THE NATIONAL TRANSPORT INFORMATION SYSTEM IN ITALY

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1. Introduction

The National Research Council (CNR) of Italy is a public body entrusted with promoting and carrying out research in all the scientific areas.
The CNR activity generally includes:
- direct involvment in research on specific disciplines through its own Institutes (about 150);
- financial and technical support to University research;
- fostering of international scientific cooperation;
- development of five year research programs on specific sectors of great strategical importance.

The special Project on Transport Research (PFT) is part of the latter type of CNR initiatives.
The PFT has been conceived for improving the efficiency of the Italian Transport System (ITS) through:
- providing advanced methods for transport management and planning at all levels;
- promoting technological research and development in all the modal sectors;
- evaluating the impact of transportation on land use, environment, quality of life.

To pursue these basical objectives, the PFT is articulated into eight sub-projects, each one dealing with various sectorial problems representing as many research tasks.
With regard to methodological research, the activities are concentrated in a sub-project with five specific tasks:
- Task 1: supply and demand analysis and forecasting.
- Task 2: traffic analysis, management and control.
- Task 3: optimization of transport systems.
- Task 4: organization, management and optimal use of resources at firm level.
- Task 5: design and management of Data Bases for transport systems.

The realization of a National Transport Information System (SINT) is the most engaging project of Task 5 for the complexity of the problems which will be afterwards analysed.
After this brief explanation about the position of the SINT project in the PFT context, some indications on the ITS could be useful for a better understanding of the important role of the System.
For many years the ITS has shown serious functional deficiencies due to inadeguate coordination and control which have brought about:
- irrational modal distribution of traffic;
- low productivity of public enterprises;
- heavy public subsidization of passenger transport companies.

These negative aspects of the ITS have led, in 1981, to the institution of the PFT and, in 1984, of the General Plan on Transportation, both representing the political determination to reorganize the sector.
The urgency of defining efficient measures and investment programs implies an

adeguate information support to the decision makers. Of course, the knowledge of all the significant aspects of transportation is also greatly important for methodological research development.
The role of an information system in Italy is of essential importance not only for exceptional state intervention but also for ordinary transport management and planning in which are largely involved public bodies.
In fact, central administrative bodies are responsible for railway transport, most of the other modal infrastructures and partecipate, through shareholdings, to air and maritime transport companies. As for local governments, they are entrusted with the organization and control of jurisdictional passenger transport networks; they also share investment costs in infrastructures of regional interest. Subsidies for compensating budget losses (depending mostly on social fares) of passenger transport companies, are distributed by public bodies in relation to their administrative competences.
A dimension of the public share of the global expenditure in transportation, is shown, both in monetary and percentage terms, in the following table:

Global expenditure (investment + operation) for transportation

Year	Global expend.	Expenditure shares			
		Private operators	Public bodies		
			Total	Central	Local
		in billion current lire			
1981....	124.800,7	106.274,5	18.526,2	12.403,4	6.122,8
1982....	151.017,3	127.748,2	23.269,1	15.253,7	8.015,4
1983....	168.014,5	140.613,6	27.400,9	18.120,0	8.280,9
		Percentage			
1981....	100,0	85,8	14,2	9,3	4,9
1982....	100,0	84,9	15,1	9,8	5,3
1983....	100,0	83,7	16,3	10,8	5,5

Source: Ministry of Transport - Conto Nazionale dei Trasporti 1983.

The cited information source (1), the "Conto Nazionale dei Trasporti" (CNT) is an annual statistical report published by the Ministry of Transport since 1971.
This document represents the first concrete political initiative for acquiring information on all the transport activities.
The institutional law established that the CNT contained a full description of transport expenditures by modal sectors and categories of operators.
In the course of years the CNT has expanded its information content to dimensional and technical elements on traffic and available resources, transport related financial-economic aspect, etc.
However, the efficiency of this valuable report is reduced by technical constrains (printing, distribution) and deficiency of information sources in some very important areas.
As a matter of fact, the CNT publisher, the Ministry of Transport - Planning, Organization and Coordination Head Office, had pressed the PFT to include in its program the realization of a prototype for an information system.

