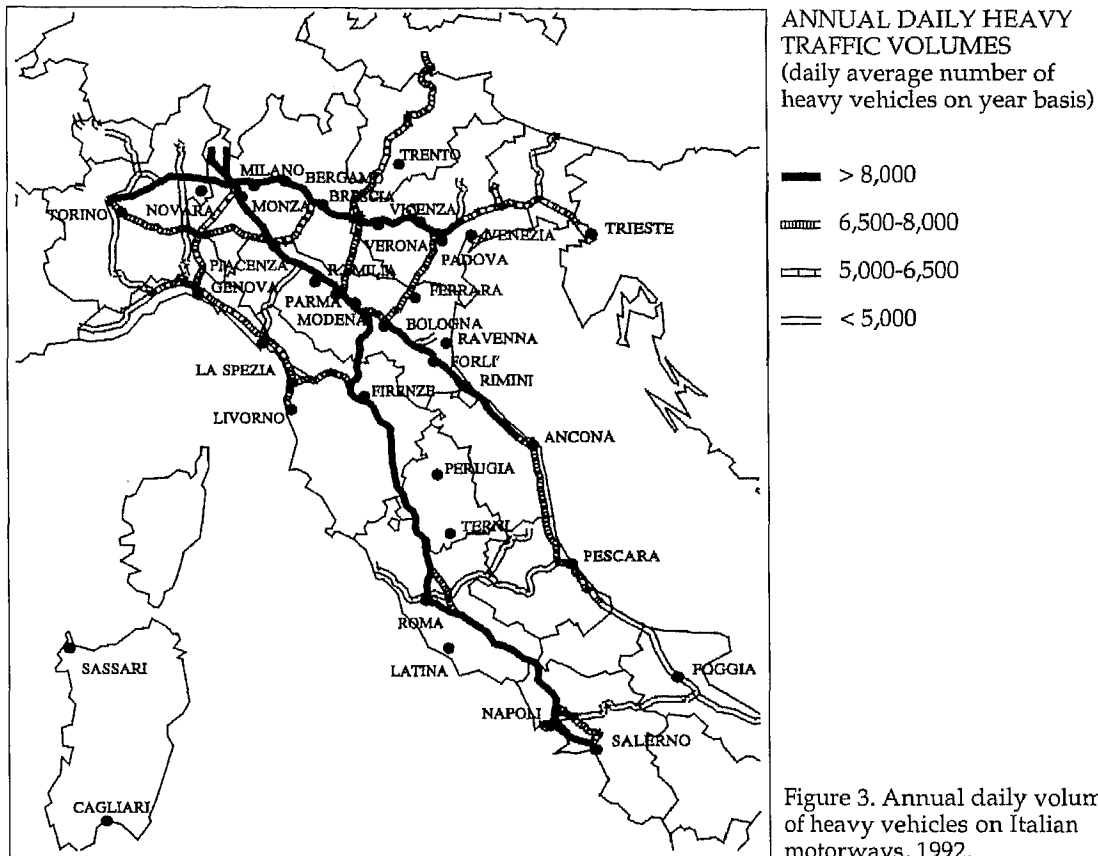


Figure 2. Annual daily traffic volumes on Italian motorways, 1992.

way network (Autostrade) and the network of main secondary roads (Strade Statali). The Italian motorways are mainly toll roads, with the exception of the Southern links from Naples to Sicily. Since drivers have usually more than one travel option, it is important to consider also the number of other alternatives to toll roads in order to evaluate the potential role of ATT in route choice situations. The spatial differences in road infrastructure over Italy are quite large. In the Northern part of Italy the main and secondary networks are both extremely dense and widespread, so that in principle the one might be a reasonable substitute for the other. On the contrary, in central and Southern part the two networks are more complementary, with the main roads connecting the bigger

cities, and the secondary ones providing connections to the smaller centres.

Below we will show some spatial variations in traffic conditions on the Italian motorway network, which are relevant for the use of ATT applications. We will focus on the following indicators; level of service (which is a proxy for congestion levels), traffic volumes, intensities of freight movements and accident rates. Unfortunately, reliable recent information on service levels for the whole network is not available. Therefore, service levels from 1985 are used (figure 1) which are based on UN traffic counts; in the case of the other three indicators more recent data are used from 1992 (figures 2-4), which are based on data from the Italian AISCAT road authority.



