DESTIN - Defining and Evaluating a Strategic Transport-Infrastructure Network in the Western Mediterranean

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SUMMARY

DESTIN is a research project set up within the European Union's Fifth Framework Programme that aims at developing and applying sustainable and operational models, methods and criteria to identify and evaluate the priorities for development of a multimodal transport-infrastructure network in the Western Mediterranean, with special emphasis on the infrastructure network in the Maghreb and its links with the Trans-European Transport Network.

DESTIN was launched in February 2003 and concluded in December 2005. One of the main achievements of the project is that its research results are now being used to support some of the most important discussions currently taking place on Euro-Mediterranean transport policy.

In particular, DESTIN developed and applied a multimodal model for international freight traffic in the Western Mediterranean that integrates the maritime mode in the modelling (with limited experiences in Europe until now) and is adapted to the scant data available in the Maghreb countries. Together with other information, the results from such model were used to define the so-called strategic transport-infrastructure network of common interest for both the Maghreb countries and the European Union.

DESTIN also defined and applied a number of methodologies to identify the main infrastructure bottlenecks that can be anticipated in such strategic network in the Maghreb. The results confirmed the need for a number of projects planned by the Maghreb Transport Ministries and justified their priority from a Euro-Mediterranean perspective.

The DESTIN strategic transport-infrastructure network and the priority projects to develop it are both valuable inputs for the policy discussions currently taking place within the framework of the GTMO (Group of the Transport Ministers of the Western Mediterranean) and the Euro-Mediterranean Transport Forum.

Furthermore, for the first time under the EU R&D Framework Programme, a consortium made up of European and Maghreb partners was responsible for a transport project and financing it, jointly with the European Union.

1. DESTIN: BACKGROUND AND OBJECTIVES

DESTIN is a project of the EU R&D Fifth Framework Programme that was conceived by the Group of Transport Ministers of the Western Mediterranean, GTMO, in 2002. The mission of the GTMO is to promote transport cooperation in the Western
Mediterranean and contribute to the Euro-Mediterranean Partnership. The members of the GTMO are the Ministers of Transport of the seven countries in the region (Algeria, France, Italy, Morocco, Portugal, Spain and Tunisia) and the Directorate General for Energy and Transport of the European Commission (EC). The CETMO, Centre for Transportation Studies for the Western Mediterranean, holds the position of GTMO technical secretariat.

At their meeting in Madrid in 2002, top GTMO representatives agreed that among the priorities for cooperation in the region was the need to define and develop a multimodal transport network in the Maghreb, which pay special emphasis on its links with the Trans-European Transport Network (TEN-T). They also expressed their interest in carrying out transport research in the Western Mediterranean and encouraging the participation of Maghreb countries in the EU R&D programmes.

With such background, DESTIN was launched in February 2003. Its fundamental goal was to implement a number of tools and methods, duly adapted to the region, that would make it possible to design a strategic transport-infrastructure network in the Maghreb which contribute to Euro-Maghreb traffic flows, and to identify the projects that will be necessary for its development. These tools and methods would need to be fully operational (so that specific results could be obtained) and designed so they could be subject to ongoing improvement within the framework of existing sub-regional cooperation. Amongst those tools, DESTIN would develop and apply specific models for forecasting international traffic flows in the Western Mediterranean, with the support of a geographic-information system and the corresponding databases.

2. THE MAIN RESULTS OF DESTIN FROM A TECHNICAL VIEWPOINT

2.1. Definition of a strategic transport-infrastructure network in the Maghreb

2.1.1. Approach

Under the DESTIN project, the process of identifying a Euro-Mediterranean network to be developed as a priority in the Maghreb was based mainly on external trade and international passenger flows between the Maghreb and the EU, with a particular focus on South-western Europe. Furthermore, it was considered the intra-Maghreb traffic flows and the territorial accessibility in this region:

- With regard to trade flows, DESTIN undertook the overwhelming task of analysing Euro-Maghreb trade figures and the freight transport chains organized in the region, taking into account the places of origin/destination and the routes followed by the goods. As a result, it was recommended a list of the most appropriate products to be included in a model for forecasting traffic patterns between the two shores of the Western Mediterranean; such modelling was replaced by a more qualitative approach whenever the model did not seem necessary or conceivable.
This international freight-traffic forecasting model is probably the most relevant tool developed under the project, given that few European models had previously included in-depth studies of combined land and maritime routes. The model is described in greater detail below.

