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Anders Langeland Agder Research Foundation
The MYSTIC Project – Only the passenger part

Methodological Framework for Modelling European Passenger And Freight Transport on Transport Infrastructure Scenarios With the ETIS

MYSTIC

Towards Origin – Destination Matrices for Europe

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	TTR, Transport and Travel Research (GB)

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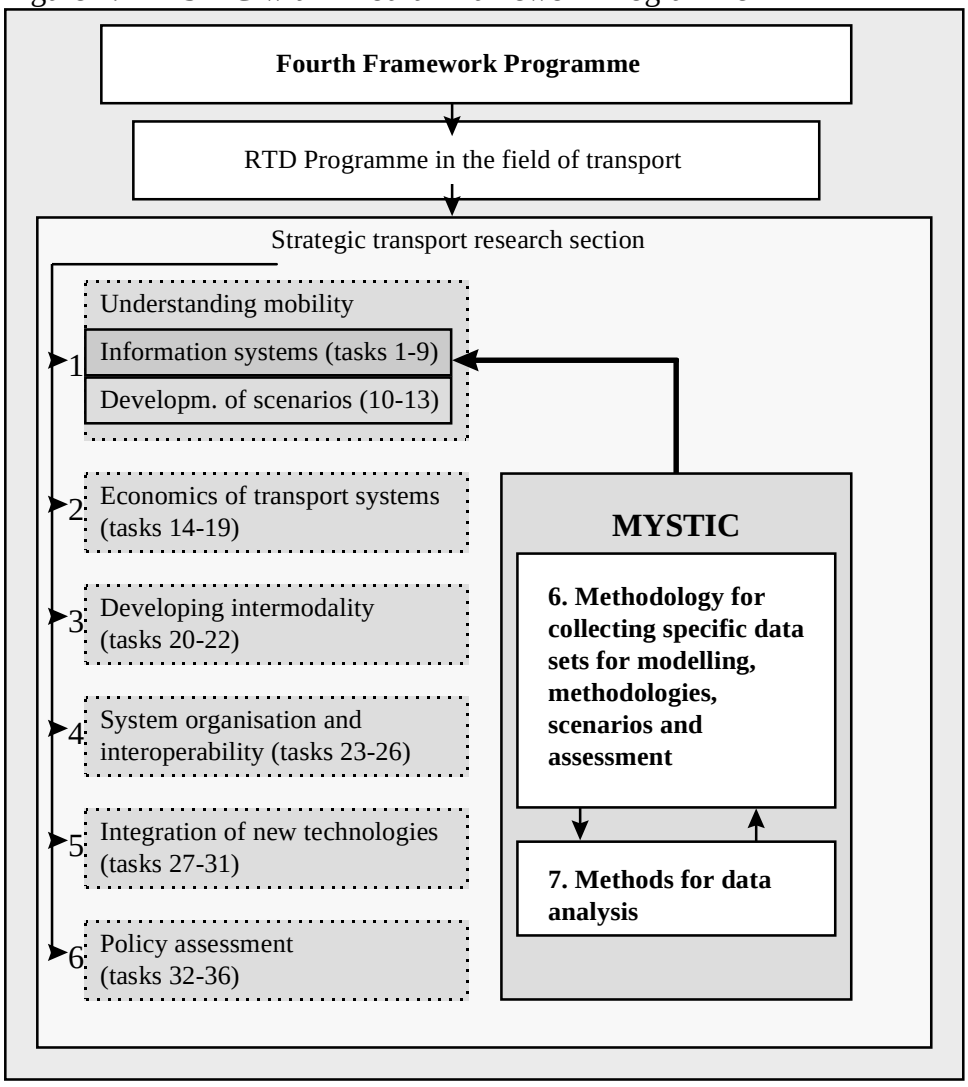
The organisation within the 4th Framework Programme

It is important to bear in mind how the work to be done in MYSTIC relates to the rest of the Strategic Section of the Transport Research Programme within the 4th Framework of the EU. This part of the research programme is divided into six fields of investigation. The MYSTIC study includes the Tasks 6 and 7, within the field "Understanding mobility", which is subdivided into "Information systems" (Tasks 1-9) and "Development of scenarios" (Tasks 10-13), see Figure 2.1.