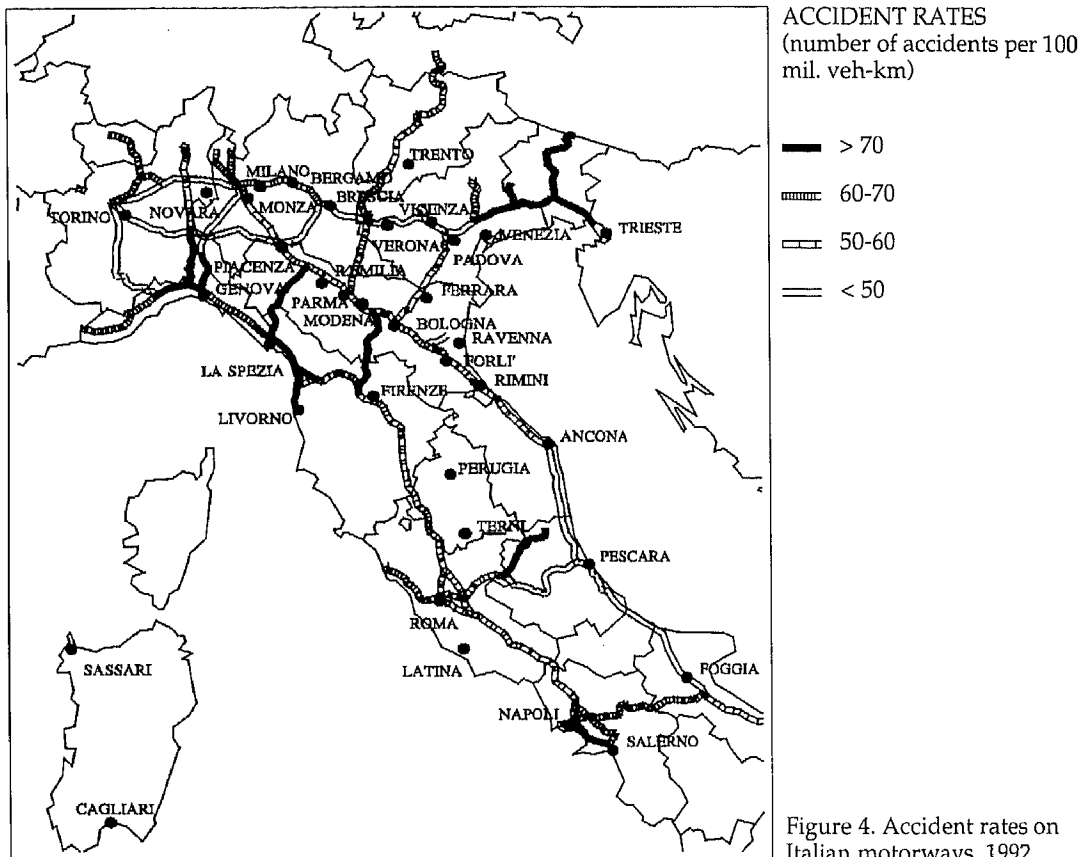
Level of Service

The level of service, basically a ratio of road capacity and traffic volume, may be interpreted as a measure of congestion problems on motorways (See MARTA, 1993 and Small, 1992) and related traffic safety (for an attempt to model the relationship between highway traffic density and safety see Shefer and Rietveld 1994). Therefore, it reveals a potential need for ATT. Looking at figure 1, we may point out the spatial variation of such problems, which seem to be concentrated on specific segments of the network. In the central and Southern part of Italy the most heavily congested motorway segments are concentrated in a few sites: the ring around Florence, the Rome feeder system, the Naples feeder system and the Adriatic corridor around Ancona. In the Northern part, problems

due to the level of service seem to be more evenly distributed. In this part of Italy two broad classes of cases can be observed: the Transalpine links and their feeders and some specific inter-urban segments.