- To identify a strategic network from the perspective of international passenger traffic, DESTIN first analysed port and airport passenger statistics on total traffic as well as traffic between the two shores of the Western Mediterranean.

  To identify the inland routes within the Maghreb countries themselves, statistics on road and rail passenger traffic were taken into account. Such statistics were complemented with the results from an assignment to the Maghreb road network of the number of passenger arriving/departing by sea and air to/from the Maghreb from/to South-western Europe.

- To complete this identification of the strategic network in the Maghreb, DESTIN considered the effect the development of the trans-Maghreb land corridor could have on intra-Maghreb freight and passenger traffic within a scenario of sub-regional integration. An analysis was also made of the contribution certain airports make to the accessibility of ultra-peripheral regions, particularly in the Southern Maghreb.

2.1.2. Model for forecasting international freight-traffic patterns

As mentioned above, the flows of freight best adapted to general-cargo transport were analysed based on results obtained using a model specifically developed within the framework of DESTIN. This model referred to the distribution of traffic among the different transport modes and the choice of routes, as well as traffic generation and geographic distribution.

2.1.2.1 Modal distribution and choice of routes

Under the DESTIN model, assignment of freight to the network was based on the concept of transport chains, bearing in mind the different multimodal chains that could be used to transport each kind of merchandise between the two shores. For each type of chain, the generalised lowest-cost route between each pair of origin/destination regions (NUTS II or equivalent) was identified. This was calculated by adding together the costs of all stages in the chain under the customer's perspective of the transport service. These costs were taken as a basis for the modal distribution and assignment of freight to the network between each origin/destination region, and freight was distributed among the possible transport chains using a logit formula, depending on the cost of each chain.

- Definition of multimodal chains: In general, freight-transport chains involve two inland routes (one in Europe and the other in the Maghreb) linked by a sea crossing, presumably on container ships, ro/ro or general-cargo ships. The results are multimodal chains such as those shown in the figure below. The
model also takes into consideration four intermodal chains based entirely on land transport that can enter into effect when a permanent rail link will be built across the Straits of Gibraltar.

Multimodal transport chains considered for the DESTIN sub-model on modal distribution and network-assignment

- **Relationship between freight and multimodal chains:** Although the model in fact allows for differentiating the chains by product type (eight product types in all), at the end of the model application under the DESTIN project, the freight had been rearranged into two groups, depending on its unit value and the value placed on transport time by the shipper.

- **Calculation of the overall transport costs between each pair of origin/destination regions:** The costs of each multimodal chain were calculated based on the costs of each modal link, plus the cost of each connection between transport modes. The cost function always distinguishes between the "list price" (applied by the transport operator, depending on the route followed or linked to the transit of cargo through a port) and another factor that measures the value for the importer/exporter of the time taken for goods to travel between their places of origin and destination.

- **Choice of route and modal distribution:** For each kind of good included in the model, the lowest-cost itinerary was calculated (using algorithms included in the DESTIN geographic-information system) between each pair of origin/destination regions for every conceivable kind of chain, in both north-south and south-north directions. The freight was then distributed among the most profitable transport chains in accordance with a logit formula and assigned to the network between each origin/destination. Finally, the results of the assignments were added up to obtain the total traffic for each product on the network. The geographic-information system then made it possible to present the traffic figures according to a number of different criteria.
Example of lowest-cost route for a Road-Ro/Ro-Road chain, transporting general cargo between Île de France and Marrakech
Source: DESTIN model

Example of presentation of gross results of the network-assignment sub-model
Source: DESTIN model

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Validating the results:

As far as possible, DESTIN calibrated - or, rather, validated - the results obtained under the modal-distribution and route-choice sub-model for the base year by comparing them with other available data. The results of this assessment were more than acceptable.