Presently, after three years since the start of the project, the SINT prototype is undergoing implementation and tests, while for the operative phase, the beginning is expected in 1987.
In the course of the SINT project, various and complex problems had to be tackled with considerable financial and human resources.
This matter is to be subsequently treated with different detail levels. In fact, the priority topics are the ones related to information contents and organizative aspects while computer science appliances will be only synthetically outlined as, on this matter, vast and exhaustive documents have already been produced by the experts involved in the project.
The subsequent description of the SINT project follows the Work Program and particularly the phases from 1 to 5.

Design phases

Phase 1 - Definition of general requirements.
Phase 2 - Analysis of modal sectors and inventory of information sources.
Phase 3 - Definition of detailed requirements.
Phase 4 - Design of HW - SW structures.

Realization phases

Phase 5 - Data homogenization and standardization; surveys on critical areas.
Phase 6 - Implementation of HW - SW structures.
Phase 7 - Input procedures, tests, setup, operation.

2. The General Requirements

The definition of the general requirements is of great importance for pursuing the principal SINT objective: to provide adeguate information for the description, control and forecasting of the Italian transport system.
The complexity of this problem suggested the Direction of PFT to gather in a special Commettee the representatives of central and regional governments, Carriers Associations, Labour Unions, public bodies dealing with statistical reports, in order to ascertain their information requirements and avalaibility to cooperate in data collection problems.
The indications obtained from the Committee have led to define:

a) Pre-eminent users

- at a central level: the Ministries of Transport, Merchant Marine, Public Works, Budget and Economical Planning.
- at a local level: Regional Governments

b) Aggregation levels

- by jurisdictional areas: provincial, regional, national;
- by modal sectors: rail, road, sea, air;
- by type of service: passenger, freight;
- by type of activity: on third party account, on own account.

c) Categories of information on transportation

- Available resources
  - . Infrastructures (technical and dimensional characteristics);
  - . Fleets and vehicles (number by type and load capacity);
  - . personnel (number by function);
  - . enterprises (number by type and dimensions).
- Traffic
  - . transport demand and supply;
  - . principal traffic flows (O/D).
- Operating expenses and revenues
  - . expenses (personnel, energy, interests, depreciation);

. revenues (traffic receipts , public current subsidies).

d) Other information

Transport demand generating factors

. industrial and agricultural productions, population, employment, per capite income, consumptions, environment, land use, legislation, etc.

The definition of the general requirements reflects the principle of obtaining, in a short term, a clear enough picture of the ITS (and also of its interactions with other national aspects), which could be , on the long run, improved.

With regard to specific characteristics, they have been established on the basis of the following criteria:

- Pre-eminent users. Public bodies envisaged as priority users are the ones more directly involved in transport planning and management. Of course, at a lower level, there is a large number of other potential users: the 92 provincial governments, the largest of Italy's 8000 municipalities, large transport companies, etc. Finally, last but not least, the scientific community interested in transport research.
- Aggregation levels. They have been fixed whith the intention of representing the transport activities by homogeneous categories of operators.
  This solution allows, through the comparison of different transport sub-systems, to realize analytical evaluations and control on all the ITS sectors. Moreover, an homogeneous group of operators can be considered as a single undertaking which activities are measurable by normal book-keeping procedures.
- Categories of information on transportation. Most of the scheme follows book keeping standards for evaluating the economical results deriving from the employment of available resources.
  In this case, monetary values are integrated with physical data pertaining to technical aspects of transportation which are of essential importance.
  The acquirement of both type of values brings about engaging problems. In the case of infrastructures, for instance, it is very difficult to estabilish the amount of their value while an exhaustive technical description is quite possible.
  On the contrary, it is much easier to measure the production in monetary terms (revenues), than in traffic units. A possible solution to these problems is expected from specific methodological studies.
- Other information. The PFT, as mentioned earlier, includes research on mathematical models for the optimization, forecasting and control of transport systems.
  The products of this research line, after an appropriate selection, are to be stored in the Bank of Mathematical Models which will be one of the SINT subsystems.

The "Other information" requirements, therefore, are to be defined mainly on the basis of models input specifications and also after specific needs of priority users. The problems related to the acquirement of this type of information are limited, as most of them are collected and provided by Italy's Census Bureau (ISTAT) for the National Accounting and Statistical Systems.