Traffic Flows

Daily traffic flows reveal the relative importance in terms of users' needs and also provide a proxy for the potential number of people that may be affected by the implementation of ATT devices. From figure 2 we can observe the importance in terms of traffic flows of the corridors and links feeding the Milan metropolitan area, especially the Milan-Brescia link, and the Naples-Salerno link. Some other links play also a vital role in the Italian interurban network. These are in particular the



intergrated Milan-Bologna-Florence-Rome-Naples corridor (Autostrada del Sole), with a particular emphasis on the Milan-Bologna link, the Milan-Venice corridor and the Bologna-Ancona corridor. Summarizing, the following patterns appear to emerge:

- a high polarization of traffic gravitating around the Milan metropolitan area, a high intensity of traffic around Naples and a relatively minor relevance of the traffic situation in Rome, Genua and Turin;
- high traffic intensities on the Northern inter-urban corridors;
- an important role played by the Autostrada del Sole in connecting the Northern and Southern parts of Italy.

Flows of Heavy Vehicles

Traffic problems due to the presence of heavy vehicles are quite common for the whole Italian network. From figure 3 it can be observed that these problems are quite evenly distributed over the entire network. In particular, it can be noticed that almost every link of the dense Northern part of the network suffers from large flows of heavy vehicles, in combination with the Autostrada del Sole as well as the Bologna-Ancona corridors which operate as North-South traffic arteries.

Accident Rates

Safety is one of the most pressing problems in transportation. There are therefore large expectations of the role that ATT can play in

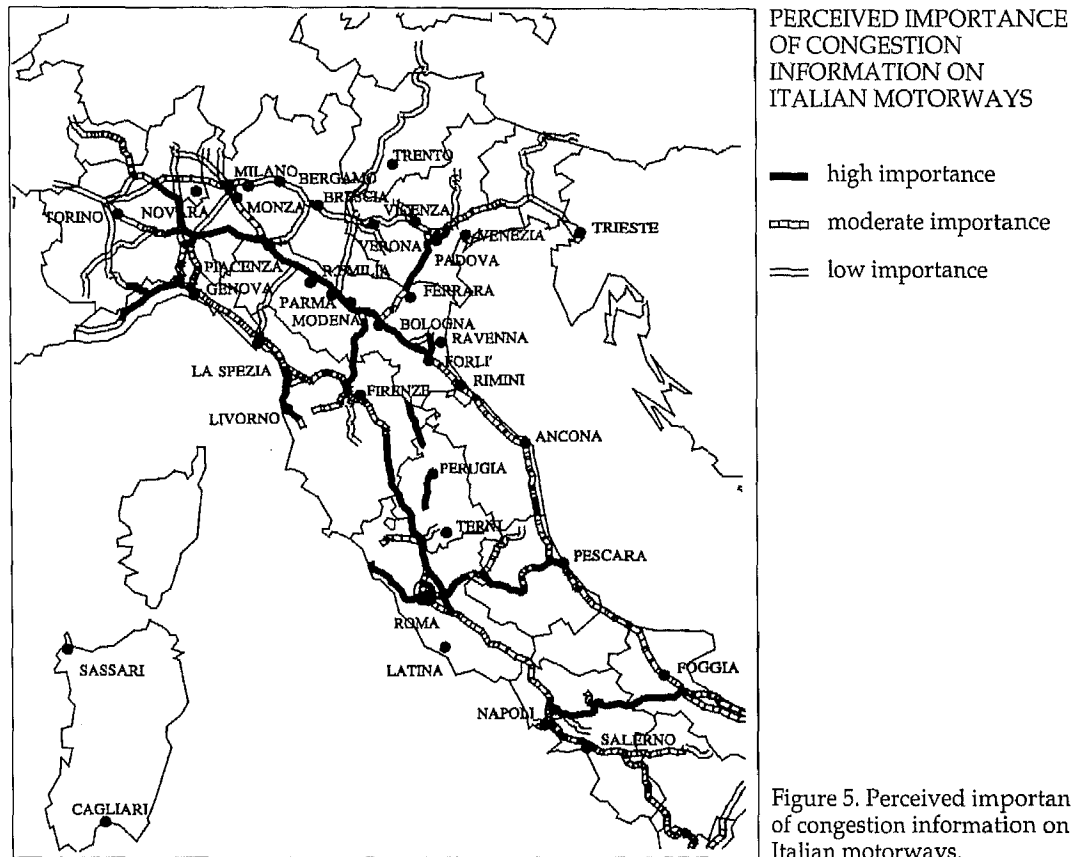


Figure 5. Perceived importance of congestion information on Italian motorways.