First, the cost levels and routes of some known transport chains were compared with the estimated costs and routes proposed by the model. Second, DESTIN compared real usage percentages for the three maritime conditioning modes (containers, trailers and general cargo) with the percentages produced by the model. The results were then checked against data available on cargo transits in ports; the volumes of cargo loaded/discharged in each Maghreb port and shipped to or received from each country in South-eastern Europe were taken as the basis for these comparisons. Lastly, the results were compared with the information available on inland routes, with particular reference to the major road corridors used for trade between the Iberian Peninsula and the rest of Europe, the main rail corridors used in Europe for
long-distance freight transport; heavy-duty traffic on each Maghreb country's national road network; and general-cargo traffic in the Maghreb rail network.

2.1.2.2. Traffic generation and geographic distribution

DESTIN also developed a sub-model (limited to trade between the Maghreb and the four countries in South-western Europe) that allowed for forecasting the origin/destination matrices in 2010 and 2020 for each of the products later assigned to the network. The matrices were created using a gravity formula for the European region and Maghreb countries, where the emission and attraction factors were production and population parameters, and impedance was a function of the generalised transport cost obtained from the network-assignment sub-model.

The sub-model on traffic generation and geographic distribution was calibrated using 2001 statistics, which is equivalent to consider into the future the present cross-sectional distribution. Therefore, the formulas drawn up do not necessarily take into account any future changes in trade patterns and it was consequently recommended that a new assessment of the sub-model should be made in coming years.

However, in view of these limitations, DESTIN developed an interface that allowed for some sensitivity analysis of forecasts based on the parameter values in the sub-model formulas. The interface was also designed to systematize the calculations and display of the sub-model forecasts, while facilitating data transfer to the network-assignment sub-model.

Start menu of the DESTIN user interface for the traffic generation and geographic distribution sub-model
2.1.3. Analysis of the effects of several transport scenarios on the definition of the strategic network

Bearing in mind its objectives, the DESTIN project did not focus on agreeing upon the definition of one or more scenarios used to calculate overall international traffic figures for the strategic transport network. Rather, it analysed the effects that several transport policies or scenarios would have on the transport system between Europe and the Maghreb and, consequently, on the proposed strategic network.

With this aim in mind, some of the scenarios envisaged, with the help of the freight-transport model developed by DESTIN, were:
- reopening cross-border international freight traffic between the three Maghreb countries;
- giving priority to freight traffic by rail by completing most of the planned railway projects in the Maghreb and strengthening the interoperability between rail and ports;
- developing policies to give priority to road freight traffic by implementing the entire trans-Maghreb highway, as well as other relevant road-transport projects; or
- building and starting up a rail tunnel between the Iberian Peninsula and Morocco across the Straits of Gibraltar.

Furthermore, a transport-system sensitivity study was carried out to evaluate the possible effects of implementing the Motorways of the Sea concept in the Mediterranean. The study was carried out by giving priority to specific relationships between ports on both sides of the Mediterranean and improving the maritime services between them.

2.1.4. Proposed strategic network

All the above analysis made it possible to propose a strategic network that facilitate international freight and passenger flows between the Maghreb and the EU, as well as link the major urban areas and economic centres of the three Maghreb countries. The way in which this network (made up of networks of land, maritime and air infrastructure) is described is similar to the EU’s approach to the TEN-T. Although the proposal refers to the three Maghreb countries, mention is also made of the strategic components of the TEN-T in South western Europe from the perspective of international trade with the Maghreb.

2.2. Identifying the projects required to develop the strategic network

The objective of the second phase of DESTIN was to define and apply criteria and methods that would help identify the projects needed to develop the strategic infrastructure network defined for the Maghreb during the first phase.
DESTIN therefore aimed to define a series of relatively simple methodologies that would make it possible to estimate the capacity of the road, rail, port and airport infrastructure making up the Maghreb strategic network. A comparison between the results of applying these methodologies and the traffic forecasts for each time period would then make it possible to pinpoint current and future bottlenecks.