Figure 1: MYSTIC within Fourth Framework Programme

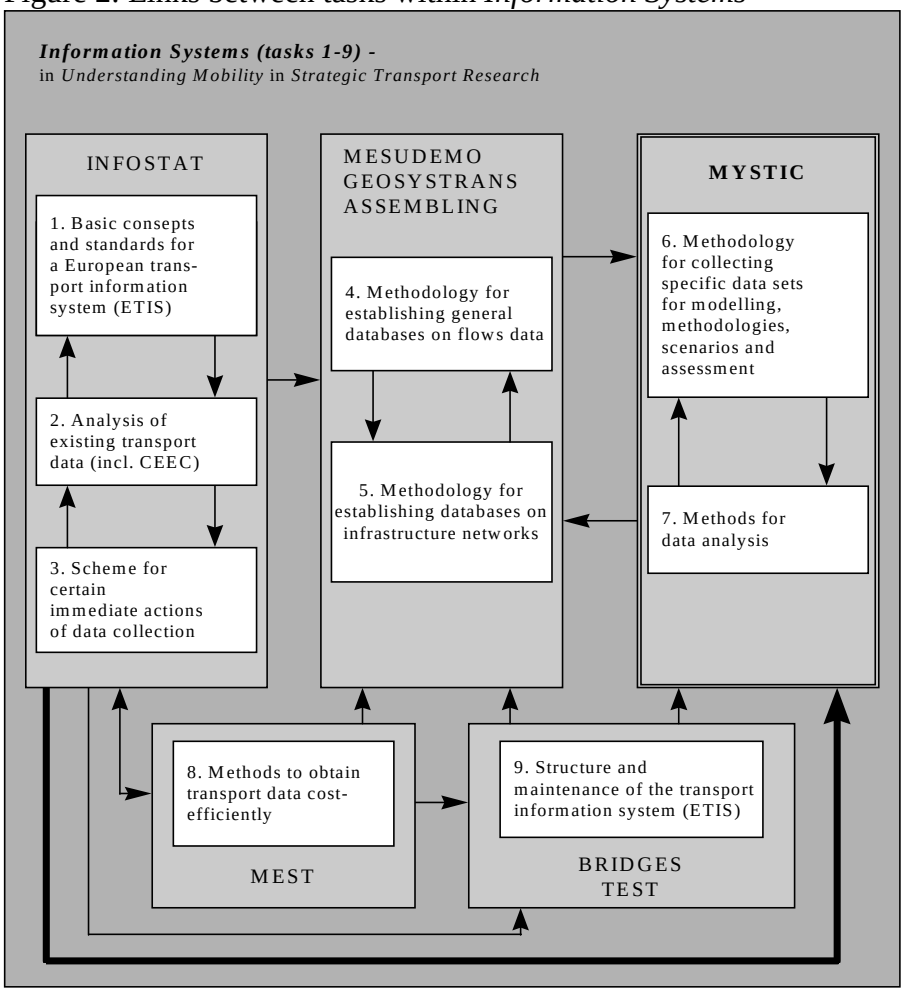


This is to underline the fact that MYSTIC will not be permitted to evolve in isolation from the line of thinking that has resulted in the division of labour between projects as well as the interrelations between them.

Connections between MYSTIC and other tasks and projects within Information systems

MYSTIC brings the process of creating ETIS one step further, and it is therefore of great importance that MYSTIC continue to build on the work done in previous or ongoing projects in the research programme.

Figure 2: Links between tasks within *Information Systems*



In the INFOSTAT-project the fundamentals of European transport databases have been studied with the ultimate goal to provide the framework which will lead to the installation of a European Transport Information System (ETIS).

The on-going MESUDEMO project will, in interaction with GEOSYSTRANS and ASSEMBLING, issue recommendations for establishing general databases for transport flows and infrastructure information.
While MYSTIC will develop sets of methods for collecting specific data sets needed for modelling, as well as refine the methods for data analysis, the project will use the outcomes of the related projects to the largest possible extent.

Context passenger transport

An efficient transport system underpins the European economies and the quality of life of its individuals, whose insatiable appetite for mobility causes an ever-increasing need for more and better transport infrastructure and services. The Commission finds itself at the centre of this issue, as member countries increasingly turn to it to help orchestrate the international transport system. To meet this need, the Commission has set out its vision of the future direction for European transport in the Common Transport Policy (CTP) and identified the need to develop a Trans European Transport Network (TEN). The Transport RTD programme supports these objectives, by supplying first class research to help achieve its policy and by developing an effective strategy (Strategic Transport Research) which it should follow to help coordinate the development of transport systems - for which both the Commission and member countries need high quality information.