3. Analysis of modal sectors and inventory of information sources.

The research developed in this phase is propaedeutical of detailed requirements definition. After to having estabilished, in the general requirements,

the variables to be acquired it is necessary to analyse, on the basis of the aggregation levels, each modal sector to ascertain:
- number of operators by functions , juridical status, dimensions;
- inventory of information sources.

In fact, the first survey showld lead to a detailed picture of all the categories of operators which activities are to be described following the general criteria but also using the proper units of measure for the specific technical aspects of modal sectors. Besides, the knowledge of the juridical status and dimensions of the operators is very important for evaluating data collection problems as successively described.

As for the inventory of information sources which has to be carried out simultaneously with the survey on modal sectors, the expected result is a general view of existing archivies which structures and contents are to be afterwards analysed.

For a better understanding of the strategical solutions adopted for the SINT project, it seems useful to outline the modal sectors situation obtained after the survey.

Furthermore, the description of some peculiarities of the ITS, which are significant to information problems, might help in evaluating the transferability of the Italian experience into other national contexts.

The modal sectors dimensional data are largely approximated but adeguate enough to the actual scope.

ROAD

N°	OPERATORS	JURIDICAL STATUS	DIMENSION
INFRASTRUCTURES			
23	COMPANIES OPERATING MOTORWAYS HELD IN CONCESSION	STATE SHAREHOLDINGS	NETWORK: KM 6.000
1	STATE HIGHWAYS CORPORATION	STATE CORP.	NETWORK: KM 45.000
95	PROVINCIAL ROADS ADMINISTRATIONS	PUBLIC OFFICES	NETWORK: KM 106.000
8000	MUNICIPAL ROADS ADMINISTRATIONS	PUBLIC OFFICES	NETWORK: KM 142.000

ROAD

N°	OPERATORS	JURIDICAL STATUS	DIMENSION
PASSENGERS			
970	COMPANIES OPERATING REGIONAL SERVICES HELD IN CONCESSION	PRIVATE COMPANIES, REGIONAL CONSORTIA	EMPLOYEES: N° 57.000 BUSES: N° 23.000
260	COMPANIES OPERATING MUNICIPAL SERVICES HELD IN CONCESSION	PRIVATE COMPANIES, MUNICIPAL CORPORATIONS	EMPLOYEES: N° 60.000 BUSES: N° 14.000
	COMPANIES OPERATING:		VEHICLES:
	.INTERREGIONAL BUS SERVICE	PRIVATE COMPANIES	.N° 2.000
	.TOURISM BUS SERV.	AND	.N° 4.000
	.TAXI CABS	CO-OPERATIVES	.N° 11.000
	.HIRE CARS		.N° 22.000
	HOUSEHOLD, FIRMS USING PRIVATE:	HOUSEHOULDS AND PRIVATE	VEHICLES:
	.BUS	FIRMS	.N° 30.000
	.CARS		.N° 20 MILL.
FREIGHT			
200.000	ON THIRD PARTY CARRIERS	PRIVATE COMPANIES	OF UNDERTAKINGS: 83% OWNS 1 VEH. 10% " 2 " 3% " 3 " 1% " 4 " 3% " > 4 " N° OF VEHICLES: 214.000 LOAD CAPACITY: 2.3 MILL. TONS
980.000	ON OWN ACCOUNT OPERATORS	PRIVATE COMPANIES	N° OF VEHICLES: 1.140.000 LOAD CAPACITY: 2.8 MILL TONS

RAILWAYS

N° OPERATORS	JURIDICAL STATUS	DIMENSION
PASSENGERS AND FREIGHT		
1 ITALIAN STATE RAILWAYS	STATE CORP.	NETWORK KM 16.000 EMPLOYEES: N° 245.000
25 MINOR COMP'S OPERATING LOCAL NETWORK HELD IN CONCESSION	20 PRIVATE, 5 STATE CONTROLLED CORPORATIONS	NETWORK: KM 3.600 EMPLOYEES: N° 18.000