Logically, any project involving improvements to infrastructure or new construction designed to resolve the problems of insufficient capacity should be classified as a priority for developing the strategic network. And this is why these methodologies are of interest. However, it is recognized that this approach alone is not sufficiently extensive to identify all the projects required, given that it does not take into account other criteria (which may be just as important) such as territorial development and modifications to the network configuration within a scenario of Maghreb integration. A complete list of projects should therefore include the ones that were generated during the capacity study, plus any others linked to criteria of territorial development and Maghreb integration. And, in any case, there would still be a number of voluntarist projects that would not fall within these new criteria.
2.2.1. Projects required from the perspective of insufficient capacity

Definition of methodologies to identify bottlenecks...

The methods defined by DESTIN to calculate infrastructure capacity do not attempt to obtain an accurate diagnosis, but, rather, to provide an overall uniform vision of the capacity-to-demand ratio in the region. When the methodologies were being defined, DESTIN considered it essential for them to be based on data that could be accessed relatively easily, so that they could be reused in the future, either directly or after updating. Furthermore, it was borne in mind that the objectives of DESTIN were oriented towards the medium and long term and addressed problems from a regional perspective.

...in the road network

The capacity of the roads in the Maghreb strategic transport network was evaluated using a formula based on the recommendations of the Highway Capacity Manual. The minimum road-infrastructure characteristics that needed to be known before the formula could be applied were the number of lanes on each stretch of road, the annual average daily traffic and the percentage of heavy-goods traffic, the width of the carriageway and shoulder, and the type of terrain.

The estimated capacity was compared with the actual traffic for the reference year and with each national administration's traffic forecasts for 2010 and 2020.

...in the rail network

The traffic capacity of a railway line is difficult to determine, given the many factors involved. Indeed, all the methods analysed within the framework of DESTIN for the purpose of defining a methodology of its own required information that was difficult to obtain or evaluate. Of all the approaches analysed, the methodology used in Italy by Ferrovia dello Stato was considered to be of particular interest due to the application possibilities it offered. However, even this method required certain information that was not available for the whole strategic rail network, particularly with reference to determining the least advantageous sections between two junctions. Current and forecast traffic was therefore finally compared with current mean values, depending on the characteristics of the line and its operating system. The approach was deemed valid, given that, on the whole, present and future usage of most sections of the strategic rail network in the Maghreb are still far from having capacity problems, except perhaps for just a few, very specific, stretches.

...in airport infrastructure

There are a number of possible approaches for calculating the capacity of a complex infrastructure such as an airport. DESTIN decided to define a methodology whereby the optimum capacity of an airport was determined based on calculations of the
capacities of three major airport sub-systems: runways, parking areas and passenger terminals. The optimum-capacity value thus represented the capacity that a given airport could offer, provided it was capable of effectively making full use of the infrastructure at its disposal.

If demand proves to be higher than the optimum capacity calculated, the method identifies the sub-system(s) where action needs to be taken to increase the airport's potential capacity. When the declared capacity of an airport differs substantially from the calculated capacity, a more exhaustive study is needed to determine the reasons for the divergence.

... in port terminals

DESTIN defined a methodology for calculating the capacity of a port terminal based on certain essential data and information that are normally available, or at least accessible in the port or terminal itself. The proposed formulas were designed to produce reasonably satisfactory results using just a limited number of basic parameters and without making the calculations too complicated. The methodology therefore avoided the use of simulation or complex analytical procedures which may be more accurate, but require a deeper, more complete knowledge of how the terminal and the logistics chain function. Furthermore, such procedures are more costly and time-consuming.