This high quality information will help to develop, to maintain and to regulate the Trans European Transport Network (TEN), as well as the linkages that feed into it. Also, information will be required to support and develop the Common Transport Policy (CTP), to support effective decision making and to underpin any actions taken. This need for information is to be met by a high quality, state-of-the-art information system, referred to as the European Transport Information System (ETIS). The 4th Framework Strategic Transport Research tasks have been structured so as to address key issues, which would need to be resolved in developing the ETIS. One of these is the need for a detailed understanding of the pattern of European travel demand, which lie at the core of effective development of the Trans European Transport Networks and would be an essential component for the ETIS. Policy makers, governments, and providers of transport infrastructure and services need to know where people travel from and where they are going to, so that the appropriate transport system can be provided. Amazingly, this essential European origin-destination information does not currently exist and by not knowing the pattern of pan European travel demand, those who need to know are working completely blind.

This very important gap in knowledge is addressed by MYSTIC, which seeks to advance our ability in this area so that (eventually) we may be able to have origin-destination (o-d) information at a pan-European level. There are no pan European datasets from which to build up the origin-destination pattern of passenger travel and, even if there were, the problems associated with travel at a pan-European scale are different to those at say a National scale. The same is true of methodologies, whereby, methodologies developed for an urban, regional or even a National scale do not apply at the pan-European level and while we may be able to draw upon their ideas, the approach at a pan-European scale needs to be rethought and key aspects researched in-depth. This part of the MYSTIC project has been structured to progress the state of the art so as to provide a methodology for building up the pattern of origin-destination passenger travel at a pan-European scale so that the pan European passenger origin-destination matrix could become a reality.

Objectives

The objective of the passengers part of MYSTIC was to develop a methodology for building a pan-European passenger o-d matrix and to test it using a case study. In fact two case studies were undertaken the first - the European case Study – was at a pan European level and sought to merge the existing o-d datasets together to produce a European o-d matrix covering road and rail. The objective of this was to develop the tools and techniques for merging different datasets and show how they could be used to produce a European trip matrix. The second – the UK case study – was at a detailed National level and sought to show how different detailed datasets could be held in a database and used to build detailed trip matrices for infrastructure scheme design and assessment.

The European Case Study Collecting Existing Datasets

The Commission wrote to National governments asking for o-d data to be provided to the MYSTIC project. There was generally a good response and we were able to incorporate various different types of data from eight countries. This included all the major types of data collection methodologies for o-d data (apart from on-train o-d interviews which could be fitted into our categorisation anyway). In summary the data sources and data types were as shown in the table below:

