

AN ATTEMPT TO MATCH RESEARCH EFFORTS AND LONG TERM
TRANSPORT NEEDS

By

Umberto Montalenti
Advisor to the National Research Council of Italy
Corso Giovanni Lanza, 110
10133 Torino
ITALY

There are three main programs in Italy, founded by the National Research Council and aimed to match the industrial and University research efforts and long term transport needs, in addition to the regular academic research and the RandD activities run in Industry to improve its current products line.

They all are in the frame of a number of multi-years research plans called "Progetti Finalizzati", that is projects oriented towards national comprehensive objectives and requiring contribution of a plurality of different research capabilities wherever they are: the University, Industry, public and private research Centers, individual experts and the users.

As in other industrialized countries, such kind of oriented and co-ordinated action is intended to accelerate the innovation process in fields of social interest, where the large research costs and the incertitude of results would not encourage Industry to invest alone.

Moreover, the convergence of efforts from different parties, including the final users, toward common objectives should act as a stimulus and speed up the transfer of research

results into concrete applications.

Some of the areas covered according to this scheme, since 1973:

- Energy,
- Man's health,
- Land use and environment,
- Development of food sources,
- Advanced technologies.

The first group of researches in the transport field, has been developed as a sub-project of "Progetto Finalizzato Energia n.1" (1976-1982) in a section of it called "Energy conservation in traction". As the starting date suggests, this sub-project has been prompted by the first energy crisis. It was intended essentially to collect information, explore different ways of action, start some demonstration activities and individuate subjects to be further deepened in a next wider transport program.

Some of the areas explored:

- mobility needs and projections,
- improvement in energy efficiency in road and rail vehicles and recovery of kinetic energy,
- improvement of thermal efficiency in conventional engines; evaluation and testing of new propulsion systems and alternative fuels,
- improvement in vehicles aerodynamics by computational and experimental research,
- computerized control for engines, vehicles and traffic.

RESEARCH AND TRANSPORT NEEDS

The second and main program devoted to the transport issue is one called "Progetto Finalizzato Trasporti", started at the beginning of 1982. On this I am going to comment more widely here.

Finally, a third group of researches, complementary to those of the two above-mentioned programmes and requiring a deeper insight into the energy aspects, has been included in a new Energy Project recently approved by the Government.

Progetto Finalizzato Trasporti, as said the largest of the three research programmes, started as an effort to look into the future of the national transport needs, as already foreshadowed by the several deficiencies in the present situation. Accordingly, the following guide-lines have been assigned to it:

- for use in the short term:

researches in hard and software, intended to improve -in the present transport system- operation, control and use of vehicles and infrastructures and to rationalize the use of energetic, human and financial resources;

- for use in the medium term:

provide basic knowledge as a support to formulate transport plans at central and local levels, through the analysis of transport systems and subsystems in relationship to the settlement models; assess the technological feasibility

of new transport systems and components; develop and run demonstration tests;

- for use in the longer period:

develop a set of orientation assumptions on the national transport system, based on plausible scenarios of the territorial and socio-economic evolution.

The underlying national objectives of such a research structure can be summarized in: providing better information and methodological support to planners, central and local, public and private; individuating more efficient structures and services at the global and modal levels; enhancing the energy conservation issue; improving the environment conditions and particularly the quality of urban life; stimulating the competitiveness of both transport companies and manufacturers.

To implement such purposes, the five years program has been structured in eight sub-projects, the first two of them covering general studies and methodologies and the other six devoted to specific transport sub-systems(+).

In particular, sub-project 1 deals with the interactions between transport and land use and includes elaboration of a system of socio-economic-territorial scenarios for use by the transport planners, while sub-project 2 will make available models, algorithms and other working tools to planners, operators and research workers in the specific subprojects. Among them a distributed data base, which

(+) Annex 1 provides a complete list of the research themes in each of the sub-projects.

will contain all the relevant information pertaining to the national transport system.

Urban transport, the subject of Sub-project 3, is dimensionally the most important sector, since 37 million persons, 65% of the Italian population, live in the metropolitan areas, and in the 10 largest metropolitan areas out of a total of 24 million people, 3 million commute every day. Here, therefore, the largest resources are appropriated.

As in other sub-projects there are three levels of researches:

- studies, including in this case analysis of demand and offer; analysis of mobility in urban areas; development of techniques for adequate operation and management of the transport services.

The results of this level of researches are transferred to users, planners and operators, in form of manuals, packages of software, procedures and other written material.

Among the first products of this activity there is an Origin-Destination model, tailored for small and medium size towns and characterized by a reduced need of input data and some new ideas for the data collection phase. An application is being brought about in the town of Parma.

- Development of technologies in infrastructures, including the parking problems, in vehicles and in traffic control.

A real time monitoring and traffic control system, designed to implement such strategies as ensuring priority at the intersections to the collective means running on segregated

lanes is in course of application in the city of Turin. It is a hierarchical distributed system based on automatic detection, a central miniprocessor keeping under control the whole area and giving traffic forecasts within the time span of minutes and a local control through microprocessors at the intersections, predicting traffic within a time span of seconds (see Annex 2).

- A demonstration programme in pilot urban areas, after comparative evaluation and selection of some improved and innovative systems, including electric vehicles.

A first demonstration program will be performed with bimodal trolleybuses in the diesel version, followed by a contact cable version. Soon afterwards a fleet of electric vans will be tested in the city of Turin, in co-operation with the national Telephone Company and some industrial suppliers.

Sub-project 4 concerns road traffic and motor vehicles. It too has a studies section, which is particularly devoted to the extra-urban road systems: requirements' analysis, design, safety (the fog along the river Po valley is a nightmare to many motorists).