The methodology calculated the capacity of each port terminal, analysed individually as an isolated infrastructure. The total capacity of the port was thus the sum of the capacities of all terminals in the port, adjusted, where applicable, by the capacity of common areas such as accesses and jetties. Even if there are many specialized terminals, the described methodology focuses on the conventional multipurpose general-cargo terminals and container and ro/ro terminals - the ones that are most frequently subject to expansion and construction projects in the Maghreb.

Unfortunately, the proposed methodology could not be applied, given the impossibility of gathering all the necessary data. The limitations of port capacity were consequently analysed by combining data from a number of recent studies carried out on the national level.

Validation of results obtained from the methodologies

To validate the results obtained through applying the above methodologies, the Transport Ministries of each Maghreb country were asked to identify the projects affecting their infrastructure network that they anticipated carrying out by 2010 and 2020.

It is interesting to note that, except for the railways, the correspondence between the infrastructure that DESTIN considered to be deficient and that for which the governments of the Maghreb countries have capacity-expansion plans is, on the whole, more than satisfactory.
3. THE CONTRIBUTION OF DESTIN TO THE EURO-MEDITERRANEAN PARTNERSHIP PROCESS

3.1. Euro-Maghreb cooperation: the root of DESTIN’s success

DESTIN can be considered a successful project, in great measure because was based on and contributed to real Euro-Maghreb cooperation.

On one hand, a consortium of four European and three Maghreb partners was formed to implement the project. The Maghreb partners’ participation accounted for approximately 40% of the total project budget. DESTIN has been, in fact, the first EU transport research project to receive financing from Maghreb countries.

DESTIN also enjoyed the collaboration of a Group of Experts, with representatives from the seven transport ministries in the region. Its mission was to ensure the involvement in the project of those ministries and to obtain their opinions on the appropriateness of the project approaches, methods and results. The meetings of the Group of Experts – five in total - also contributed towards coordinating the work carried out by DESTIN and that of the Euro-Mediterranean Transport Forum and the EU High Level Group on the extension of the major trans-European transport axes to the neighbouring countries, two initiatives launched by the EC.

At the end of the project, the Group of Experts expressed its opinion that, on the whole, the work carried out within the framework of DESTIN was of high quality and that the project made a useful contribution (based particularly on technical criteria) to the process of identifying a network of Euro-Mediterranean interest to be developed as a priority in the Maghreb. In fact, the strategic network proposed by DESTIN gave rise to only a few, specific observations from the Group of Experts, often relating to the differences between the proposed network and the infrastructure-development plans in each country.

3.2. Using the DESTIN results in the discussions on Euro-Mediterranean transport policy

It is important to note that the results obtained by DESTIN were made available to the GTMO so that it could express its position with respect to the Euro-Mediterranean transport policy promoted by the EC. In fact, the GTMO viewpoint is expected to be formally stated at a meeting of the Transport Ministers scheduled for later this year.

The same results have also been made available to the EC, so that it can include them within the agreement process currently under way through the Euro-Mediterranean Transport Forum. The fundamental mission of this Forum - organized by the EC since 1999 - is to develop regional transport cooperation in accordance with the Euro-Mediterranean Partnership process, formally started up in 1995, after the Barcelona Declaration. The Euro-Mediterranean Transport Forum brings
together top civil servants from Mediterranean partner countries, EU Member States, the EC and several international institutions (e.g. the EIB, IMO). At its seventh meeting in Brussels, the Forum approved the draft conclusions that were later adopted by the Ministers at the First Euro-Mediterranean Transport Ministerial Conference held in Marrakech in December 2005.

Finally, it was also interesting for the EC to verify the degree to which the results obtained by DESTIN coincided with the conclusions reached on the extension of the main pan-European transport corridors with the neighbouring countries by an ad-hoc High Level Group that was set up in the autumn of 2004, also by the EC. This High Level Group - chaired by former EC Vice President Loyola de Palacio - was entrusted with carrying out a one-year study on ways of extending the main corridors of the TEN-T into the EU’s neighbouring countries in Europe, Asia and North Africa, and reaching an agreement on the priority projects involving these corridors, with a view to channelling resources and financial aid into them.