this context. Figure 4 provides a clear view of how (relative) numbers of traffic accidents are spatially distributed over the Italian network. From these maps it appears that safety is more related to other aspects (probably the physical lay-out of the road, local weather conditions and local driving habits) than to traffic volumes or levels of service. In particular, corridors with relatively high rates appear to be Bologna-Florence, Parma-La Spezia-Livorno, Treviso-Trieste, the Genua feeder system and the Teramo-Rome corridor. Among these only the Bologna-Florence corridor is both quite congested and unsafe.

From the above analysis of the characteristics of the Italian motorway network it is evident that the potential use of ATT systems may largely vary between various road corridors, depending on their geo-

graphical location and traffic conditions. However, as stated in our introduction, the key issue for the potential of ATT applications is the individual response and acceptance. Spatial variations in the ATT potential and use are dependent on the different ways individuals respond to ATT stimuli in different situational conditions. In the following section some acceptance assumptions on this field are tested.

Spatial Analysis of Motorway Drivers' Attitudes

In addition to the aggregate spatial analysis in the previous section depicting mainly the supply side of the Italian motorway system, a disaggregated spatial analysis of motorway user preferences has been carried out in the same case area. The aim was to discover

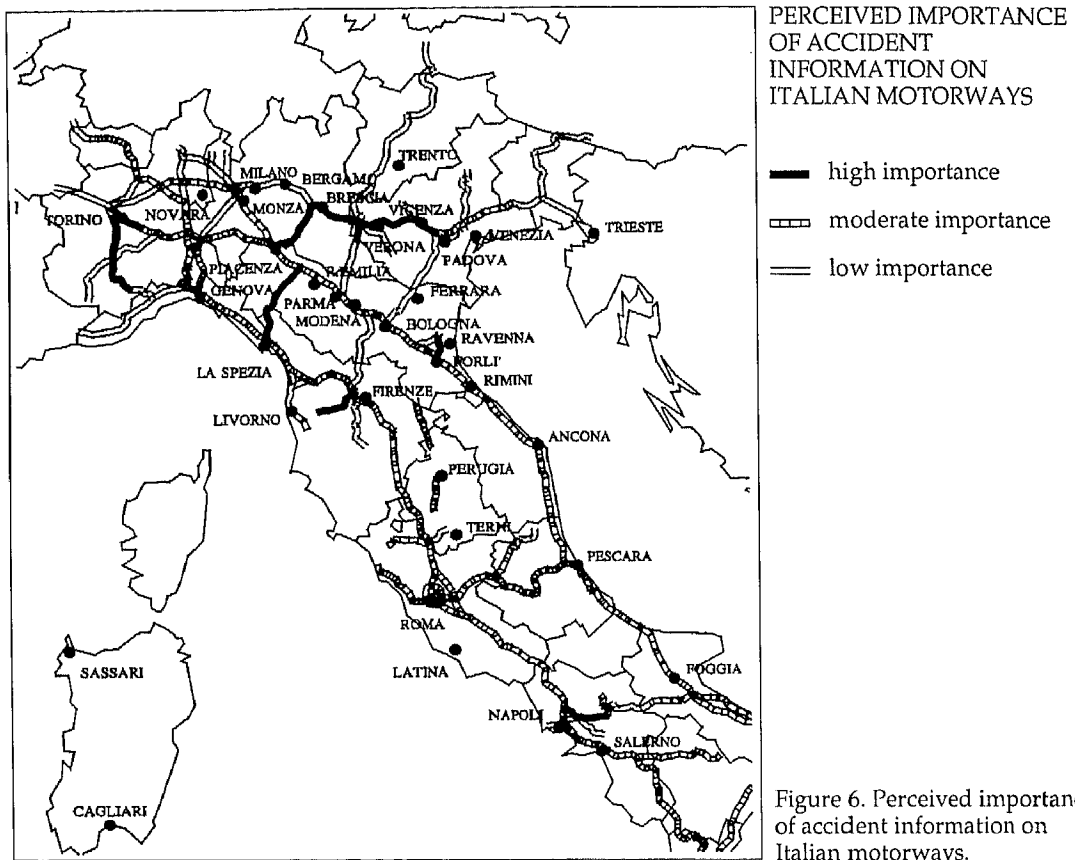


Figure 6. Perceived importance of accident information on Italian motorways.