Figure 3: Available passenger data in different countries

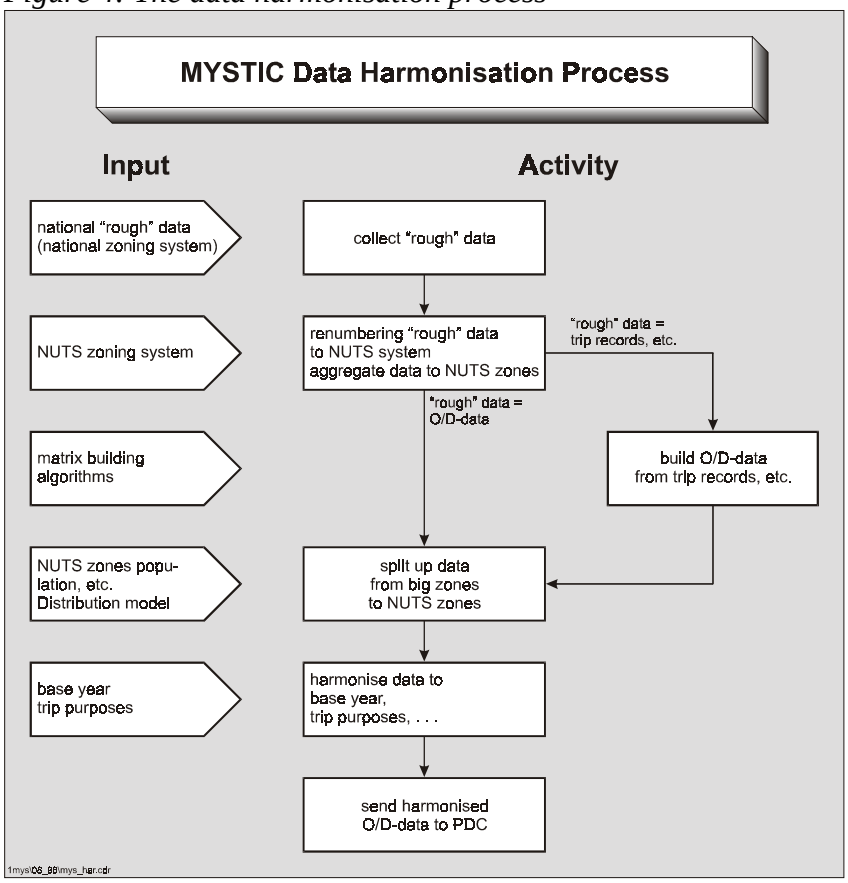
Country	Mode	Base year	Source	Number of zones	Geographical area	National or Inter-national	Institution data holder
Denmark	Rail	1992	Ticket sales	1000	Parishes and groups of parishes	Inter-national	Road Administration
	Road	1992	Roadside interviews, car owner register				Rail Administration
	Air	1997			Airports	Inter national	Copenhagen airport authority
Finland	Rail	1992	NTS	450	Municipalities	National	Road Administration
	Road	1992	NTS	450	Municipalities	National	Road Administration
	Air	1992	NTS	450	Municipalities	National	Road Administration
France	Road	1993	Enquete Transport		Departements NUTS3/NUTS 2	National and Inter-national	Service Economique et Statistique
	Rail						
	A7ir						
Germany	Road	1991	RSI, modelling	453	NUTS 3	Inter-national	Ministry of Transport
	Rail	1991	Tickets, Modelling	453	NUTS 3		
	Air	1991	Counts, Modelling	194	NUTS 2		
Grt Britain	Road	1981-1991	RSI, IPS,	3000	Study specific zones	Inter-national	DETR
	Rail	1997	Tickets, modelling	11,000	Wards (NUTS5/6)		
	Air	1995	CAA				

Country	Mode	Base year	Source	Number of zones	Geographical area	National or Inter-national	Institution data holder
Norway	Rail	1995	Ticket sales, counts	435	municipalities	National	TOI, State Railways
	Rail	1997	Ticket sales	19	Counties		State Railways
	Road	1995	Car ownership register, counts	435	municipalities		TOI
	Air	1995	Travel survey				
	Air	1997				National/in ternational	Directorate for Aviation
Sweden	Rail	1993	NTS	668	sams	National	Rail Administration
	Road						
	Air						
	Rail	1992	Tourist data-base, counts, hotel statistics	300	Eurostat, Regions 1989	Inter-national	Transek AB/ Swedish Railways

Data Harmonisation

During the data analysis stage various inconsistencies were found between the different datasets and these were grouped into two types: those we could take account of and those which we could not. The former inconsistencies were addressed in a data harmonisation step where the data were brought to a common platform ready for matrix building. The harmonisation process is illustrated in the figure below:

Figure 4: The data harmonisation process



In the harmonisation step, no attempt was made to compensate for those inconsistencies which could not be easily accommodated because to do so could have jeopardised the integrity of the data. These inconsistencies were therefore passed through into the final delivered Merged Matrix. This is important when interpreting the detail of the Merged Matrix. Two particular inconsistencies need to be explained: firstly the French household data which was used to build many of the trips to and from France and secondly the long distance cut-off which existed in several datasets including the French household data and the German long-distance matrix.

The French household data was obtained from a personal household interview and travel diary as a structured random sample of French households. Trips in France could be made from those resident outside of France. This was the only suitable data source in France for matrix building and it was therefore used to fill many of the French cells of the o-d matrix. These cells therefore do not contain trips in France from non-French residents. The trip pattern by different nationalities may be completely different (eg if German holidaymakers head for the French beaches, then not only would these trips in France not be intercepted by the French household survey but it would be wrong to try to infer such movements from the French household data). This effect is likely to be a larger proportion of travel in certain places (e.g. near borders or in Paris) and to simply apply a global factor could be misleading. This inconsistency was left in the European Merged Matrix. When it is completed, the European-wide travel diary survey could possibly provide a useful source of data for compensating for this inconsistency at a later date.