SEA

N° OPERATORS	JURIDICAL STATUS	DIMENSION
SEAPORTS		
17 MAJOR SEAPORTS COMPANIES	PUBLIC CONSORTIA	EMBARKED + DISEMBARKED GOODS: 277 MILL. TONS
25 MINOR SEAPORTS ADMINISTRATIONS	STATE OFFICES	62 MILL. TONS
CARRIERS		
	CABOTAGE	
17 SHIPPING CO'S OPERATING REGULAR CONNECTIONS WITH AND AMONG ISLANDS (FREIGHT AND PASSENGERS)	6 STATE SHAREHOLDINGS, 1 ITALIAN STATE RAILWAYS, 10 PRIVATE SHIPOWNERS	FLEET: N° 127 FERRIES N° 48 CARGO-PASSENG. N° 35 HYDROFOILS
= SHIPPING CO'S OPERATING COASTAL FREIGHT TRAFFIC	PRIVATE SHIPOWNERS	FLEET: = CARGOS
	INTERNATIONAL	
800 SHIPPING COMPANIES	PRIVATE SHIPOWNERS	FLEET: TOTAL GROSS TONNAGE: 9 MILL.

AIR

N°	OPERATORS	JURIDICAL STATUS	DIMENSION
AIRPORTS			
32	MAJOR AIRPORTS MANAGEMENTS	19 PUBLIC AND PRIVATE CONSORTIA, 13 CIVIL AVIAT. OFFICES	TRAFFIC: PASS.: 30 MILL. GOODS: 270.000 T. MAIL: 85.000 T. EMPLOYEES: N. 12.000
CARRIERS			
1	INTERNATIONAL AND DOMESTIC AIRLINE	3 STATE SHAREHOLDINGS, 1 PRIVATE CORP.	TRAFFIC: PASS. KM 15 BILL. TONS. KM 2 BILL. EMPLYEES: N. 21.000
3	DOMESTIC AIRLINES		

The inventory of information sources has been carried out by taking into account all the operators singled out through the modal sectors survey.
The inventory results have demonstrated that the ITS can be divided, whith respect to information problems, into 3 areas:

A - With limited problems: the area includes the sectors with high concentration of activities in public and semi-public operators using EDP systems for managerial purposes: rail, air, sea (only state shareholdings).

B - With normal problems: in this area the activities are decentralized but have a public management and/or financial support: road and sea infrastructures; passengers public transport.

C - With difficult problems: includes transports carried out by a large number of private operators: road freight, private cars, international maritime freight.

For each information source have been acquired, in the course of the inventory and by a special form, the following characteristics:
- correspondence to the general requirements;
- reliability;
- up-dating (regularity, intervals);
- type of files (paper, magnetic);
- access problems (technical, bureaucratic, reservedness).

The considerable amount of descriptive elements acquired in this research stage, has provided a valuable base to the decisions pertaining to specific requirements definition.

4. Definition of detailed requirements

The first approach to the problem consisted in preparing a synoptical table

having on the columns the variables (determined in the general requirements) and on the lines the transport operators by modal sectors.
By using a few symbols, the indications related to information avalaibility, reliability, up-dating, aggregation levels, type of files have been reported on this table.
The situation which emerged after this process has shown that for rail and air sectors the actual operative subsystems can provide a quantity of information largely exceeding the requirements while for road and sea sectors it is necessary to resort to complex and expensive surveys for filling up serious gaps.
In defining the detailed requirements, foreseable data collection costs for critical areas have been properly considered and therefore information standards have been fixed at a minimum level.
On the contrary, in the areas where information can be easily acquired, a reasonable increase of the SINT contents has been provided.
With regard to surveys on critical areas, the priorities have been estabilished on the basis of the role of the sub-systems in the national economy. After this principle the areas to be surveyed are, in the order: road freight transport, private cars, international maritime freight transport.
The PFT funds which can be assigned to the surveys are not sufficient for the realization of the whole program.
As a consequence, it has been decided to carry out a thorough survey in road freight transport and only a feasibility study for the private cars survey.
As for the maritime sector, positive contacts have been estabilished with the Ministry of Merchant Marine for defining the requirements of data to be collected, through joint initiatives, by the same Ministry and the National Census Bureau.
The road freight transport survey is of essential importance as in this area the available information (as previously indicated) are limited to descriptive elements of vehicles and operators.
Therefore, the quantity and quality of traffic, which after approximated estimates absorbs 70% of the global freight flow, are almost unknown.
The complexity of a survey in this sub-sector, that depends mostly on the presence of a very large number of small private firms, had suggested the realization of pre-surveys on which to base the definition of the methodologies to be used.
The detailed survey design has been submitted for examination to the representatives of public bodies directly involved in this area in order to select the method, out of the four provided by the study, which could better meet the priority task. The results obtained through this initiative have allowed the start of a joint cooperation plan which provides the simultaneous execution of three of the four different surveys defined by the feasibility study (2) and also the outline of a general agreement for systematical up-dating by the institutional bodies.
The great interest arisen from the road freight survey derives largely from the intense planning activity, started by the Ministry of Transport, for reorganizing the sector. In particular, one of the short term objective is to increase the railway share of freight traffic (around 9% of total) and consequently to reduce the congestion in some vital sections of the road network.
Coherently with this goal, the road freight survey has been primarily conceived for obtaining a picture of medium-long range traffic through O/D matrixes by class of goods at provincial and regional levels, in 1986.