variations in individual attitudes towards the use of ATT information between users of different parts of the Italian inter-urban road network, and to see to what extent these attitudes would show a correlation with the actual traffic conditions, as described in the previous section. In particular, the hypothesis may be investigated that (i) the perceived need of dynamic congestion information is higher as the average level of congestion the driver is used to is higher, and (ii) the perceived need of information on traffic accidents is higher as relatively many accidents occur on the motorway concerned.

Such an analysis requires a large empirical data base on the preferences of Italian road users. The relevant information was gathered from a large national driver survey on attitudes towards various forms of telematics applications for inter-urban use carried out

in October 1993. It had a sample size of about 1000 drivers. Surveyed drivers were asked to rank the perceived importance they attached to various types of dynamic information which could be obtained from telematics media during the car trip: information on prevailing congestion, accidents, roads works, weather circumstances etc.

The crucial step in the analysis was the link to be made between the attitudes of the drivers and the parts of the inter-urban network used. Based on the origin and destination places of the trips of the surveyed driver, the respective motorway routes were assessed. For this part of the analysis a dedicated GIS-software application (called MathGis) was developed which was able to deal specifically with the assignment of this kind of spatial survey data to the Italian inter-urban road network concerned. The

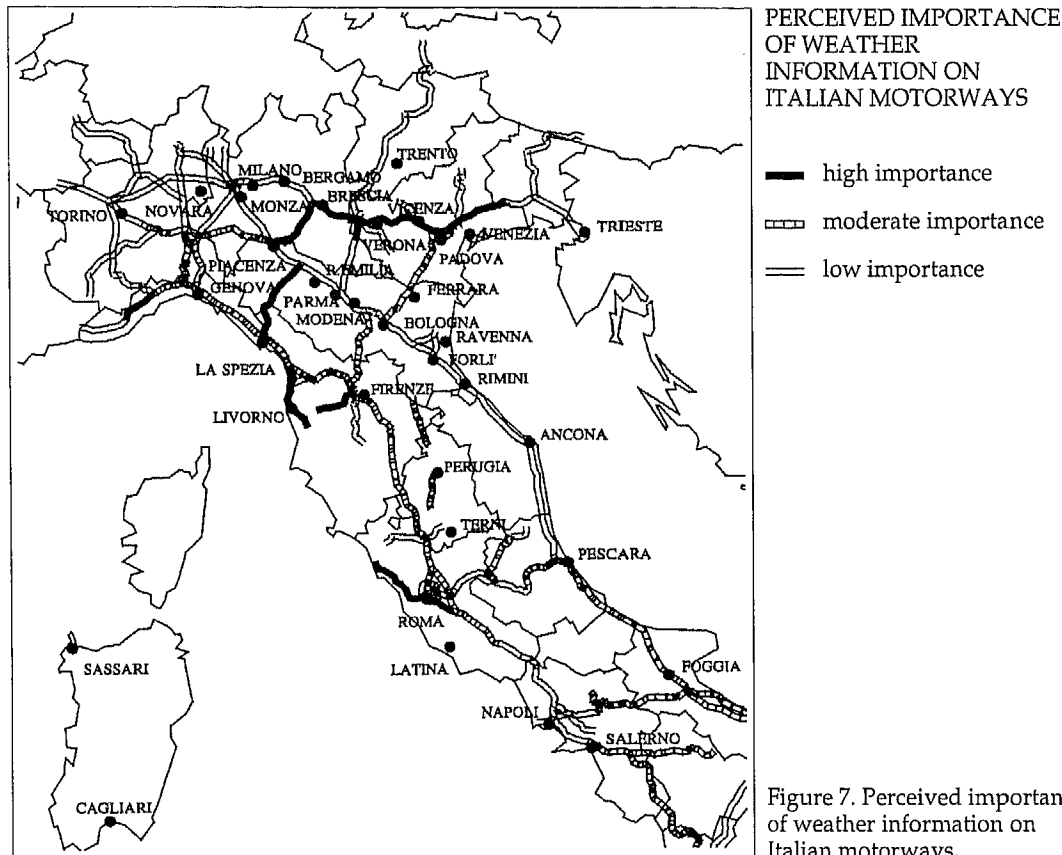


Figure 7. Perceived importance of weather information on Italian motorways.