In the technology and demonstration sections (group of themes 2 and 3, see Annex 1) Subproject 4 concentrates mainly on the energy, safety and environmental issues, with intensive participation of the automotive industry's labs. Capitalizing on results reached in the Energy Project n.1, this sub-project works at further developing and integrating them.

To mention only some of the more remarkable results, fuel economies of 10 to 15% in mixed travel conditions and 30%

and more on highway have shown attainable for cars through aerodynamic redesign, in comparison with the fuel consumption of current models having a reference C_x value around 0,40. On loaded lorries a fuel consumption reduction of 10 to 18% has been demonstrated for speeds between 60 and 90 km/h with just a spoiler between driver cab and load, but substantially higher savings are pre-announced by redesign of the cabin and adequate smoothing of the trailers.

Encouraging results have been obtained with a small-size (1470 cm³), direct injection diesel engine: 238 g/kWh and a very flat consumption curve, leading to an average saving of 10 to 12% referred to the best pre-chamber engines and up to 30% if referred to the current I.C. engines. But space for further gains is evidenced by these bench tests. Experimental work, together with computational research on turbulence, injection and combustion is continuing now, also with even smaller engines.

Kinetic energy recovery has given fuel savings of 14% in hybrid cars and of 14 to 22% in the battery version of the hybrid bus. Work goes on in two other versions: flywheel with hydrostatic transmission and flywheel with electric transmission. The expectations are of even better results, however the cost factor is penalizing exceedingly the application on the automobile and is still under assessment for the bus case.

Continuous power transmission, controlled by a microprocessor, has allowed a fuel saving of some 15% in town and 10% out of town, while the modular engine concept, in different versions has given savings of 20 to 40% on the test bench. A fleet of 15 taxis, equipped with

modular engines derived from these tests has just covered a total of 40.000 km in the city of Milan. The engines embodied the simplest fuel partialization version, with multipoint injection and an electronic control such that the drivers did not even perceive what was happening under the hood. The global fuel economy resulted in a round 20%.

Several other interventions, along lines followed also elsewhere, are at work in the context of this sub-project, including tests with mixed fuels, use of composite materials to reduce weight, use of ceramics, etc. One of the main efforts, however, as far as the technological activities are concerned, consists now in trying to integrate in one single motorvehicle as much as possible of the improvements obtained separately, in the attempt to individuate a reasonable trade-off between energy saving, safety and the environmental requirements, with due consideration to the cost constraint.

The long distance passenger and freight transport is dealt with in Sub-project 5, "Long Distance Guided Transport" and 6, "Intermodal Freights Transport".

In the passenger transport case, evaluation of the Rail/Wheel transport system against the levitation technologies -in the specific case of the Peninsula- is the central research area of the studies section, while automatic traffic control, safety and elaboration of modern developments for electric traction and the rolling stock are the main subjects in the technology section of the sub-project.

The diagram in Annex 4 shows an attempt to provide a first orientation in the choice among several long distance systems, taking into account the required capacity in passenger per year, the travel velocity and the value a traveller would

give to the time he spend in way.

Among the technological developments in course, I just mention some of those which show closer to a satisfactory conclusion: an algorithm, already validated, for the automatic control of traffic in large junctions; use of optical fibers for data transmission and telecommands; a light weight, single suspension truck with self aligning, self orientable wheels; a simple, low cost bench for research on the rail-wheel interaction; light alloy body structures with minimized weight through computerized design procedures.

For the intermodal freights transport, the central research areas are, respectively, studies about the optimum location of the intermodal stations and technologies for the transfer equipment at the stations and for the road and rail vehicles. Among these, two developments are by now near to the prototype phase: a polyvalent waggon, particularly apt to carry trailers, and an articulate waggon for large cases, both designed to maximize the net-load/dead-weight ratio.

With the exception of a short course of the river Po, Italy has no appreciable internal waterways. However she is a long peninsula flanked by the Adriatic, the Tirrenian and the Ionian seas: 8.000 km of coastal routes, plus the connections with most of the Mediterranean harbours. Could a well organized shipping trade offer a more substantial contribution to the transport demand, particularly freights, than it does to-day? Is there a need for many small, or few large, well equipped harbours especially in view of national needs for imported coal? Such analysis and the study of opportunities and technologies for the ship-rail-road

movement of bulk loads and containers are the central areas of sub-project 7: "Coastal Shipping and Interfaces with Ground Transport".

An analysis of demand, including an O-D analysis for the inland sources of traffic, is at an advanced stage, as well as a system for the simulation of harbours' traffic and the training of personnel.

Also Sub-project 8: "Air Transport and its Interfaces with Ground Transport" is mainly one of studies, operation analysis and evaluations.

Again comes the point of optimum number, size and location of airports and their interfacing with the transport system on the ground. Another analysis concerns the real value or, to say it better, the valid field of operation for a regional aviation system, versus the convenience of establishing a fast rail system or a levitation train or, simply, an express bus service.

As it appears from this short summary, the subdivision of the Project in sections devoted to specific transport modes is there just for a practical organization of the research work, but the need for a close correlation among the different subsystems to optimize the response to the demand of mobility on the land is underlined both in the general sub-projects 1 and 2, and in each of the specific sub-projects, whenever problems of modal choice or of intermodal transport arise.

Although the Project is oriented to national needs, many of the specific research objectives and themes are of international

RESEARCH AND TRANSPORT NEEDS

scope, and in its planning phase the Project has certainly benefited of the experience done in other Countries.

I hope that -although rather interlocutory- this presentation may give rise to some exchanges of opinions and, possibly, open the way to co-operation in the fields of common interest.

Now the Project has entered his second year of activities and a Seminar on the first results is expected to take place in April.