Some datasets had a long distance cut-off whereby trips which were shorter than a certain cut-off were not included. This applies particularly to the French data and the German matrix. To elicit a travel diary in a household interview survey a decision needs to be made about the time period over which to elicit all the trips made by the household. Generally for Urban and corridor studies a one-day travel diary is elicited whereby all the trips made during one day are recorded. Due to the relative infrequency of long distance trips (e.g. international travel), the one-day period is too short. The conventional methodology is to record all long distance trips over a three (or sometimes six) month period. The survey design needs to specify which trips are to be excluded or else the interviewer is likely to be recording unnecessary short distance trips. The conventional method uses a cut-off of 80 – 100 kilometres. For this reason the French data excluded trips less than this cut-off. There was a French short distance travel diary undertaken for a specific purpose and it was not used for this study. The German matrix came as two matrices one for short distance trips and one for long distance trips with the cut-off at 50 km. Our harmonisation used the long distance matrix with a 100 km cut-off. It would not be easy to compensate for the cut-off and this was therefore passed through into the Merged Matrix as one of the inconsistencies in the matrix cells.

The harmonisation guideline is shown below:

Figure 5: Passenger data harmonisation guidelines

Zoning system:	internal (national) area: NUTS 3 zone	
	external (non-national) area: NUTS 3 or coarser level[1)]	
Format:	Origin-Destination matrix (i.e. trip records etc. must be built into a matrix)	
Base year:	1997	
Time period:	Complete calendar year (24 hours/day, 365 days/year)	
Population of trips:	all interzonal person trips[2)] between NUTS 3 zones made by car or rail as the main mode (intrazonal trips excluded at NUTS 3 level). Note: all trip purposes to be included, separate matrices for car and rail trips are required, all interzonal trip to be included irrespective of trip length.	
Population of trip makers:	all residents and non residents (no age limits) in the country to which the „national" matrix under consideration refers (but see note below).	
Non nationals	NOT HARMONISED	Some datasets did not contain trips from non nationals (e.g. French Enquete Transports)
Distance cut-off	NOT HARMONISED	Some datasets omitted short distance trips below a distance threshold or cut-off.

Results

The study was successful and our ideas about the methodology required to produce a pan European passenger o-d trip matrix were honed-up into a workable methodology whose efficacy was demonstrated in the case studies. Existing data can make a valuable contribution to producing the pan European passenger o-d trip matrix. The study showed the importance of establishing an organisational structure which secures sensitive data and provides as free a flow of information as possible within the constraints that data owners place upon the use of their data by others. The database approach described herein provides a framework within which this can be organised optimally. The matrices it produces can be used at both a detailed scheme appraisal level and at a pan European level for policy analysis.

The study produced a European Merged o-d Passenger Matrix with o-d datasets from the following countries: Denmark, Finland, France, Germany, The Netherlands, Norway, Sweden and the United Kingdom. The matrix was partially harmonised to represent person trips per year in 1997 by road and by rail. However certain aspects could not be harmonised without jeopardising the integrity for the underlying data. If this matrix is used by others account must be taken of the underlying data and how it

[1)] In case of coarser level, however, all external zones have to be aggregates of NUTS 3 zones in the corresponding country.

[2)] trip defined according to „modal trip stage concept"

was merged because the evidence may not support the conclusions drawn from it – please be careful!.

With close co-operation with DETR, the study produced a UK national o-d database together with matrices and tools. These are to be used for infrastructure planning and appraisal. The success of this case study underlines the extensive capability and usefulness of such an o-d database. When translated to the European scale, the benefits to all member countries are compounded resulting in an extremely valuable resource for planning the European transport system of the future.

Conclusions and Recommendations

The study shows that the overall components of the methodology for producing the pan European o-d passenger trip matrix are as follows:
Assemble existing o-d datasets: e.g. household o-d interviews, roadside o-d interviews, on-train o-d interviews, already-constructed o-d matrices: Other data sources outlined below are needed to harmonise individual data sets into a common specification. This can comprise only part of the data needed.
Existing ticket sales data: This would help derive rail and air o-d matrices

A new pan European household travel diary survey: e.g. project DATELINE

A new pan European roadside and on-system interview o-d survey: This is a major new o-d survey comprising roadside interviews, on-train interviews and at-airport interviews at major screenlines, railway stations and airports across Europe. Surveys are an expensive undertaking especially at the scale needed for a well-specified European passenger o-d matrix and the cost is best spread over many years. We recommend that it be a rolling programme of surveys to be developed by the Commission's RTD research programme in association with member governments initially and then to be taken over by Eurostat and undertaken as a rolling programme so as to gradually improve the o-d matrix over time. The initial research project could undertake an initial 250 interview sites on important road and rail links which cross major European screenlines and at key airports. The data from this would provide robust estimates of all cells which traverse the screenline and as such builds-in a relatively high level of reliability to the matrix. The complete survey would be designed so that when taken in conjunction with the other data, it provides for optimum estimates of the matrix.