output of this analysis was a visualization of ATT preference patterns of inter-urban drivers across the Italian road network (for details see MARTA, 1994).

The assignment of these revealed attitudes towards ATT information on the Italian road network is represented in figures 5, 6 and 7. From figure 5, we see that dynamic information on congestion is perceived as highly important in some very specific parts of the network: the orbital motorways around Rome and Naples, all corridors connecting the north-western part of the network to France and the Transalpine links to Austria and Jugoslavia. An explanation for the relatively moderate and low preferences for this kind of traffic information on the congested Milan ring may be that some road users can easily find alternatives once a traffic jam – which is a

usual situation – occurs, so that they would not attach a high value to this information.

The importance of the provision of dynamic information on accident occurrence (figure 6) seems to be generally low, except for some specific sites in the north-eastern part of the Italian network, mainly on the Bologna-Padua-Venice-Trieste corridor. Moderate values are found on the Parma-La Spezia link. Interesting is the low perceived importance of accident information on the Bologna-Florence corridor, a road connection that is known as one of the more unsafe parts of the network. Apparently, such a case of frequent non-recurrent traffic congestion does not generate a high need for prior traffic information, perhaps because on this route the number of alternatives is very low, so that there is not a case for many choices.

In general, weather information (figure 7) seems to be the most popular type of information that Italian drivers would like to receive. The spatial distribution of this preference shows however a clear pattern. In the Southern regions we observe that in general the perceived importance assigned to weather information is generally low to moderate. On the contrary, in Central and Northern Italy, especially in the north-eastern part, we observe that the perceived importance attached to this type of information is generally high or at least moderate. The preference for weather information seems to be strongly connected with the preference for accident information, especially on the Bologna-Venice-Trieste corridor and on the Parma-La Spezia link, which are relatively unsafe road links owing to frequent bad weather conditions for traffic. Also on the Bologna-Florence link we observe a high perceived importance attached to this type of information.

Policy Implications

In this paper we have tried to describe and analyse regions and road corridors in Italy with respect to features that play an explanatory role regarding the relevance, use and adoption rates of ATT applications. Two approaches were used; on the one hand an aggregate, descriptive analysis of relevant socio-economic, infrastructural and traffic demand related aspects and on the other hand a quantitative, individual-based analysis of user preferences towards certain types of ATT. The chosen case study area, Italy, offers in this respect some quite relevant spatial socio-economic contrasts.

Looking at both aggregate needs indicators for ATT in relation to traffic conditions (e.g. level of congestion, traffic flows, accidents) and consumer market size indicators (e.g. income per capita and population density), it can be concluded that there is a large opportunity for commercializing ATT devices,

especially in the Northern part of Italy compared to the South.

When we investigate individual attitudes, it appears that in some cases preferences for certain types of ATT information clearly depend on individual needs, as reflected by the traffic conditions which drivers are used to. By means of mapping preference patterns for different types of ATT information supported by dedicated advanced GIS-software specifically developed for this purpose, the results from our Italian national survey of inter-urban road users lead to the following conclusions:

- weather information services seem to be more popular in some northern corridors, especially in the regions subject to foggy weather conditions;
- congestion information devices seem to be relatively strongly needed around the main city rings and feeding corridors;
- accident signalling technology is perceived to be particularly important on some dangerous links in the north-eastern part of Italy.

These findings have clear implications for the implementation of ATT systems on the European road network. The importance of the user response to ATT services and the diversity in responses under different traffic conditions implies a need for a further development of ATT systems based on a thorough assessment of ATT preferences and their variations. Clearly, more research on the market potential of ATT technologies and their spatial (regional and urban) dimensions is highly desirable.

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