On the basis of this picture it will be possible to evaluate the amount of traffic which could be conveniently shifted from road to rail and the consequent impact on the State Railway network.
Proceeding in the examination of the surveys program, the second priority area concerns the use of private cars because of the important social-economical problems which are directly originated from this type of traffic.
Besides the well known negative aspects of private motorization (accidents, congestion of urban areas , pollution, etc.) it is also considerable the amount of financial resources absorbed by this sub-sector.
In fact, the figures obtained through an estimate method for the optimal use of the scarce avalaible information (3) indicate that, in 1983, the global expenditure in this area (in current Italian lire) includes 44.000 billion for operating costs and 21.000 billion for new vehicles and overhauling costs.
A specific survey should acquire, at least, some basic information for defining: the average annual kilometers travelled by class of cars, type of traffic (urban, intercity), categories of users (commuters,professionals,, tourists, others).
The avalaibility of these elements can lead to the evaluation of the role of the car use in the economy (final or intermediate consumptions) as well as in the transport system (systematic or irregular traffic, alternative or integrative to public service etc.).
These results are, of course, considerably important in transport planning and management.
As mentioned earlier, the PFT efforts are limited to provide methodological support and cooperation to the Census Bureau which, as responsible for national statistical and economical reports, will be surely involved in this large scale survey. In conclusion, in this phase of the SINT design,there have been estabilished the detailed information contents of the system and at the same time a concrete program for a convenient solution of data collection problems.

5. The HW - SW structure

The design of this structure has required a considerable effort by the experts involved in the SINT project for the serious problems related to the large amount of data to be acquired and processed, to the type and distribution both of users and information sources.
In particular, the survey on information sources has brought to the location of pre-eminent EDP systems in which are concentrated most of the available data.
The valuable benefits of a direct acquisition of data has suggested the study of a sophisticated SW, the Network Data Management System (NDMS), for connecting heterogeneous Data Bases and realizing, therefore, a virtual Data Base including all the pre-eminent information sub-systems.
A limited average computer experience of the SINT potential users has been prudentially assumed in designing the interrogation language and consequently advanced user-friendly procedures have been envisaged.
In short, the SINT structure is composed of:

a) a heterogeneous and coordinated Data Base realized both by physical connection of existing sub-systems and loading of data obtained from other files and surveys;
b) a Bank of mathematical models (for optimization, forecast and simulation) and packages for data processing;
c) a collection of national and EEC norms on transportation;

d) a Data Base of information sources on transportation.
This brief reference is surely inadeguate to describe the problems and the solutions adopted by computer science experts but, as previously announced, this paper is focused on other aspects of the SINT project. Furthermore, a vast and exhaustive documentation on this matter has already been produced by the research Institute (4) responsible for the SINT realization.

6. Data homogenization and standardization; surveys on critical areas

The general view of information problems in the transport area, obtained through the survey on modal sectors and the abalysis of data sources, has allowed to define short, medium and long term programs to reach possible and satisfactory solutions.
The short term program (partially concluded), which should enable the SINT prototype to be partially operative in 1986, provides:
- implementation of HW - SW structures (phase 6 of work program);
- loading of directly usable data (obtained both from existing files and surveys), test, set up (phase 7 of work program).

The medium term program objective is the optimal exploitation of available information through homogenization problems solution.
The long term program aims to the realization of a well defined and continuous data flow interesting all the transport activities.
While for the short term program the activities to be carried out mostly imply evident technical problems, for the other two programs, respectively, the methodological and political-organizative aspects are prevailing.
In fact, the medium term program, started in December 1985, should lead to the definition of methods for available data homogenization and also data collection standards to be adopted by specific categories of operators.
The homogenization problems, emerged after the analysis of information sources, mainly originate from difference of:
- variables contents;
- up-dating intervals;
- modal and territorial aggregation levels.