Encourage National Governments to build national o-d databases: A Government collects o-d data for planning new transport infrastructure and services. This data is often not held centrally and can be much more useful assembled into a National database for matrix building. The MYSTIC toolbox can help member governments in this process and can help in connecting National o-d databases together.

Assemble other o-d data: Transport operators and others collect o-d data for planning new transportation and operating services. This data can be used to build the matrix and it is important to elicit the support of all data owners to contribute data and make use of the matrix. This is also an organisation building activity.

Merging and combining the above different types of o-d data: The methodological advances made by MYSTIC can be used and built upon to improve the matrix. The methodology itself can be improved upon with further research

The inclusion of non o-d data: e.g. count data, population and demographic data: This data would be used in conjunction with modelling (the matrix improving methodology outlined below) to improve the resulting matrix.

Matrix improving methodology: this would take the o-d matrix resulting from the best possible merged matrix, the non o-d data and use modelling to improve the matrix in areas where the non o-d data can add information. The modelling for this was analysed as part of MYSTIC and various methodologies would be applicable. These matrix improving methodologies could themselves be improved upon with further research.

The data could be put into an o-d database and the organisational framework put in place to maintain, market and offer users the service of supplying extracts from the data, matrices and tools. The organisational framework needs to be set up with great care so as to safeguard the data. This could be initiated with an EC research project which could subsequently be taken over by Eurostat as a service for member governments, transport operators and private clients. The service is unlikely to cost a lot to operate (provided the new data collection costs are excluded) and if successful could be self financing.

We recommend that the commission set up a research project which could set up the o-d database, set up its maintenance, marketing and provide the service of supplying data, matrices and tools free to users. The o-d database could comprise an assembly of existing datasets, the pan European household travel diary o-d survey data, rail and air ticket sales data, counts and other non o-d data. The research project could design, set up and initiate the first phase of a rolling programme of roadside surveys and on-system interviews which could provide additional data for the o-d database. The project could use the o-d database to build a pan European o-d passenger trip matrix as described above. The project could research better methodologies for matrix merging, combining and improving and develop the tools which could be made available to member governments and data contributing organisations. The project could develop computer linkages with other databases proving exchange of data with them and so that the data can be used to improve the matrix. The project should provide a focus of expertise for o-d data and its uses and support the activities of researchers, analysis and modellers. In order to effect the surveys and the organisation building part of the project, the project timescale should be 4 years and have a budget of 4.5 m euro.

The output of such an EC project could be a pan European passenger o-d database, trip matrices and tools which could be used to help government. It could be used to help plan policy, allow inter country comparisons (e.g. of mobility, trip patterns, trip length, trips per citizen etc) so that policies can be targeted at locations where they are most needed. It could support modelling which could open up the whole field of forecasting and allow analysis of what-if scenarios, alternative pricing mechanisms etc.

It could support National policy and planning initiatives. The o-d matrices at member government level would fit together at country borders so that countries themselves can

plan their transport system knowing that the data fits together with that of their neighbours. This is particularly important for those countries which have problems with transit traffic.

Infrastructure providers could use the o-d matrices to help plan their schemes, services and operations. This is as important for appraisal of the TEN's as it is for the other parts of the transport network.

European rail transport is key to maintaining mobility in Europe in the long term. However train operators who are faced with the need to capture new markets from road when at present they have no idea how big this market is, where it wishes to travel to, its detailed market segmentation and how to influence it. The o-d matrix together with its supporting database will help understand these markets for them and play a key role in capturing road travel.

The o-d database could provide a consistent set of data, matrices and tools for European policy analysis, member Government policy analysis, infrastructure appraisal, transport planning and network operational optimisation. The consistency of the database will help ensure that differences of view are not based on differences in the information used to support them.

O-d data is very expensive to collect and is a valuable resource. In many cases this valuable resource is simply thrown away. It should be assembled, stored in as a resource for the future - and used. The recommended approach of assembling a pan European o-d database could provide a fundamental and valuable resource for the future.