In the first case, it is necessary to establish proper definitions for each considered variable in order to get to a satisfactory comparability level. This task implies considerable efforts as the problems to be solved are various and complex. In fact, some of them are basically technical as in the case of defining methods and units of measure for physical variables.
Instead, when dealing with economic-financial aspects as, for instance, capital and depreciation evaluation, possible solutions depend on the effective involvment of high ranking academic and government experts. With regard to up-dating intervals and territorial aggregation levels, most of the homogenization problems can be solved by specific methods for estimating the needed variables as correctly as possible.
Modal aggregation problems are a consequence of multimodal activities of some industries such as local transport corporations (buses, secondary railways, subways), Italian State Railway (which also operates ferry lines), etc.
In these cases it is necessary to exert pressure on Firms Associations and managements for obtaining, from their accounting and statistical systems, satisfactory modal analyses. The PFT initiatives related to the medium term program consist of:
- study of estimate methods;

- set up of standards for multimodal industries accounting systems;
- joint efforts with the Ministry of Transport for the institution, on the part of the Census Bureau (ISTAT), of a Committee for Statistics in Transportation, composed of experts selected on the basis of envisaged problems.

The PFT role in this Committee is to transfer all the experiences acquired through the SINT project, to submit problems which can't be handled in the limits of a research program and to provide active cooperation to get, as soon as possible, to satisfactory results. The Committee, which has started its activity in June 1985, is formally entrusted with the "study of possible initiatives for the coordination, integration and development of information in the transport sector".

In March 1986 the Committee has completed a study which has confirmed the validity of the process for defining the SINT requirements (carried out in 1984), and produced an updated picture of available information sources. Coherently with the medium and long term programs, previously outlined, the Committee is now working on specific problems dealing whith homogenization and standardization. Actually, the attention is focused on the PFT road freight traffic surveys for defining, on the basis of concrete elements, a standard procedure for systematical updating.

The Committee work program provides the study of specific problems by restricted panels and plenary sessions for examination and approval of proposed solutions.

One of the most engaging issues in the Committee agenda is the actual partial compatibility of the SINT requirements with the National Accounting System methodology (SEC international system) pertaining to transportation. The possible solutions vary from harmonization criteria to innovative general procedures.

The conclusion of the Committee program can be reasonably expected by the middle of 1987.

By the end of the study activity, some of the most urgent and feasible proposals of the Committee might have already been realized.

The considerable political interest in transportation, concretely expressed by the actual intense planning activity (in the limits of the 1985 General Plan for Transportation), allows optimistical expectations of getting the indispensable government support for the realization of systematical data flows.

In fact, the achievement of this goal requires both financial support, for data collection costs, and proper regulations for obtaining information from private operators.

7. Conclusions

By the end of the PFT research (first half of 1988), the most tangible product of the SINT preoject, in accordance with the fixed objective, will be a very functional and advanced prototype containing the most of required information, a Bank of mathematical models and packages, specific Data Bases, sophisticated computer science appliances.

In addition to this result, many other extremely important achievements have already been reached.

First of all, it has to be considered the great attention drawn on information problems which has led to the general involvement of public institutional bodies in the activities of the mentioned ISTAT Committee.

At the same time, it has also been emphasized the essential role of

information in view of providing scientific support to decision making procedures.

Besides, the joint partecipation to the SINT project of academic researchers, government officials, transport operators, has allowed a mutually profitable exchange of knowledge and experiences on various topics.

Of course, other benefits have also been obtained especially by Public Administrations that are the priority users of all the PFT methodological research.

As for the SINT future development, it depends largely on the capability of the public body, which will be entrusted with the management of the system, of dealing with such a difficult task.

Reasonable hypothesis, to be examined at a political level, indicate the ISTAT and the Ministry of Transport as possible responsible for the SINT management and updating. It is also envisaged a continuous cooperation by a restricted version of the actual ISTAT Committee.

Obviously, the PFT assistance in the SINT transfer phase is also extremely important in order to get the maximum benefits from research efforts.

Whether these benefits will produce long or short lasting effects it is far beyond the limits of a research program.

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